The Encouraging Activity to Stimulate Young Minds Study:
a curriculum-based physical activity intervention
to enhance learning and health outcomes in the primary school

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Thesis submitted in fulfilment of the requirements for the award of the degree of

Doctor of Philosophy

The University of Newcastle

6th January 2016
Statement of Originality

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University’s Digital Repository, subject to the provisions of the Copyright Act 1968.

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Professional editor, Dr Guenter Plum from FunctionalEdit.com, provided proofreading services, according to the guidelines laid out in the university-endorsed national ‘Guidelines for editing research theses’. Dr Plum’s editing services included fixing typographical, spelling and common grammatical errors; checking in-text references against list of references; checking numbering of tables and figures; checking consistency in lay-out, and checking references for conformance with JAMA.
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Publications arising from this thesis

The following peer-reviewed publications and presentations have been produced as a result of the research conducted for this thesis. I am the lead author for all four papers.

The four papers are presented sequentially and detail the design, implementation, development and evaluation of the EASY Minds program. The program was specifically developed to target areas of both public health and educational concern, as identified in the literature, and the findings presented in this thesis will contribute greatly to the limited literature regarding successful curriculum-based physical activity programs for primary school children.


Presentations – Refereed Conference Abstracts

The following conference abstracts were all oral presentations:


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Abstract

Objective

Multiple physical and psychological health benefits can be attained when children participate in the recommended levels of physical activity. Schools have been identified as important institutions for the promotion of physical activity among children. However, the crowded school curriculum and competing school demands have affected both the quantity and quality of physical activity opportunities provided to children within primary school settings. As such, novel strategies are required to assist teachers to promote physical activity throughout the school day.

The primary aim of this thesis was to evaluate the impact of a program that utilised physical activity integration as a teaching strategy to enhance engagement in mathematics lessons in primary schools. The primary outcome for the Encouraging Activity to Stimulate Young Minds (EASY Minds) study was children’s objectively measured physical activity (accelerometry) across the school day. Secondary outcomes included school-based sedentary time, and a range of key educational outcomes including children’s on-task behaviour, mathematical achievement and attitude towards mathematics.

A secondary aim of this thesis was to examine the feasibility of integrating physical activity in the mathematics curriculum focussing on enjoyment and engagement and the quality of the pedagogy movement-based learning promotes.

Methods

This thesis contains two distinct phases. Phase one was a pilot randomised controlled trial in a single school planned and delivered by the research team. Phase two was a cluster randomised controlled trial involving eight schools, which was delivered by trained classroom teachers.

Phase 1

Phase one involved a pilot randomised controlled trial (RCT) that was conducted in one primary school, in the Hunter Region, NSW, Australia. Children from Grades 5 and 6 were recruited for the study (n = 54; mean age 10.53 years ± 0.7) and were randomised by class into the EASY Minds intervention (n = 27) or the control (n = 27) conditions. This intervention was delivered by the PhD candidate.
The EASY Minds intervention was a six week school-based physical activity program that embedded physical activity within the primary school mathematics curriculum for up to three 60 minute sessions per week. The control groups participated in their usual daily mathematics program. The PhD candidate was responsible for delivering all program sessions (n = 17) at the intervention school in the pilot study.

In the pilot study, assessments were taken at baseline, three and six, weeks to determine changes in physical activity and on task behaviour. Physical activity was measured using Actigraph accelerometers (GT3X, Pensacola, USA). On-task behaviour was measured using a momentary time sampling procedure and reported as a percentage of time. Intervention effects in the pilot study were assessed using linear mixed models following the intention to treat principle.

Using intention-to-treat analysis, significant intervention effects were found for MVPA (9.7%, 95% CI=7.6 to 11.8, p<0.001) and sedentary time (-22.4%, 95% CI=−24.9 to 12.2, p<0.001) for the intervention group during Mathematics lessons (9.30am-10.30am). Significant intervention effects were also shown for MVPA 8.7% (95% CI = 5.8 to 11.6, p<0.001) and sedentary time -18.6% (95% CI = -24.9 to -12.2, p<0.001) across the whole school day. Furthermore, children displayed significantly greater ‘on-task’ behaviour across the intervention period with a 19.9% (95% CI = 2.4 to 37.4, p = 0.03) mean difference between groups.

**Process evaluation:** Measures of recruitment, retention, adherence and satisfaction were very high. All of the participating schools’ principals and teachers agreed to participate in the EASY Minds study. In the pilot study, the recruitment rate for students was 96.4%. Retention rate was expectedly high (100%) as the program was school-based and delivered in the daily planned Mathematics sessions. Of the 18 scheduled curriculum sessions, 17 were delivered as intended. There was an overall attendance rate of 94% across the 17 taught sessions. It was clear from teacher and student evaluations that the program was innovative, appealing and of great benefit. Scores on the evaluation survey completed by the 27 students in the intervention group ranged from 4.0 to 4.9 out of 5 for the 20 items indicating high to very high satisfaction rates for the EASY Minds program. Students found the program highly enjoyable, mean score=4.6 (SD=0.7), the students enjoyed working outside the classroom 4.9 (0.3) and incorporating PA into their lessons 4.7 (0.5).
**Phase 2**

In Phase two, a cluster RCT was conducted in eight primary schools in the Hunter Region, NSW, Australia. Teachers (n=10) from Grades 5 and 6 were recruited for the studies alongside their students (n = 240; mean age = 11.10 years ± 0.7) and were randomized by school into the EASY Minds intervention (n = 142 students) or the control (n = 98) group. Following the pilot study the intervention was revised and refined. The EASY Minds program cluster RCT involved the professional learning of classroom teachers to deliver the program and the inclusion of the key academic measures of attainment and attitude were also included. Additionally, focus groups with the students and interviews with the teachers were carried out to provide a detailed quantitative process evaluation.

In the cluster RCT, assessments were taken at baseline and 6-weeks to determine changes in physical activity and changes in on task behaviour, mathematical attitude and mathematical performance. Physical activity was measured using Actigraph accelerometers (GT3X, Pensacola, USA), on task behaviour was measured using momentary time sampling, mathematical attitude was measured using a validated 24 item questionnaire and achievement measured using a Mathematics Progressive Achievement test. Intervention effects were assessed using linear mixed models.

Process evaluation measures of recruitment, retention, adherence and satisfaction were assessed in both trials to determine program feasibility. In addition, student focus groups and teacher interviews were conducted following the cluster RCT to gain insights into the barriers and facilitators of program implementation and delivery and examine the quality of the learning.

Significant intervention effects were found for PA across the school day (adjusted mean difference 103 CPM, 95% CI 36.5 to 169.7, \( p = 0.008 \)). Intervention effects were also found for PA (168 CPM, 95% CI 90.1 to 247.4, \( p=0.008 \)) and MVPA (2.6%, 95% CI 0.9 to 4.4, \( p=.009 \)) in mathematics lessons, sedentary time across the school day (-3.5%, 95% CI -7.0 to -0.13, \( p= 0.044 \)) and during mathematics (-8.2%, CI -13.0 to -2.0, \( p = 0.010 \)) and on-task behaviour (13.8%, 95% CI 4.0 to 23.6, \( p = 0.011 \)), but not for mathematics performance or attitude.

In the cluster RCT, all teachers reported that they delivered the recommended three sessions per week of movement-based learning. A total of 18 fidelity checks were carried out over the evaluation period and teachers responded well to researcher feedback with
mean scores for promoting mathematical concepts rising from 3.3 to 4.4, activity levels 3.4 to 4.1 and engagement 3.7 to 4.3. Teachers also reported that they were also now integrating physical activity in other curriculum areas. Mean scores from the student evaluation survey ranged from 3.4 to 4.7 out of 5 (1 = strongly disagree to 5 strongly agree), indicating high to very high overall satisfaction rates for the EASY Minds program. Teacher evaluation of the professional learning day was very positive with mean scores of 5.0 for all nine items on the survey. Teachers added additional written feedback commenting on the high level of engagement, real life practical participation and realistic expectations of the study.

The focus group data and teacher interviews revealed positive student and teacher perceptions of the program. The program provided positive experiences for teachers and students, both in terms of enjoyment and engagement in maths lessons, while ensuring high quality learning experiences. Embedding movement-based learning throughout the school day, across subject areas, had a significant positive effect on children’s enjoyment and engagement in mathematics without compromising the quality of learning.

Conclusion

The EASY Minds intervention has highlighted the potential for integrating physical activity across the curriculum in mathematics as a viable option for classroom teachers to increase physical activity (PA) within the school setting and students’ on-task behavior, without sacrificing academic performance. EASY Minds offers a practical solution to the constraints to children’s school-based physical activity levels brought on by a crowded school curriculum. It may well be that future attempts to change school policy and practice in regard to physical activity promotion needs to focus on the academic benefits of such an approach to change teachers attitudes and beliefs.
Overview – Contribution Statement

The EASY Minds program was a novel intervention designed, implemented and evaluated as a PhD study. The program was specifically developed to address both public health and educational outcomes. An outline of the contribution that I, Nick Riley, made to the EASY Minds study is outlined below.

Program design and development

Under the guidance of my supervisors, I was responsible for the design and development of the entire EASY Minds program. This included designing all program components (including program sessions, student and staff resources, and presentations), and amending specific program components for the modified program evaluated in the cluster RCT based on participant feedback and the results of the pilot study.

Ethics and safety approval

I was responsible for gaining ethics approval from the University of Newcastle, the Newcastle–Maitland Catholic Schools Office, the NSW Department for Education and Communities (SERAP2013011) the Australian New Zealand Clinical Trial Registry (ACTRN12613000637741) and for completing all related safety and child protection procedures relating to the implementation of both trials in the primary school setting. This included: developing a study proposal and justification, completing all ethics forms, developing information statements and consent forms for teachers, parents, children and school Principals, developing assessment protocols and forms for all physical and educational assessments, developing the student and staff questionnaires and evaluation surveys, and ensuring all mandated child protection checks were completed for research staff.

Measurement of study outcomes, data collection and entry

In correspondence with my supervisors, appropriate outcome measures were decided upon. I was wholly responsible for training more than 15 volunteer research assistants in conducting the baseline tests, organising assessment sessions (including ordering and organising all equipment and scheduling sessions in the school) and supervising research assistants during all assessment sessions. I was responsible for entering the data and for the safe handling of all confidential participant information.
**Intervention delivery**

I was responsible for delivering all program sessions (n = 17) at the intervention school in the pilot study. I also led the professional learning sessions for classroom teachers with my supervisors in the clustered RCT of the EASY Minds study. This included recruitment, organisation of tasks and development of all resources for the pilot study, professional learning and example lessons in the cluster RCT.

**Analysis of data**

In correspondence with my supervisors and other co-authors, the methods of statistical analysis were decided upon and I completed all analyses using appropriate computer software (SPSS), interpreted the results and presented the data in either text, table or figure formats.

**Acquiring funding**

I was a chief investigator on grants that funded the EASY Minds cluster RCT. This included two successful grants from the NSW Department for Education and Communities ($54,000) and the Priority Research Centre in Physical Activity and Nutrition at the University of Newcastle ($4,000).

**Presenting study results at conferences**

I was responsible for presenting the findings of the EASY Minds study (both oral and/or poster presentations) at several conferences (local and international) and in the University Three-Minute Thesis competition (see page viii for full details).
Chapter One

Introduction

1.1 Background and context

Globally, less than 20% of young people achieve the recommended guidelines of 60 minutes per day of moderate-to-vigorous physical activity (MVPA)\(^1\). This is of great concern as multiple physical and psychological health benefits can be attained by being active. Studies have shown that children who participate in high levels of physical activity, especially vigorous activity, display fewer markers for Metabolic Syndrome, have a decreased risk of developing cardiovascular disease and are less likely to develop other chronic illnesses such as obesity, Type 2 diabetes, osteoporosis and some cancers\(^2\). They are also less likely to suffer from psychological disorders\(^3\), and more likely to perform better academically\(^4\).

Thus, there is an urgent need for evidence-based programs that target the physical activity levels of children\(^5,6\).

Schools have long been recognised as important institutions for the promotion of physical activity among children\(^7,8\); however, children’s time at school is commonly characterised by low levels of physical activity and poor quality curriculum-based movement learning experiences. In fact, for many children, the school day is often very sedentary including prolonged periods of sitting\(^9\). There is also an emerging body of literature that demonstrates that sedentary behaviour is associated with a range of lifestyle diseases\(^10\) and poorer mental health. Therefore, reducing sitting time in schools may have important health benefits\(^11-13\).

The school is an ideal setting for promoting physical activity. There are numerous opportunities in the school setting for the promotion of physical activity including the health and physical education curriculum, recess and lunch breaks, active transportation, before and after school clubs and inter-school sport. Although health and physical education is widely acknowledged as the foundation for promoting physical activity, studies have questioned both the quality and quantity of health and physical education lessons\(^8\). In 2012, a NSW (Australia) Auditor General’s report\(^14\) called for schools to improve physical activity opportunities and experiences within the primary school. Internationally, the Centers for Disease Control and Prevention have identified a number
of key strategies to promote physical activity in their Comprehensive School Physical Activity program\textsuperscript{15}. Both reports have recommended that teachers maximise the use of existing time by integrating physical activity across the curriculum. This may be important because integrating physical activity within the existing curriculum could be a potentially time- and cost-effective solution for both teachers and schools that may have a multiplicity of other benefits from both a health and educational perspective.

Several large-scale studies including Take 10\textsuperscript{16}, Texas I Can\textsuperscript{17} and Physical Activity Across the Curriculum\textsuperscript{9} have highlighted the potential of the integration approach by demonstrating an increase in MVPA\textsuperscript{17}, increased on-task behaviour\textsuperscript{18,19} and enhanced cognitive functioning\textsuperscript{9,20}. Several recent reviews have highlighted the potential of integrating physical activity into the existing school curriculum. A systematic review by Erwin et al. in 2012 reported that curriculum-based interventions have been implemented across various continents including North America, Europe, and Australasia but they were often not stand-alone and were run and analysed simultaneously with other interventions (e.g. recess, lunch). The authors found these interventions had been positive and showed a significant and moderate effect on physical activity and learning outcomes. The review also recommended that studies that promote physical activity within curriculum time should measure both health and academic related outcomes\textsuperscript{21}. However, despite the potential of physical activity integration in the classroom, there are concerns regarding the sustainability of such an approach, when the research support is withdrawn, and as such, sustainable strategies need to be identified and pursued to ensure physical integration becomes part of a teacher’s daily and weekly routine\textsuperscript{22}.

It is important for all physical activity interventions to be evidence-based and rigorously evaluated to determine whether and how an intervention worked and how future interventions can be improved\textsuperscript{23,24} and programs sustained. Furthermore, the sustainability of many existing physical activity programs is questionable, given that primary school teachers currently face an already over-crowded curriculum, therefore additional programs that do not align with mandatory curriculum requirements may be considered a time burden by classroom teachers and schools.
1.2 Limitations of existing school-based physical activity integration interventions

Although some studies have reported positive effects on physical activity outcomes, as well as some educational outcomes\(^\text{17,19}\) (mainly time on task), the potential impact of school-based physical activity interventions have been hampered\(^\text{25}\) by their failure to:

- use an objective measure of physical activity;
- report on a range of key educational outcomes such as attitude, attainment and engagement;
- specifically target mathematics or any single specific subject area in which to embed physical activity within the primary school curriculum;
- align physical activity programs with the existing school curricula or educational objectives in the primary school setting to ease the burden of an already crowded curriculum\(^\text{15}\).

Of additional concern, there have been increasing international concerns regarding students’ attitude and engagement and ultimately performance in mathematics. It has been generally acknowledged that the most powerful influence on a student’s attitude towards mathematics is the teacher and the pedagogical repertoire employed\(^\text{26}\). Mathematics engagement has also been linked to the notion of ‘fun’ activities\(^\text{27}\) and activities that promote active participation, social interaction and teach mathematics concepts that are relevant and meaningful to students\(^\text{28}\). Therefore, physically active mathematics lessons that embed quality pedagogy may not only increase students daily physical activity they also have the potential to enhance learning in mathematics.

1.2 Purpose of study

The overall purpose of this study was to evaluate the feasibility and efficacy of a primary school-based physical activity integration program for mathematics. The intervention known as the EASY (Encouraging Activity to Stimulate Young) Minds study provides a significant and original contribution to the literature. No other study has investigated the feasibility and effectiveness of a school-based physical activity program that directly aligns with the school mathematics syllabus, and targets improvements in both physical activity and a number of key educational outcomes including mathematical on-task
behaviour, attitude and performance of primary school-aged children. The EASY Minds program promotes and facilitates participation in ‘enjoyable’ physical activities within mathematics and is designed specifically to target areas of both public health and educational concern, as identified in the literature. These concerns include:

- Inadequate physical activity levels of children;
- Declining engagement in mathematics within the primary school;
- Need for quality programs and resources to support teachers implement physical activity integration programs in primary schools.

Furthermore, this study aims to provide a comprehensive process evaluation and provide a sustainable program, adding to the literature in this area.

1.3 Research questions

**Research Questions**

*Pilot RCT*

1. What is the impact of a school-based intervention (EASY Minds) on the school physical activity levels of primary school-aged children when delivered by an experienced physical activity researcher?

2. What is the feasibility of the EASY Minds Program for improving physical activity and educational outcomes in the primary school when delivered by an experienced physical activity researcher?

*Cluster RCT*

3. What is the impact of the EASY Minds program on the physical activity levels of primary school-aged children when delivered by trained classroom teachers? (Primary Research question).

4. What are the effects of the program on a range of educational outcomes including on-task classroom behaviour, mathematical performance and mathematical attitude when delivered by trained classroom teachers?
5. What is the feasibility of the EASY Minds Program for improving physical activity and educational outcomes in the primary school when delivered by classroom teachers?

6. What are student and teacher perceptions of the EASY Minds Program?

1.4 Significance of study

The EASY Minds program is an innovative physical activity curriculum intervention that is directly aligned with the day-to-day teaching of the NSW K-12 mathematics syllabus. The EASY Minds program was designed to be incorporated into the existing school day without adding to an already crowded school teaching program which has been previously highlighted by teachers in NSW, Australia and indeed worldwide, as a major barrier for schools to implement new initiatives or meet physical activity guidelines. As well as promoting physical activity, the EASY Minds program aimed to positively influence a range of important academic outcomes and improve students’ on-task behaviour. Mathematics is an area of great concern to many researchers as student engagement is declining and previous studies have demonstrated student interest and attitudes are key predictors of academic success.

In response to methodological shortfalls identified in previous reviews of physical activity interventions, the EASY Minds program was evaluated using a rigorous study design. First, the EASY Minds study adhered to the Consolidation Standards of Reporting Trials (CONSORT) guidelines. Second, primary and secondary outcomes were measured by trained research assistants who were blinded to treatment allocation at baseline, all assessments being conducted using validated assessments; additional steps were taken to minimise the risk of bias (e.g. use of intention-to-treat imputation for missing data, and adequately powered to detect changes in primary outcomes). Furthermore, a detailed process evaluation was conducted and included measures of recruitment, retention, adherence and satisfaction to provide valuable evidence for future program refinement and implementation.

1.5 Thesis structure

The thesis contains: an overall abstract; a summary of the main findings in each paper; a review of the literature; four published papers detailing the findings of the EASY Minds
study presented as individual chapters; and a discussion and summary of all findings presented in the final chapter. This thesis provides a detailed presentation of the EASY Minds study from conception, to implementation and evaluation.

The thesis chapters are as follows:

**Chapter One:** The Introduction: this chapter includes contextual information, a rationale for the implementation of the EASY Minds study, and an outline of limitations evident in existing school-based physical activity intervention studies. Furthermore, details of the purpose and aims of the EASY Minds study, and the significant contribution that this study will make to the literature, are also detailed in this chapter.

**Chapter Two:** Literature review: This chapter discusses the rationale for promoting physical activity and physical activity in children, and provides an overview of the associated health benefits. Current physical activity levels in children are summarised, along with recent physical activity recommendations for this age group. The chapter also provides a review of the impact of recent school-based physical activity physical activity integration interventions and examines the potential of a curriculum-based intervention.

**Chapter Three:** The results of the EASY Minds pilot RCT including a description of the feasibility and preliminary efficacy of the EASY Minds intervention for improving physical activity in primary school-aged children is presented in this chapter previously published as:


**Chapter Four:** This chapter describes the rationale and methods of the EASY Minds cluster randomised controlled trial for improving the physical activity levels of Grades 5 and 6 primary school children. This chapter was previously published as:

- Riley N, Lubans DR, Holmes K, Morgan PJ. Rationale and study protocol of the EASY Minds (Encouraging Activity to Stimulate Young Minds) program: cluster randomized controlled trial of a primary school-based physical activity integration

*Chapter Five:* The findings of the EASY Minds cluster randomised controlled trial are presented in this chapter, previously published as:


*Chapter Six:* The qualitative findings of the EASY Minds RCT are provided in this chapter including both student and teacher perceptions.

This paper is currently under review in the *Eurasia Journal of Science and Technology Education*.

*Chapter Seven:* Discussion: In this chapter, an overview and synthesis of the key findings of the EASY Minds study will be presented. Study significance and limitations are then presented, implications for professional practice, pre-service education and teacher training in schools, and recommendations for future research, are identified.
Chapter Two

Literature Review

This chapter provides a rationale for promoting physical activity with children including the associated health benefits and current recommendations. The role of school-based physical activity promotion and the association between physical activity and academic performance is summarised alongside a review of previous curriculum-based physical activity interventions. Figure 2.1 summarises the structure of Chapter Two.

Figure 2.1: Schematic diagram summarising structure of chapter
2.1 Physical activity in children

Existing U.S., Australian and UK physical activity guidelines\(^{31,32}\) recommend children and adolescents participate in:

- Moderate-vigorous physical activity (MVPA) for at least 60 min per day;
- Vigorous intensity physical activity (VPA) at least three times per week;
- Muscle and bone strengthening physical activities at least three times per week;
- Break up long periods of sitting as often as possible.

2.2 Benefits of physical activity for children

A well established and increasing body of literature provides comprehensive evidence that multiple physical and psychological health benefits can be attained when children are adequately active\(^{33-37}\). Studies have shown that children who participate in high levels of physical activity, especially vigorous activity, benefit both in the short- and long-term\(^{38}\). Active children are at lower risk of being overweight and obese and have a decreased risk of developing chronic illnesses\(^{2,39}\) and are more likely to experience positive mental health\(^{21,40}\).

Emerging evidence suggests that reducing sitting time or sedentary behaviour may have important and independent health implications for children\(^{41}\). Studies have found that sedentary behaviour is associated with a higher risk of being overweight\(^{10}\), adverse metabolic markers\(^{42}\) and poorer mental health\(^{12}\). Although the physiological mechanisms that underpin the association between sedentary time, physical activity and health are not fully understood\(^{11}\) reducing sitting time and promoting physical activity across the school day may have important health benefits for children\(^{11,13}\).

2.2.1 Physical and psychological

The physical health benefits of physical activity include improved body composition, the prevention of being overweight and obese, and improved skeletal\(^{43}\), metabolic\(^{34}\) and cardiovascular health\(^{44}\). Research focused on preventing cardiovascular disease has recognised that whilst the symptoms may only become apparent in adulthood, the onset of the disease often stems from childhood\(^{45}\). Reviews have provided evidence that the more physical activity undertaken the greater the health benefit\(^{32}\), whilst others have suggested that the greatest benefits can be achieved through participation in high intensity
physical activity\textsuperscript{46,33}. Additionally there is some evidence of tracking\textsuperscript{47} indicating a positive association between physical activity levels in childhood and adulthood; that is, children who display high levels of physical activity during early years are likely to be more active as adults\textsuperscript{6}.

The benefits of physical activity are not, however, restricted to the physical domain. They also include many positive psychosocial outcomes. These include a reduction in the symptoms of depression and anxiety\textsuperscript{12} and improvements in both self-confidence and self-esteem\textsuperscript{12,48}. Further to this, participation in physical activity during the school years has been shown to reduce the likelihood of other social problems including aggression and misbehaviour\textsuperscript{49,50}.

\subsection*{2.2.2 Physical activity and the brain}

There is an increasing body of literature that focuses on the association between physical activity and academic performance. More recently, experimental studies have demonstrated that physical activity enhances children’s cognitive functioning, concentration and on-task behaviour\textsuperscript{51}. Earlier research, which has focused mostly on rodents, has indicated that physical activity is a potent stimulator of the key molecular and cellular components that underlies brain structure and brain function\textsuperscript{52}. Recent research in humans resulting from advances in neuroimaging techniques has indicated that exercise leads to changes in both brain structure and functioning\textsuperscript{54}. In summary, physical activity promotes better oxygen flow to the brain\textsuperscript{53} and increases neuroplasticity (growth of brain cells). Physical activity provides potential protection from age-related brain tissue loss\textsuperscript{54} and is positively associated with both brain health and cognitive function in children\textsuperscript{55}. Cognitive functioning benefits may include: executive function, attention, episodic memory, language, processing speed and working memory\textsuperscript{56}. Academic performance is a function of these cognitive processes\textsuperscript{57}. Children’s ability to perform these cognitive processes gives rise to attributes associated with learning\textsuperscript{57}.

The research linking physical activity and cognitive functioning has generally focused on testing ‘arousal’ theories. Studies have found strong associations between physical activity and the cognitive abilities of the cerebellum\textsuperscript{58}. Physical activity has also been found to increase neurons, dendrites and synapses which are all essential in cognitive development\textsuperscript{59}. It has been suggested that the brain is activated during physical activity
by increasing blood flow to these essential areas and learning is stimulated\textsuperscript{60}. Childhood provides a critical period for brain growth, which is characterised by the maturation of structures that are involved in both cognitive functioning and the fine tuning of the brain circuitry that supports the operation of the adult brain\textsuperscript{61}. Therefore, the school years provide an ideal opportunity to use physical activity to optimise cognitive functioning and brain health. However, much of the current available literature is limited by the small number of randomised controlled trials that focus on how changes in physical activity levels predict changes in both brain structure and brain function in children\textsuperscript{52}.

\subsection*{2.2.3 Physical activity and academic performance}

There is a growing body of research focusing on the association between school-based physical activity and academic performance\textsuperscript{55,62,63}. Academic performance outcomes can be categorised into three distinct areas. These are: i) academic achievement based on grades and test scores such as SATS in the UK and NAPLAN in Australia as well as other standardised instruments; ii) academic behaviour can be measured by instruments that monitor academic or on-task behaviour, including momentary time sampling or analysing attendance records; and, iii) cognitive skills and attitudes – cognitive skills and attitudes include measures of attention, concentration, memory and mood.

Several systematic reviews of the literature focusing on the association between school-based physical activity and academic performance have been conducted\textsuperscript{21,40}. The review carried out by the Centres for Disease Control and Prevention found 50 studies that had reported on this association. Within these 50 studies, there were 251 reported associations between school-based physical activity and the various indicators of academic performance. Of these reported, 51\% were positive, 47\% were not significant and only 2\% were negative. These findings from the review are consistent with previous reviews of physical activity and academic achievement\textsuperscript{64,65}. The ‘Comprehensive School Physical Activity Programs: A guide for Schools’\textsuperscript{15} states that there is substantial evidence that physical activity can help improve academic achievement including grades and test scores, and it can also influence cognitive skills and attitudes including concentration, attention, and classroom behaviour. Several of these studies will be discussed in the section on school-based physical activity interventions (see Section 2.7). Some of the key findings suggest that children who are physically active tend to perform better.
academically and children who are physically fit are likely to have stronger academic performance\(^9\).

### 2.3 Prevalence of physical activity and physical activity measurement

Global estimates demonstrate that between 70–80\% of young people are not achieving the recommended 60 minutes of ‘health enhancing’ physical activity each day\(^1\). Furthermore, a global trend for increased sedentary time in children is evident\(^66\). Alarmingly in 2009, physical inactivity was identified as the fourth leading risk factor for non-communicable risk diseases and accounted for more than 3 million preventable deaths\(^67\).

Several international studies have described levels of physical activity of children in relation to national physical activity guidelines. For example, the UK millennium cohort study (\(n = 6497\), ages 7–8) reported that the median daily physical activity level was 595 counts per minute, children were sedentary for a median of 6.4 hours per day, and consequently only 51\% met the physical activity guidelines. In Australia, the 2014 report card on physical activity and youth graded the physical activity levels of Australian youth as a D minus as only 20\% met the current guidelines\(^69\). Similar to the UK millennium study, boys were shown to be more active than girls. Coincidently, data from developed and developing countries consistently reports that more boys than girls meet the current physical activity guidelines and also that physical activity levels decline with age\(^1,70-72\).

The HELENA cross-sectional study (\(n = 2,200\)) undertaken in nine European countries measured physical activity objectively using accelerometry. Similarly, this study found that only 56.8\% of boys and 27.5\% of girls met the MVPA guidelines. A United States study again using accelerometry has reported only 42\% of children aged 6–11 met the public health recommendations\(^73\).

Measuring physical activity levels globally has been difficult as it was only in the 1990’s that a standardised instrument, the International Physical Activity Questionnaire (IPAQ) was developed\(^74\). This was followed by the development of the Global Physical Activity Questionnaire (GPAQ)\(^75\). Whilst these and subsequent questionnaires (self-report) are considered the most feasible in large-scale population surveys, they are limited in that they are reliant on self-report bias, memory recall and interpretation. They also do not provide an accurate measurement of activity type, intensity, frequency and duration.
Improvements in technology have seen the development and use of both pedometers and accelerometers to provide an objective and relatively accurate measurement of physical activity levels. It is widely accepted that accelerometers are advantageous when working with children because unlike self-report measures of PA, they help eliminate the previously mentioned language and literacy difficulties, recall bias and social desirability bias. Whilst several activity monitors are available, the Actigraph accelerometer has acceptable reliability and validity in both children and adolescents. The raw data from an accelerometer can also be used to provide a mean counts per minute (CPM) by dividing the sum of the activity counts by the number of minutes of wear time. Accelerometers allow physical activity data to be classified into sedentary, light, moderate and vigorous intensities using prediction equations that allow activity counts to be converted to units of energy expenditure.

2.4 Role of schools in physical activity promotion

It is generally accepted that the foundations of physical activity behaviours are set early in life. Schools have been widely recognised and identified as key institutions for the promotion of physical activity. Whilst a number of sectors in society have the potential to influence children’s physical activity, (including families, community organisations, media outlets and government agencies) it is schools and the education sectors that may have the greatest influence and potential to improve physical activity in young people. Children spend approximately six hours a day in school, five days a week, for 42 of 52 weeks of a calendar year. A recent study found that children spend the majority of their time in school in an academic classroom setting yet this accounts for less than 5% of a student’s daily physical activity. Previous research has highlighted the key role that teachers and other school staff play in promoting the health of their students by maximising school-based physical activity and also acting as role models whilst supporting student involvement. Previously, studies have highlighted that teachers are critical to the success of school-based physical activity promotion (see Section 2.8).

There are a number of barriers influencing the quality and quantity of physical activity opportunities within the primary school. These barriers have often been categorised as either institutional or teacher-related. Institutional examples include restrictive school policies, the crowded school curriculum, poor or outdated existing facilities, budget constraints and a lack of equipment. Teacher-related factors include a general lack of
teacher confidence, lack of interest, poor levels of expertise and inadequate training in pre-teacher training at university.\textsuperscript{85,86} These issues are consistent across the globe.\textsuperscript{79} For example in a recent study in the United States, a lack of PE specialists, financial restrictions and the crowded school curriculum were the most cited barriers to providing physical activity opportunities in the school setting.\textsuperscript{87} In an Australian study, a lack of teacher confidence was cited amongst classroom primary teachers.\textsuperscript{84}

In 2013 the Centres for Disease Control and Prevention (CDC) identified a number of key strategies for schools to promote physical activity in their Comprehensive School Physical Activity Program (CSPAP).\textsuperscript{15} Similarly, in NSW Australia the 2012 Auditor General’s Report identified strategies whereby schools contribute towards arresting the decline in physical activity of children. Both of these reports recommend that schools develop a multi-component school-based program to promote and provide opportunities for physical activity across the school day and before and after school.

Recommendations to promote physical activity within primary schools fall into five areas.\textsuperscript{15}

- Quality physical education;
- Physical activity during the school day;
- Physical activity before and after school;
- Staff involvement;
- Family and community involvement.

Physical education is regarded as the primary vehicle for physical activity promotion during the school day. In the majority of countries, physical education is mandatory across the school years and some countries set duration recommendations such as 150 minutes per week as stipulated by the National Association for Sport and Physical Education (NASPE), or the 150 minutes of planned physical activity per week including PE stipulated in the NSW auditor General’s report.\textsuperscript{88} Despite these recommendations surveys have found that in the United States only 7.9% of primary schools achieved this benchmark.\textsuperscript{89} In NSW it was reported that 70% of schools met the planned target. However, it is worth noting that this measure was based on a school principal self-report measure, which may be prone to social desirability bias.\textsuperscript{90} Furthermore, despite the fact that quality PE can have positive health implications for children, studies have revealed
that MVPA and actual activity time in PE lessons falls well below the 50% target set by national bodies.

Schools also afford other opportunities to promote physical activity across the school day. These include recess and lunch and the integration of physical activity across the curriculum. It has been recommended that young people should spend 40% of recess and lunch being active. However, some studies have found that many children spend the majority of this time engaged in sedentary activity, especially girls. Whilst this pattern varies from country to country, it is widely accepted that activity during these periods declines with age and as children move into upper primary and secondary schools, physical activity levels drop considerably. Reducing sitting time or sedentary behaviour and promoting physical activity has important and independent health and academic implications for children.

Other opportunities to enhance physical activity include regular active breaks throughout classroom time, often referred to as energisers, or the integration of physical activity within the classroom. Energisers are typically activities that simply reduce sitting time and enhance energy expenditure, e.g. students watching and joining in a short dance clip or jumping around the classroom. Integration activities are specifically designed to support the school curriculum and engage children and enhance learning e.g. students jumping the answer to a mathematics problem.

Opportunities to provide children with physical activities, both before, and after school can enable students to engage in activity that can be safe, sociable and supervised. Examples include a walking or riding to school program, intramural programs, interscholastic sport and after school activity programs run by community organisations.

Finally, it may well be that schools need to be supported by, and engage family and community support, to maximise the existing opportunities to promote physical activity. Previous research has highlighted that the support of parents and siblings is influential, as is support offered by community organisations.
2.5 School-based physical activity interventions

As schools are so widely regarded as critical in promoting physical activity it is necessary to examine the impact, success, lessons and shortfalls of previous physical activity interventions conducted in schools.

There is a wealth of evidence that suggests that school-based interventions are potentially an effective way to promote physical activity levels. There have been a large number of systematic reviews that demonstrate the efficacy of school-based approaches to physical activity promotion. Of the 16 trials studied in the recent Kriemler review, 100% had a significant effect on physical activity levels. The review by van Sluijs reported only 47% were significant, whereas Salmon found that interventions within school that used an objective measure of physical activity (e.g., accelerometers) were more effective. However, a systematic review by Metcalf showed only a small effect size for school-based interventions when physical activity was measured using accelerometers.

As discussed previously, physical education is a renowned vehicle for physical activity promotion in schools. However, high levels of activity need to be balanced alongside the need for instruction, feedback and reflection. A systematic review by Lonsdale and colleagues found that physical education-based interventions can lead to increases in MVPA by about 24%. The authors suggested that the translation of these findings will be dependent upon professional learning and are dependent on the quality of teacher pedagogy. However, several research studies have reported that teachers are now spending less curriculum time in physical education as a result of increased pressure of standardised testing in primary schools.

There has also been significant research into the opportunities that are afforded during unstructured play at both recess and lunch. These areas of study generally focus upon engaging children in higher levels of activity and improving the school physical environment to promote and maximise physical activity opportunities. Recess and lunch have been targeted by interventions that promote games and provide additional sports equipment where others have targeted the physical environment by providing additional playground markings or promoted fixed structures to promote activity. Whilst these studies are limited in nature they have demonstrated their potential efficacy. A recent systematic review advocated that all schools should provide regular recess to
students and the key to active participation in recess, lies in supportive school policies and the provision of both playground markings and changes to schools physical environment (e.g. play equipment)\textsuperscript{113}. However, to simply increase the amount of daily recess would potentially reduce school curriculum time and place further strain on an already crowded school curriculum. Of interest, studies have also shown that schools that meet national physical activity recommendations for physical education were less likely to meet national recommendations for recess and vice versa\textsuperscript{114}.

\textbf{2.6 Rationale for a curriculum-based approach to physical activity integration}

Previous research has highlighted that taking active breaks within the school day (classroom time) can not only enhance the physical activity levels of children, but also lead to increases in ‘on-task’ behaviour within the classroom. A recent study in Ireland has found increased activity as a result of 10 minute energisers\textsuperscript{115} within classroom instruction time. There was a significant difference in the change in daily steps from baseline to follow-up between groups. Mean daily in-school steps for the intervention at baseline and follow-up were 5351 and 5054. Corresponding values for the control group were 5469 and 4246. Mahar et al. reported that on task-behaviour was improved by 8\% and by as much as 20\%, with the least attentive students, when children received 10 minute energiser sessions each day\textsuperscript{18}. These results have been further supported by research that has demonstrated that exercise breaks can help students maintain behaviour for longer periods\textsuperscript{19}. Additionally, a further study in the United States has suggested that exercise breaks of at least 10 minutes duration are needed to improve time on-task, as breaks of only 5 minutes reported no differences in time spent on-task\textsuperscript{20}. Whilst time on-task is not a perfect proxy for whether a student is paying attention or engaged, it is an observable metric that is used frequently by teachers\textsuperscript{116}.

Researchers have previously advocated the use of active breaks in the classroom because it is a low-budget and cost-effective strategy for increasing physical activity\textsuperscript{16,18,20,115}. Whilst this approach to increasing children’s physical activity levels has potential in demonstrating to schools and school policy makers both the positive academic and health-related outcomes of a curriculum-based approach, this method is not without its limitations. Adding physical activity breaks or energisers may place further strain on an already crowded curriculum. For example in the Irish study\textsuperscript{115} although physical activity
levels increased, it could be argued that these activity breaks consisting of stretching and pulse-raising exercises to music for 10 minutes per day meant there was 50 minutes less academic instruction time for teachers each week. Alternatively, integrating PA within the existing curriculum does not place strain on the crowded curriculum but offers a potentially time- and cost-effective strategy that is currently under researched.

### 2.7 Previous curriculum-based physical activity interventions

Previous PA integration interventions within the school curriculum have been infrequent considering the multitude of studies that have demonstrated the association between physical activity and academic performance. Perhaps one of the most well-known and frequently cited programs that integrated physical activity into the existing curriculum to be implemented, evaluated and refined since its inception in 1999 is the Take 10 initiative. As of August 2010, Take 10 in its various forms has been disseminated to over 40,000 classrooms in the United States\(^1\). Much of this work has been focussed upon and influencing obesity-related outcomes and behaviours. Other well-known studies include Texas-I-Can, Physical Activity Across the Curriculum (PAAC) and Happy10.

A narrative review of the literature reported that classroom-based physical activity interventions have been implemented in various countries including the United States, Germany, Sweden, Canada and New Zealand\(^2\). The review noted that classroom-based interventions are often not stand-alone and are presented and analysed simultaneously with other interventions, e.g. recess, after school and the like. The review also found that interventions offered in the United States were more effective, while the length of an intervention did not significantly influence the physical activity outcomes. However, the key outcome from the review was recommending that, in this age of standardised testing and time restrictions placed upon teachers, it is imperative that interventions include both health and academic-related outcomes.

The Take 10 program has developed a series of resource kits containing activity cards, worksheets and other teacher resources that are available in both grade specific and subject specific folders\(^1\). The recent paper by Kibbe et al. explored the impact of the Take 10 program over 10 years. They reported that teachers were willing and able to implement classroom-based physical activity integrated lessons, and experienced higher activity levels, improved time on-task and achieved moderate energy expenditure levels.
Take 10 involves teachers running short sessions for 10 minutes throughout the school day using repetitive physical activity to reinforce previously taught academic concepts. In fact it may be that this approach places a further strain on the already congested school day. Additionally, some teachers may well believe that these sessions are in fact a substitute for regular PE. Consequently, many of the benefits physical education can provide students with including appropriate knowledge, skills, behaviours, and confidence to be physically active, may be missed.

The ‘Texas I Can’ intervention included academic lessons that were fully integrated activity across the lesson to teach key concepts. Originally tested in three elementary schools, researchers trained teachers to modify their existing lesson plans to incorporate physical activity across the core school curriculum (maths, language, arts, science). Unfortunately, process evaluation revealed less than 25% of sessions were implemented with teachers citing lack of planning time and equipment as a barrier despite teachers supporting the concept. Consequently the research team developed deliverable session plans and ran a whole day’s professional learning which saw the lessons implemented by 47 teachers across 8 schools (4 controls, 4 interventions). In terms of physical activity, a significant intervention effect was noted. Activity in this study was measured by pedometer steps; however a sample did wear accelerometers and it was reported that 20% of lessons were spent in MVPA. Other findings included a significant increase in time on task in lessons following the intervention. No measure was taken of engagement time on-task during the intervention lesson. A proximal spelling test was also used to assess academic performance, but the results were not significant. Therefore, perhaps crucially the integration of active lessons did not impede academic performance.

Another large scale trial of a curriculum intervention was Physical Activity Across the Curriculum (PAAC), a three year clustered RCT conducted in 24 elementary schools. This trial utilised both lessons and Take 10 resources. A one day professional learning workshop was delivered focusing on developing teacher competency and strategies in delivering 90 minutes of MVPA lessons per week over three years. The primary outcome of PAAC was a change in the Body Mass Index (BMI). No significant difference in BMI was reported. Results taken from a random sample only (n = 77) indicated a significant increase in physical activity across the school day. Interestingly, the study found significant improvements in academic achievement in reading, maths and spelling.
from the baseline. Whilst the authors cannot guarantee this was attributable to the intervention, this finding highlights the potential impact of embedding physical activity within the curriculum on education outcomes.

Of the limited number of truly physically active, integrated curriculum-based interventions where activity has been used to teach or reinforce academic concepts within the primary school, seldom have they been subject specific. There has been one previous attempt to promote children’s health through a physically active maths class\textsuperscript{119}. In this study the effects of integrating physical activity within the maths content on school day physical activity levels were examined. Despite finding that children’s physical activity levels ($n = 75$) significantly improved from the baseline, this study failed to use a control group as a comparison.

A recent systematic review of physically active lessons by Norris et al.\textsuperscript{25} has reported that, of eleven studies identified as meeting the criteria (having both physical activity and educational outcomes, featuring a control group, and involving either children or adolescents), five examined physical activity only, and three educational outcomes only, whilst only three measured both physical activity and educational outcomes. All had some evidence of increased physical activity in either the whole intervention group or some specific demographic and either significantly improved some measure of academic outcome or at least results were no different compared to inactive teaching\textsuperscript{25}. The review concluded that despite this encouraging evidence, there are too few studies to draw firm conclusions and as such, future high-quality studies using rigorous research methods are required.

Previous school-based PA interventions have highlighted the importance of teacher behaviour on intervention outcomes\textsuperscript{120} and professional development has been identified as a critical factor in improving the effects of such studies\textsuperscript{121}. Without direct teacher involvement the sustainability of such programs becomes questionable beyond the study period. Indeed a recent systematic review has highlighted the need for teachers to act as agents of change and to be involved in the delivery of subsequent programs\textsuperscript{21}.

Previously successful studies\textsuperscript{122,123} have used a diffusion of innovations model\textsuperscript{124} whereby teachers are more likely to adopt a new innovation if they view it as relative to current
practice, simple to understand, introduced gradually, and likely to produce observable results.

2.8 The role of teachers in physical activity promotion

Previous research on teachers’ perceptions of integrating physical activity in academic classes has consistently found that whilst teachers are willing, barriers exist\textsuperscript{86,125,126} (see Section 2.4).

Despite the potential for the integration of physical activity in the classroom, numerous concerns are held regarding both the teacher’s role and involvement and the long term sustainability of successful interventions. Previous school-based physical activity interventions have highlighted the importance of the participating teachers in intervention outcomes\textsuperscript{120}, and professional development has been identified as a critical factor in improving the effects of such studies\textsuperscript{83,121}. Without direct teacher involvement and deeper engagement with intervention components, the sustainability of such programs becomes questionable beyond the study period. Indeed, the recent systematic review by Erwin highlighted the need for teachers to act as ‘agents of change’ and to be involved in the design and delivery of subsequent programs\textsuperscript{21}. Results from previous interventions have reported that movement-based learning has the potential to increase time on-task\textsuperscript{17,117,118}. This increased student engagement, i.e. behaviour that suggests students are on task is crucial for successful learning\textsuperscript{127}. It has been suggested that physical activity may be particularly beneficial for kinaesthetic learners\textsuperscript{17}. However, there is a lack of consensus regarding this assertion and it is more likely that the physical activity and the novel teaching alone increases engagement rather than any connection to learning styles. It is necessary that future research will need to identify successful programmes and provide evidence of both the positive academic and health outcomes of such an approach.

2.9 Children’s primary school experiences with mathematics

Enhancing student engagement may be particularly important for mathematics, as studies have demonstrated that student interest and attitudes towards an academic subject are key predictors of academic success\textsuperscript{30}. Attitude towards mathematics plays a significant role in mathematics achievement\textsuperscript{128} and the development of negative attitudes has long been a concern in mathematics education\textsuperscript{27}. There is also growing evidence that subject boundaries within schools may act to inhibit innovation and the development of
interdisciplinary skills such as problem solving, creativity, collaboration and self-regulation\textsuperscript{129}. Ultimately, this can lead to student disengagement, particularly evident in traditional academic subject areas such as mathematics\textsuperscript{130}. It is widely accepted that by the end of Grade 6 (ages 12–13), students are developing lifelong attitudes towards mathematics\textsuperscript{131} and that disengagement in mathematics is considered a factor in the declining trend in mathematical performance among students internationally\textsuperscript{132}. Student enjoyment of mathematics is also recognised as a key ingredient for addressing student disengagement\textsuperscript{133} and that attitudes towards mathematics are not stable and fixed\textsuperscript{134}, therefore innovative interventions, such as PA integration, may have the potential to positively affect attitudes and engagement\textsuperscript{134}.

A clear focus for engaging students in the learning process for the last three decades has been through quality teaching. In Australia, as in many other western nations there have been a series of initiatives to raise teaching quality and enhance professional standards\textsuperscript{135}. One such example is the NSW Quality Teaching Model. The NSW Quality Teaching Model\textsuperscript{136} was designed to promote ‘good’ teaching practices. The framework encourages teachers to develop innovative skills that promote high levels of intellectual quality (IQ), establish a quality learning environment (QLE) and generate significance (SIG) by making learning meaningful and purposeful\textsuperscript{135}. Like many other teaching models this particular model is based on research showing that ‘of all the things that schools can control, it is the quality of the pedagogy that most directly and most powerfully affects the quality of learning outcomes that student’s demonstrate’\textsuperscript{136}. For example, IQ is developed when work is challenging, and requires academic engagement and centred on significant concepts. A QLE is created when the classroom or other learning environments e.g. the playground, offers students support. Finally to achieve high quality learning students need to see why, and that their learning matters. Many students view mathematics as a set of isolated procedures, failing to see real-life applications of their learning outside of the classroom\textsuperscript{137}. In addition, social interaction within the classroom is recognised as an important contributor to positive learning outcomes. However, researchers have found that mathematics classrooms and the individualistic nature of mathematics lessons may actually discourage social interaction and learning, which could reduce engagement and understanding\textsuperscript{27}.
2.10 Summary

Although the influence on teachers and school policy makers of high stakes standardised testing vary from country to country, many teachers have reported a narrowing of the school curriculum due to time and curriculum constraints. It is accepted that it is unrealistic to ask teachers to simply add extra physical activity to their day. What is likely to motivate teachers to implement a curriculum where physical activity is used in the learning process is if we can demonstrate the positive impact not just on children’s health but on how adding physical activity to the curriculum can enhance student engagement and/or performance. It appears most likely that if physical activity is to be used effectively within academic instruction time then teachers at both pre-service level and an experienced level will require training in integration skills and take ownership for integrating physical activity across subject disciplines.
Chapter Three

Outcomes and process evaluation of a program integrating physical activity into the primary school mathematics curriculum: The EASY Minds pilot randomised controlled trial

This paper describes the feasibility and preliminary efficacy of the EASY Minds intervention for increasing physical activity in primary school-aged children. The innovative program proved to be efficacious for significantly improving children’s school-based physical activity and reducing time spent in sedentary behaviour both during mathematics and across the school day. A significant intervention effect was also found for on-task behaviour during mathematics lessons. A detailed process evaluation suggested that the program was feasible for use in the primary school setting.

This chapter addresses the following research questions:

1. What is the impact of a school-based intervention (EASY Minds) on the school physical activity levels of primary school-aged children when delivered by an experienced physical activity researcher?

2. What is the feasibility of the EASY Minds program for improving physical activity and educational outcomes in the primary school when delivered by an experienced physical activity researcher?


(See Appendix 1 for published version.)

3.1 Abstract

Objectives: This study evaluated the feasibility of the ‘Encouraging Activity to Stimulate Young (EASY) Minds’ program, a school-based intervention for integrating physical activity (PA) into mathematics lessons.

Design: randomized controlled trial
Methods: Two classes from a single school (n=54) were randomised to receive either the 6-week EASY Minds intervention (n= 27) or follow their usual school program (n= 27). The intervention involved the embedding of PA across the pre-existing mathematics program for three x 60 minute sessions per week. Changes in PA were measured using accelerometers and ‘on-task’ behaviour was measured using momentary time sampling observation.

Results: Using intention-to-treat analysis, significant intervention effects were found for MVPA (9.7%, 95%CI=7.6 to 11.8, p=<0.001) and sedentary time (-22.4%, CI=-24.9 to -12.2, p≤0.001) for the intervention group during Mathematics lessons (9.30am-10.30am). Significant intervention effects were also shown for MVPA 8.7% (95% CI=5.8 to 11.6, p=<0.001 and sedentary time -18.6% (95% CI=-24.9 to -12.2, p=<0.001) across the whole school day. Furthermore, children displayed significantly greater ‘on-task’ behaviour across the intervention period with a 19.9% (95% CI=2.4 to 37.4, p=<0.03) mean difference between groups.

Conclusions: The EASY Minds program demonstrated that integrating movement across the primary mathematics syllabus is feasible and efficacious in enhancing school based-PA and improving on-task behaviour in mathematics lessons.

Key Words: physical activity, on task behaviour, integration, mathematics, primary school

3.2 Introduction

Multiple physical and psychological health benefits can be attained when children participate in the recommended levels of physical activity (PA)\textsuperscript{33}. Worldwide, the proportion of young people meeting PA guidelines of 60 minutes per day of moderate-to-vigorous (MVPA) or health enhancing PA is less than 20%\textsuperscript{1}. While schools are in a unique position to promote health enhancing PA, children’s time at school is commonly characterised by prolonged bouts of sitting\textsuperscript{9} and poorly taught Physical Education (PE), lessons that involve low levels of activity\textsuperscript{103}. Emerging research also indicates that reducing sedentary behaviour may improve the health of children and, therefore, reducing sitting time across the school day should be a health priority\textsuperscript{13}. 
Increased concern over a crowded school curriculum has reduced PA throughout the school day. In addition, as standardised testing and school accountability increases, PE and PA in general, have become increasingly marginalised as numeracy and literacy targets become a dominant focus in many schools. PE represents one of the key opportunities to develop positive attitudes to PA and teach students the knowledge and skills to lead active lifestyles; significant barriers exist to quality PE in the primary school. Barriers identified are both teacher-related and institutional. Furthermore, activity levels in PE are often very low and it has been suggested that children do not compensate for reduced PA throughout the school day by increasing PA outside school hours.

As such, other innovative strategies are required to engage students in PA and overcome some of the barriers inherent in curriculum-based approaches to PA promotion. One such recommendation is to embrace classroom-based PA and promote PA across the curriculum as part of a whole-school approach to PA promotion.

Indeed, the benefits of integrating PA may extend beyond students realising the health benefits of increased physical activity. For example, emerging research suggests that movement aids learning and that the integration of PA across the curriculum may actually enhance learning in other curriculum areas. There is an increasing body of literature that is focussing on the association between PA and academic performance and provides evidence that physical activity enhances children’s cognitive functioning, concentration and on-task behaviour. Several studies have revealed children who are more physically active tend to perform better academically, that children who are physically active and fit are likely to have stronger academic performance and activity breaks can improve cognitive performance and classroom behaviour.

Previous classroom-based physical activity interventions have found that the benefits of integrating PA during the school day include both increased total PA for students and positive learning outcomes. A number of studies have evaluated the effects of integrating PA across the primary curriculum to assist the learning process. The Take 10 program has been disseminated to more than 40,000 classrooms in the United States and replicated in both China and the UK. These studies have utilised short 10 minute bouts of PA (originally known as energisers) and have subsequently been used to reinforce previously taught academic concepts. It may well be that this approach actually intensifies...
the crowded curriculum issue and places further strain on academic instruction time or teachers may believe that these energisers are in fact a substitute for regular PE. ‘Texas I can’ has developed physically active lessons that fully integrate PA\(^\text{17}\). However, these studies have used pedometer steps as a measure of PA levels and therefore actual intensity of PA has not been examined. One recent study has focussed on PA integration and maths with promising results but the authors recognised the need that future studies need to use a control group to serve as a comparison\(^\text{119}\).

Erwin’s et al recent review strongly recommends that more research on the effect of classroom-based physical activity interventions on both physical activity and learning and health outcomes is warranted as PA integration can potentially be an inexpensive and effective intervention for improving both learning and health outcomes for all learners\(^\text{21}\).

Of the limited number of truly PA-integrated curriculum-based interventions, where activity has been used to teach or reinforce academic concepts in primary schools, none to our knowledge, have reported time spent in MVPA across the school day in a specific subject area, e.g. mathematics and reported on-task behaviour. Therefore, the aim of this unique study was to assess the feasibility and preliminary efficacy of the Encouraging Activity to Stimulate Young (EASY) Minds program that involved the embedding of PA and reduction in sitting time across the pre-existing mathematics program.

### 3.3 Methods

Study approval was sought and obtained from the University of Newcastle Research Ethics Committee, Newcastle and Maitland Catholic Schools Diocese and the school Principal from one independent primary school in Newcastle, New South Wales (NSW), Australia. Information leaflets, parental and participant consent forms were sent home with students and those who returned signed consent forms were permitted to participate in the study.

The study design involved a randomised controlled trial (RCT) and the two classes were assigned to either the EASY Minds intervention or a wait list control group. The design, conduct and reporting of the EASY minds program will adhere to the Consolidation Standards of Reporting Trials (CONSORT) guidelines\(^\text{141}\). Two classes of Years 5 and 6 students from one primary school were recruited. A randomisation envelope was prepared.
and a blinded independent third party allocated the two classes into one of the two groups. Randomisation by class was completed before baseline assessments in February 2012.

The EASY Minds program involved the integration of PA within mathematics for Stage 3 children. Stage 3 is the last two years (Years 5 and 6) of the Australian primary school education system (ages 10–12 years). The program ran for 6-weeks with 3 x 60 minute lessons per week, taught by a member of the research team (NR) who was a qualified primary/PE teacher with 21 years’ experience. Movement-based learning experiences were embedded in Mathematics lessons on three occasions per week over the six week period (Table 3.1 provides example activities). Movement was used to both explicitly teach and reinforce mathematic concepts. The researcher used the class teachers existing Mathematics program. No rewards were offered for participating in the study. Specific outcomes for Mathematics from the NSW Board of Studies syllabi were addressed in the program. The primary outcome was children’s school-based MVPA levels. Actigraph accelerometers (GT3X, Pensacola, USA) were used to provide an objective measure of both PA intensity and duration. The Actigraph accelerometer has acceptable reliability and validity in both children and adolescents.

Table 3.1: Example activities used in the EASY Minds program

<table>
<thead>
<tr>
<th>Academic concepts</th>
<th>Description of activity</th>
</tr>
</thead>
</table>
| Recall multiplication facts | • Students performed a modified version of the popular dance ‘Macarena’ whilst recalling mathematics facts. This involved crossing the right hand to left shoulder, left hand to right shoulder, right hand to left hip and left hand to right hip whilst recalling number facts.  
• Students performed slap count whilst recalling mathematics facts. This involved students facing a partner and taking turns to place their right hand on the palm of their partner’s right hand and then their left hand in their partner’s left hand whilst recalling number facts.  
• Drill ladders- students used a variety of footwork patterns and recalled multiplication facts whilst stepping in each rung. |
| Multiple choice Algorithms | • Students were given an algorithm on the whiteboard with four possible answers.  
• Students responded to the answer by performing a set movement  
• E. g. Answer A= Tricep dips, B= Squats, C= March on spot |
| Create line graphs         | Students completed a 10 minute aerobic routine and recorded heart rates every minute (Heart Rate Monitor worn by several children). This information was then used to create a line graph. |
| Estimate distance          | • Students estimated distances around the school; e.g., Classroom to office. They counted steps, recorded using a pedometer and checked using a trundle wheel.  
• Students threw, kicked and struck objects of different sizes. They then estimated and measured distances using tape measures. |
<table>
<thead>
<tr>
<th>Academic concepts</th>
<th>Description of activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a digital stopwatch</td>
<td>Students used a stopwatch and timed themselves over various short distances, 10, 20 m. They used this information to predict how long it would take to race 100m. This was used for a variety of locomotor movements.</td>
</tr>
<tr>
<td>Work out mode, mean</td>
<td>Students completed a tabloid of activities including, skipping, throw and catch, ball bouncing, shuttle runs over 30-second periods. The results of groups were compiled and students worked out means, modes and median values</td>
</tr>
<tr>
<td>and median</td>
<td></td>
</tr>
<tr>
<td>Solve mathematical</td>
<td>Koosh balls were thrown on to a horizontal target mat of concentric circles with a score value. The total score was then multiplied by the number rolled on a 20 sided dice.</td>
</tr>
<tr>
<td>equations</td>
<td></td>
</tr>
</tbody>
</table>

Accelerometers were worn Monday through to Thursday, during school hours only (09.00–15.00). The classroom teachers were responsible for distributing and collecting the accelerometers on a daily basis. Accelerometers were attached to an adjustable elastic belt and worn on the right hip. Raw data from the accelerometer were screened and analysed using Meter plus software version 4.7. Participants’ PA was included for analysis if they wore the accelerometer for at least five school hours on any given day. Similarly, students were only included in the analysis if they wore the accelerometer for 50 minutes of the 9.30–10.30 intervention period. Evenson cut points were used to classify activity as sedentary, light, moderate, vigorous or moderate-to-vigorous physical activity (MVPA)\textsuperscript{142}. Data were collected in 15-second epochs and non-wear time was defined as 20 minutes of consecutive zeros. Height and weight were measured at baseline only to profile the sample. Weight was measured without shoes using a portable digital scale (Seca 770, Wedderburn) to the nearest 0.1kg and height was measured to the nearest 0.1 cm using a portable stadiometer (Design No. 1013522, Surgical and Medical Products, Seven Hills, Australia).

On task behaviour was included as a secondary outcome. Children’s on-task behaviour was observed using a momentary time sampling procedure. On-task behaviour was measured at baseline, midpoint (three weeks) and post-test (six weeks). Six students per class group were selected at random, using random statistical number tables and observed at 15 second intervals on a rotational basis over a 30-minute period in the allocated 9.30–10.30 time slot. Two trained research assistant observers observed simultaneously. This method of systematic observation has been recommended when seeking to simply describe the classroom behaviour of children\textsuperscript{116}. The assessors were blinded to the study hypothesis at baseline only. On-task behaviour included behaviour that could be
categorised as being ‘actively engaged’ or ‘passively engaged’. Actively engaged referred
to a child being actively engaged in academic responding, e.g. reading, writing,
performing a set task. Passively engaged was categorised as behaviour where the child
was listening to the teacher or a fellow student but was not actively participating in a set
task. Off-task behaviour included behaviour that can be described as being either off-task
motor, where a child moved in a manner not associated with the task (e.g. walking around
the class), off-task verbal including off task verbal discussion or off task passive where a
child was non-engaged but passive (e.g. staring into space). Momentary time sampling
involves a category being assigned at a pre-determined set time, not over a time period.
Observers listened to an electronic metronome via an ear piece that alerted them to
observe and categorise a student’s behaviour every 15 seconds.

Research assistants received two hours training focussed on identifying and classifying
behaviour into the appropriate categories and undertook a pre-trial practice in the school
to develop a consistent understanding of the categories. Following all observations, the
observers compared notes to clarify discrepancies. Classroom behaviour was reported as
a percentage of time and for this trial categorised as simply ‘on-’ or ‘off-task’.

The overall feasibility of the program was evaluated using the following metrics:
successful recruitment of participants, study retention and process evaluation
questionnaires exploring program satisfaction completed by both participating teachers
and student participants. The questionnaire (available on request) included items focussed
upon program timing (three items), instructor quality (four items), appropriateness of
program content (four items) and program impact (eight items). The questions used a
five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The analyses were performed using IBM SPSS Statistics version 20 and all variables were
checked for plausibility and missing values. Data are presented as mean (SD) for
continuous variables and counts (percentages) for categorical variables. Linear mixed
models were used to assess all outcomes for the impact of group (EASY Minds vs.
control), time (treated as categorical with levels at baseline, three and six weeks) and the
group-by-time interaction, with these three terms forming the base model. Mixed models
are robust to the biases of missing data and provide appropriate balance of Type 1 and
Type 2 errors. Mixed model analyses are consistent with the intention-to-treat principle,
assuming the data are missing at random\textsuperscript{143}. Participant age and sex were examined as
potential covariates in each model and any significant effects were adjusted for in the analyses. For each significant covariate, two-way interactions with time and treatment were also examined and, if significant, these effects were also controlled for.

3.4 Results

A total of 58 students were given information statements and consent forms. Fifty four children from Grade 5 and 6 (28 male and 26 female) were recruited with a mean age of 10.53 (±0.7) years. No children were diagnosed with learning difficulties or developmental conditions.

At baseline, 52 students completed height and weight assessments, accelerometers were worn by 54 participants and 12 students were observed for on-task behaviour. Following baseline assessments, the two participating classes were randomised into the intervention or control groups. The intervention group consisted of 27 students (14 male, 13 female) and the control group consisted of 27 participants (14 male, 13 female) (Figure 3.1).
Figure 3.1: Flow of participants through the study

The mean age and height of the participants was 10.5 (±0.7) years and 146.3 (±8.1) cm, respectively. At baseline, the control class was more physically active in terms of MVPA (10.2%, ±5.4) compared to the intervention group (6.4%, ±2.5) across the school day. Of note however, the intervention group (2.5%, ±1.4 MVPA) were more active during the 9.30–10.30 mathematics timeslot than the control group (1.1% ±1.2%). The intervention group spent 82% (±4.4%) of mathematics in sedentary behaviour and the control group 76% (±9.3). At baseline on-task behaviour was recorded as 70% (±13.0) for the control group and 60% (±11.5%) for the intervention group. Significant group by time effects favouring the intervention group were found for MVPA across both the 9.30–10.30 teaching timeslot (+9.7%, 95%CI 7.6 to 11.8) and the school day (+8.7%, 95% CI 5.8 to 11.6) from baseline to six weeks. Similar group by time effects were also found for sedentary behaviour in the teaching timeslot (-22.4%, 95% CI -27.3 to -17.6) and the school day (-18.6%, 95% CI-24.9 to -12.2), which also favoured the intervention group. A significant treatment effect was found for on-task behaviour from baseline to six weeks.
(p<0.001). During the intervention lessons (9.30–10.30) a 19.9% mean difference between groups in on-task behaviour was observed (Table 3.2).

Table 3.2. shows changes in outcome variables by treatment group from baseline to three weeks and baseline to six weeks and differences in outcomes among the treatment groups at six weeks (ITT analysis) (n = 54).
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Week</th>
<th>Treatment group</th>
<th>Mean change from baseline (95% CI)</th>
<th>Mean difference between groups (95% CI)</th>
<th>Group x time P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School day (9:00-3:00)</strong></td>
<td></td>
<td></td>
<td>Control (n = 27)</td>
<td>Easy Minds (n = 27)</td>
<td></td>
</tr>
<tr>
<td>Sed %</td>
<td>3</td>
<td></td>
<td>6.6 (2.8, 10.3)</td>
<td>-0.7 (-4.4, 3.0)</td>
<td>-7.2 (-12.5, 2.0)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>4.7 (0.2, 9.3)</td>
<td>-13.9 (-18.3, -9.4)</td>
<td>-18.6 (-24.9, -12.2)</td>
</tr>
<tr>
<td>Light %</td>
<td>3</td>
<td></td>
<td>-1.4 (-4.2, 1.4)</td>
<td>-0.2 (-2.9, 2.6)</td>
<td>1.2 (-2.7, 5.1)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>-2.0 (-5.4, 1.4)</td>
<td>10.9 (7.6, 14.2)</td>
<td>12.9 (8.2, 17.6)</td>
</tr>
<tr>
<td>Mod %&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>-2.4 (-3.4, -1.3)</td>
<td>-0.6 (-1.6, 0.5)</td>
<td>1.8 (0.3, 3.3)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>-2.6 (-3.8, -1.4)</td>
<td>1.8 (0.6, 2.9)</td>
<td>4.3 (2.7, 6.0)</td>
</tr>
<tr>
<td>Vig %</td>
<td>3</td>
<td></td>
<td>-2.9 (-4.3, -1.5)</td>
<td>1.4 (-0.0, 2.8)</td>
<td>4.3 (2.3, 6.3)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>-3.0 (-4.2, -1.9)</td>
<td>1.3 (0.1, 2.4)</td>
<td>4.3 (2.6, 5.9)</td>
</tr>
<tr>
<td>MVPA %&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>-5.3 (-7.3, -3.3)</td>
<td>0.8 (-1.2, 2.8)</td>
<td>6.1 (3.3, 8.9)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>-5.7 (-7.7, -3.6)</td>
<td>3.0 (1.0, 5.0)</td>
<td>8.7 (5.8, 11.6)</td>
</tr>
<tr>
<td><strong>Mathematics class (9:30-10:30)</strong></td>
<td></td>
<td></td>
<td>Control (n = 27)</td>
<td>Easy Minds (n = 27)</td>
<td></td>
</tr>
<tr>
<td>Sed %&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>7.2 (3.1, 11.3)</td>
<td>-16.8 (-20.6, -13.0)</td>
<td>-23.9 (-29.5, -18.3)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>2.6 (-1.0, 6.2)</td>
<td>-19.9 (-23.1, -16.6)</td>
<td>-22.4 (-27.3, -17.6)</td>
</tr>
<tr>
<td>Light %&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>-7.9 (-11.5, -4.3)</td>
<td>9.1 (5.8, 12.4)</td>
<td>17.0 (12.1, 21.8)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>-3.6 (-6.8, -0.3)</td>
<td>9.1 (6.1, 12.0)</td>
<td>12.6 (8.3, 17.0)</td>
</tr>
<tr>
<td>Mod %&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>0.1 (-0.5, 0.8)</td>
<td>0.6 (+0.0, 1.2)</td>
<td>0.5 (-0.4, 1.4)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>0.7 (-0.1, 1.5)</td>
<td>3.9 (3.2, 4.6)</td>
<td>3.2 (2.1, 4.2)</td>
</tr>
<tr>
<td>Vig %&lt;sup&gt;ac&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>0.6 (-0.5, 1.6)</td>
<td>7.1 (6.1, 8.1)</td>
<td>6.5 (5.1, 8.0)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td>0.3 (-0.8, 1.5)</td>
<td>6.7 (5.7, 7.8)</td>
<td>6.4 (4.8, 8.0)</td>
</tr>
<tr>
<td>MVPA %&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3</td>
<td></td>
<td>0.7 (-0.5, 1.9)</td>
<td>7.7 (6.6, 8.8)</td>
<td>7.0 (5.4, 8.7)</td>
</tr>
<tr>
<td>Outcome</td>
<td>Week</td>
<td>Treatment group</td>
<td>Mean change from baseline (95% CI)</td>
<td>Mean difference between groups (95% CI)</td>
<td>Group x time</td>
</tr>
<tr>
<td>---------------------------------</td>
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<td>----------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control (n = 27)</td>
<td>Easy Minds (n = 27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On task behaviour (%)</td>
<td>3</td>
<td>1.0 (-0.6, 2.5)</td>
<td>10.7 (9.3, 12.1)</td>
<td>9.7 (7.6, 11.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>5.3 (-8.9, 19.5)</td>
<td>20.2 (3.9, 36.6)</td>
<td>14.9 (-6.7, 36.5)</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>4.3 (-8.6, 17.1)</td>
<td>24.2 (12.3, 36.0)</td>
<td>19.9 (2.4, 37.4)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Abbreviations:
CI, confidence interval
ITT, intention to treat
a adjusted for gender
b adjusted for sex x treatment interaction
c n = 51 d n = 12
Scores on the evaluation survey completed by the 27 students in the intervention group ranged from 4.0 to 4.9 out of 5 for the 20 items indicating high to very high satisfaction rates for the EASY Minds program. Students found the program highly enjoyable, (mean score=4.6 ± 0.7), enjoyed working outside the classroom (4.9 ± 0.3), and incorporating PA into their lessons (4.7 ± 0.5). The classroom teachers who observed every session completed the teacher evaluation of the program. This revealed high satisfaction with both the program (4.9 ± 0.1) and its impact (4.5 ± 0.2). These positive teacher findings are consistent with other classroom-based PA interventions119. Both classroom teachers answered ‘strongly agree’ when asked if they would feel comfortable teaching the program. Classroom teachers believed the program was well received by children, due to the inclusion of the physical activity and the promotion of group tasks. Seventeen of the 18 sessions were completed as intended. The classroom teacher observed all sessions to ensure the mathematical content was covered appropriately. This was done through open dialogue between the researcher and class teachers. One session was missed due to the children all attending a religious festival.

3.5 Discussion

The primary aim of this study was to evaluate the feasibility and preliminary efficacy of a movement-based mathematics program in the primary school. The EASY Minds program resulted in significant intervention effects for MVPA during mathematics lessons and across the school day. In addition, there was a significant intervention effect for reduced sedentary time in mathematics lessons and across the school day and in ‘on-task’ behaviours. The EASY Minds program was also well received and enjoyed by teachers and students.

The increased levels of MVPA and reduced sedentary time found among children in the EASY Minds program demonstrates the potential behavioural impact of this approach and is consistent with the findings of previous studies that have integrated PA in the primary classroom18,117,119,140. However, previous studies17,18,119 have not necessarily reported PA as MVPA, but have used step counts from pedometers as their outcome and thus not been able to determine engagement in physical activity of intensity that is considered health enhancing and makes comparison problematic. Those studies that have used accelerometers have only reported MVPA and not sedentary time9. Others have used accelerometers with only a sub sample of the study group and not the whole group117,119.
The EASY Minds program resulted in a significant increase in MVPA across the school day, not just total PA (as measured by steps or counts per minute), suggesting that the integration of PA in the school curriculum can help contribute to young people meeting current PA recommendations (i.e. 60 min/day of MVPA). As part of a multi-level intervention, a small increase of six minutes MVPA during class time could have important clinical significance. It is extensively recognised that regular PA has multiple benefits for physical, mental and cognitive health. Meeting the recommended guidelines of 60 minutes MVPA per day is related to greater muscular strength, stronger bones, and improved cardiovascular health, as well as reducing and preventing conditions such as anxiety, depression and enhancing self-esteem. Additionally there is increasing evidence on the relationship between MVPA and the structure and functioning of the brain. In this study we found that students at baseline spent 66% of their school day and 79% of typical academic instruction time in sedentary activity. It is worth noting that the intervention also reduced this sedentary behaviour. The evidence on the health and developmental effects of reducing sedentary behaviour in children is currently inconsistent, but these changes and the corresponding increases in light physical activity might contribute to increased energy expenditure and obesity prevention, metabolic health, and cognitive functioning. Therefore reducing sedentary behaviour across the school day especially for children who won’t meet the current recommendations for MVPA may have physiological and academic benefits.

On-task behaviour has been shown to be a key predictor of academic success. Similar to previous studies, EASY Minds demonstrated a significant improvement in ‘on-task’ behaviour and thus movement-based learning may potentially result in increased time on task. It is important to highlight that time on task is time spent engaged in academic learning not simply time spent ‘behaving’. Future investigations need to determine if increased on-task behaviour is a result of the PA alone or the innovative approach to learning.

The strengths of the EASY Minds feasibility study are that it is an innovative and unique program that specifically integrates PA across the primary school mathematics curriculum. Importantly, the integrity of the mathematics lesson outcomes was maintained throughout. The study used trained assessors and observers for all assessments and observations. Clearly an additional benefit to school-based curriculum interventions
is that unless a child leaves the school they remain in the study for its full duration, as such retention rates are expectedly high. The use of objectively measured PA via accelerometry is a further strength of the study.

There are some major limitations that should be noted. Whilst the results of the study are very positive, it is worth noting that the program was delivered by the researcher, a HPE trained specialist, with extensive experience in the primary classroom. Further studies will need to evaluate the effectiveness of classroom teachers in delivering the program to assess both the sustainability and usability of the program in the school setting. It may well be that the single biggest barrier to PA integration will be teachers own beliefs, perceptions and attitude towards PA and it has been shown that social support provided by the classroom teacher mediates changes in children’s PA behaviours. It would therefore appear imperative that teachers are involved in the planning phase of subsequent studies. Indeed a recent systematic review has highlighted the need for teachers to act as agents of change and to be involved in the delivery of subsequent programs to improve the cost effectiveness, sustainability and feasibility of programs. A key part of this will need to be professional learning focusing on up-skilling teachers in working outside the classroom. Although results were significant for on-task behaviour, the results are limited by the small sample size and assessors only being blinded at baseline. This may have influenced the findings. Similarly, it is possible that factors outside the intervention may have been responsible for the decrease in MVPA among participants in the control group at three and six weeks across the school day. Despite this being a group RCT, the intervention was carried out in a single school and the analysis could not take into account clustering. Whilst the authors cannot be sure why there was such a significant drop in the PA levels of the control group, it is worth noting that the control group were preparing for standardised national tests, unlike the intervention group. This may or may not have influenced the classroom teacher’s willingness to provide children with opportunities to be physically active throughout the school day.

3.6 Conclusions

PE programs alone cannot achieve the goal of increasing children’s PA levels. The EASY Minds program was successful in improving MVPA, reducing sedentary time and increasing on-task behaviour. Our findings illustrate the potential of movement-based
learning in the primary school setting. This successful feasibility will be used to inform a larger RCT to determine the effect and translation of EASY minds.

**Practical Implications**

Integrating PA led to increased MVPA within the mathematics lesson and the school day

Integrating PA led to a reduction in sedentary behaviour within the mathematics lesson and the school day

Integrating PA in mathematics led to an increase in on-task behaviour

**Human Subjects Approval Statement**

This study protocol was approved by the human ethics committee at the University of Newcastle, Australia.

**Acknowledgements**

The authors would like to thank the participants for the time and effort given to this study.
Chapter Four

Rationale and study protocol of the EASY Minds (Encouraging Activity to Stimulate Young Minds) program: cluster randomised controlled trial of a primary school-based physical activity integration program for mathematics

This paper describes the rationale and methods of the EASY Minds cluster randomised controlled trial for improving the physical activity levels of Grades 5 and 6 primary school children (second trial). The methods used in the feasibility trial (Chapter 3) were evaluated and changes were made to the delivery of the EASY Minds intervention with classroom teachers being responsible for the delivery of the intervention. Additional measures included measures of mathematical attitude and mathematical performance. Details of the methodological aspects of recruitment, inclusion criteria, randomisation, intervention structure and content, assessments, process evaluation and statistical analyses are described in this paper.

This chapter presents the methodology for addressing three research questions:

1. What is the impact of the EASY Minds program on the physical activity levels of primary school-aged children when delivered by trained classroom teachers?
2. What are the effects of the program on a range of educational outcomes including on-task classroom behaviour, mathematical performance and mathematical attitude when delivered by trained classroom teachers?
3. What is the feasibility of the EASY Minds Program for improving physical activity and educational outcomes in the primary school?

4.1 Abstract

Background: Novel strategies are required to increase school-based physical activity levels of children. Integrating physical activity in mathematics lessons may lead to improvements in students’ physical activity levels as well as enjoyment, engagement and learning. The primary aim of this study is to evaluate the impact of a curriculum-based physical activity integration program known as EASY Minds (Encouraging Activity to Stimulate Young Minds) on children’s daily school time physical activity levels. Secondary aims include exploring the impact of EASY Minds on their engagement and ‘on-task’ behaviour in mathematics.

Methods: Grade 5 an 6 classes from eight public schools in New South Wales, Australia will be randomly allocated to intervention (n=4) or control (n=4) groups. Teachers from the intervention group will receive one day of professional development, a resource pack and asked to adapt their lessons to embed movement-based learning in their daily mathematics program in at least three lessons per week over a six week period. Intervention support will be provided via a weekly email and three lesson observations. The primary outcomes will be children’s physical activity levels (accelerometry) across both the school day and during mathematics lessons (moderate-to-vigorous physical activity and sedentary time). Children’s ‘on-task’ behaviour, enjoyment of mathematics and mathematics attainment will be assessed as secondary outcomes. A detailed process evaluation will be undertaken.

Discussion

EASY Minds is an innovative intervention that has the potential to improve key physical and academic outcomes for primary school aged children and help guide policy and practice regarding the teaching of mathematics.

Trial Registration No: Australian and New Zealand Clinical Trials Register
ACTRN12613000637741

Key Words

physical activity; primary school; mathematics; on task behaviour; accelerometry; randomised controlled trial
4.2 Background

Global estimates demonstrate that less than 20% of young people are achieving the guidelines of 60 minutes per day of ‘health enhancing’ moderate-to-vigorous physical activity (MVPA)\(^1\). This is of concern as multiple physical and psychological health benefits can be attained when children are physically active\(^3\). While schools have long been identified as important institutions for the promotion of physical activity (PA) among children\(^7\,\,8\), children’s time at school is commonly characterised by low levels of PA. Moreover, children also experience prolonged periods of sitting while at school\(^9\). Reducing sitting time or sedentary behaviour has important and independent health implications for children\(^4\). Studies have found that sedentary behaviour is associated with a higher risk of being overweight\(^10\), adverse metabolic markers\(^4\) and poorer mental health\(^12\). Therefore, reducing sitting time and promoting physical activity across the school day may have important health benefits for children\(^11\,\,13\).

The crowded school curriculum, competing demands on teachers, low levels of teacher expertise in PA promotion and restrictive school policies have impacted both the quality and quantity of PA opportunities in primary schools\(^8\,\,14\). Indeed, educational researchers have stated that that the single biggest barrier to PA promotion is teachers’ own beliefs, perceptions and attitude towards PA\(^13\). Despite these challenges, schools provide an ideal setting in which changes can be implemented for facilitating PA opportunities and reducing sedentary behaviour\(^14\). However, novel strategies for PA promotion throughout the school day that are feasible and appealing for teachers and schools to implement are needed\(^14\,\,14\). One such strategy is PA integration across the curriculum\(^8\,\,12\,\,15\).

The potentially appealing aspect for teachers and schools of integrating PA across the school curriculum is that the benefits to children extend beyond the health benefits of physical activity\(^5\,\,15\). For example, recent research suggests that movement aids learning and that the integration of PA across the curriculum may enhance learning in other curriculum areas\(^5\,\,15\). This challenges the belief that schools need to increase academic time and reduce PA time to improve academic performance\(^15\). There is also an increasing body of literature that focuses on the association between PA and academic performance and provides evidence that PA enhances children’s cognitive functioning, concentration and on-task behaviour\(^1\). The integration of PA into other subjects may also enhance connectedness by providing real life application of academic concepts to enable students...
to view learning as significant and meaningful\textsuperscript{135}. For example, in mathematics, using real stimuli such as stopwatches, tape measures, and trundle wheels to gather data provides a real life context and interactive teaching methods that promote movement, which are associated with greater learning\textsuperscript{135}.

The proposed program builds on a successful pilot of the EASY (Encouraging Activity to Stimulate Young) Minds program\textsuperscript{153}, where significant intervention effects were found for MVPA and sedentary time for the intervention group during mathematics lessons and across the whole school day. Furthermore, children displayed significantly greater on-task behaviour across the intervention period. However, the pilot study research was carried out in a single school and all sessions were planned and delivered by a member of the research team.

4.3 Methods/Design

Study Design

The EASY Minds program is a six week primary school-based intervention and will be evaluated using a cluster randomised controlled trial (RCT). Ethics approval has been sought and obtained from the University of Newcastle, NSW, Australia and the New South Wales Department for Education and Communities (SERAP: 2013011). The EASY Minds trial is registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12613000637741).

Following the initial recruitment processes, all eligible participants will complete baseline assessments. The design, conduct and reporting of the EASY minds program will adhere to the Consolidation Standards of Reporting Trials (CONSORT) guidelines and the extension for a cluster randomised control trials (RCT)\textsuperscript{141}. Principals, teachers and parents will need to provide written informed consent.

Recruitment and study participants

Eight government public primary schools from the Hunter Region, NSW, Australia will be recruited to participate in the EASY minds RCT. Stage 3 classes (Grades 5 and 6) at the study schools will be invited to participate in the study. School principals will receive an initial letter followed by an email. Schools will be randomly selected from a list of primary schools within a 20 km radius from the University of Newcastle. Schools will
then be matched on size and demographics using the participating schools index of community socio-educational advantage (ICSEA). The ICSEA value is determined based on family background information provided to schools directly by families and includes data relating to parental occupation, and the school education and non-school education levels they achieved.

Randomisation will occur after baseline assessments. A simple computer algorithm will be used to randomly allocate schools to either control or the treatment conditions by an independent researcher not involved in the study. This method will ensure all schools have an equal likelihood of allocation into one of the two study arms. Trained research assistants will conduct all assessments and administer all student questionnaires. All researchers will complete training sessions prior to assessment to maintain consistency and where possible, the same assessors will be used at baseline and post-test. Figure 4.1 shows the flow of participants through the study.

**Sample size Calculation**

Power calculations were conducted to determine the sample size required to detect changes in the primary outcome of accelerometer-determined physical activity counts per minute (CPM)

Calculations assumed baseline-post-test correlation scores of $r = 0.30$ and were based on 80% power, with alpha levels set at $p < 0.05$. Using the standard deviation (SD) of change observed in the EASY Minds pilot study (SD=200 CPM) and a conservative intra-class correlation coefficient (ICC = 0.15), it was calculated that a study sample of $N = 200$, with 8 clusters (i.e. schools) of 25 students would provide adequate power to detect a between group difference of 200 CPM across the school day.
Figure 4.1: Flow of participants through the EASY Minds study

**Intervention**

The EASY Minds program will involve teachers adapting mathematics lessons over a six-week (3 x 60 min sessions per week) period to ensure movement-based learning is applied to the NSW K-10 Mathematics syllabus. The intervention program will involve a one-day teacher professional learning day, the provision of equipment and resources, teacher-initiated adaptation of mathematics lessons to incorporate movement-based learning and support for teachers during program implementation.

All classroom teachers from the intervention schools will be invited to attend a six-hour professional learning workshop conducted at the university and delivered by NR, KH and PJM. The content of the professional learning day is outlined in Table 4.1. The one-day workshop includes a rationale for PA integration, presentation of results from the feasibility trial, practical examples of PA integration and a peer-supported planning session.
### Table 4.1: EASY Minds professional development workshop

<table>
<thead>
<tr>
<th>Session</th>
<th>Focus</th>
<th>Content</th>
</tr>
</thead>
</table>
| 1       | Theory | • Research on the effects of a school-based program on physical activity and academic performance.  
          |        | • Introduction to the EASY Minds program and key measures.  
          |        | • Mathematics: Student engagement in mathematics  
          |        | • Managing the learning environment |
| 2       | Practical | • Introduction to practical activities that promote mathematical concepts  
          | Movement-based | • Teachers will expand their repertoire of teaching practices by learning about and participating in activities successfully trialled in schools in advance.  
          | learning. Practical | • Links to key elements of Quality Teaching Framework e.g. quality learning environment  
          | considerations and key teaching principles. | • Engagement, high expectations, social support, self-regulation.  
          | | • Watching and discussion of previously recorded video footage of movement-based learning lessons filmed by and delivered by research team. |
| 3       | Theory | • Teachers will plan an EASY Minds enhanced mathematics unit of work and individual activities using their current mathematics unit of work using both previously prepared resources, knowledge acquired and peer support.  
          | Planning and delivery | • Teachers will be instructed in how to utilise current resources and how to embed resource kit provided into their teaching. |
| 4       | Practical | • Teachers will deliver to their peers both an indoor and outdoor movement-based activity from their lesson plan developed in previous session  
          | | • Feedback and support from peers via observation and discussion. |
| 5       | Conclusion | • Recap of key principles of movement-based lessons.  
          | | • Introduction to fidelity checking procedures.  
          | | • Explanation of email support by research team. |

The workshop is designed to engage, inspire and equip the teachers with the necessary skills to plan and deliver movement-based mathematics lesson. The professional learning day is registered and accredited with the New South Wales Institute of Teachers and attendees will be given professional learning hours towards their teacher accreditation. Attendees will be familiarised with the increasing evidence linking physical activity with academic performance and evidence related to the consequences of student disengagement from mathematics in the middle years of schooling. They will be provided with demonstrations and resources for learning experiences to promote physical activity
across the primary school mathematics curriculum. These activities and resources were previously employed in the successful feasibility trial. The professional learning day will promote two types of mathematical lessons: i) Activities that use PA as a platform for the development of procedural fluency of fundamental number operations\textsuperscript{29}. For example, students can recall multiplication tables whilst skipping, throwing and catching a ball or running through drill ladders; ii) Lessons that look at mathematics in the world around the school\textsuperscript{155}. For example, estimating and measuring distance, finding shapes and identifying their properties in the natural environment, data collection and representation involving fundamental movement skills of kicking throwing, striking. Example ideas can be found in Table 4.2.

Table 4.2: Example activities from professional learning day

<table>
<thead>
<tr>
<th>Mathematics content</th>
<th>Movement-based lesson</th>
</tr>
</thead>
</table>
| Using an empty number line | • Students are encouraged to use a number line drawn in chalk outside and utilise the jump strategy.  
• Present the students with a number problem; e.g. 8000-673.  
• Students should try to complete the number line in the most efficient way.  
• Assign each ‘jump’ a physical activity. Students can create their own movement  
• 1000=Squat, 100=jump, 10’s =lunge, 1’s = bottom kicks.  
• In this case the answer would be 7327. Students would perform 7 squats, 3 jumps, 2 lunges and 7 bottom kicks.  
• Students can be presented with a series of operations and be encouraged to use an empty number line. |
| Multiplication and Division | • Students will throw up to 5 bean bags on to a numbered target. They add up the total. They then divide the total by the number thrown. This will give the mean score.  
• Each child throws two bean bags on to the target. They then roll the 20 sided dice and multiply the number rolled by the total score.  
• Children should be encouraged to estimate their answer and record before actually working out. |
| Recognising Factors, multiples and prime numbers | • Arrange numbered flexi-domes throughout the area with the numbers in random order  
• Students run/skip/hop/side gallop etc. to the flexi-dome applicable when the scenario is given.  
• What is one factor of 40? Repeat this question but change the number e.g. 75, 16, 84 etc.  
• Show me a factor of 24, and then hop to the pair of the factor |
<table>
<thead>
<tr>
<th>Mathematics content</th>
<th>Movement-based lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find multiples of the number 3.</td>
<td></td>
</tr>
<tr>
<td>Find a prime number.</td>
<td></td>
</tr>
</tbody>
</table>

| Three Dimensional Space                     |                                                                                                        |
| Identify and describe the properties of three dimensional objects, for example number of faces, apex of a pyramid, number of edges. |                                                                                                        |
| Teachers can ask ‘How many vertices does a cube have?’ |                                                                                                        |
| Students are to answer by skipping the required amount to answer the question. Students can ask each other and work in pairs. |                                                                                                        |

| Two Dimensional Space                       | Netball court or other marked pitch.                                                                 |
| Working in small groups students are to classify all shapes they can identify on a netball court. |                                                                                                        |
| Students are to then draw and measure all key parts. |                                                                                                        |
| Students need to include length, width, radius, diameter, circumference, semi-circle and diagonals. |                                                                                                        |
| Using appropriate scale students are to draw an accurate scaled diagram |                                                                                                        |

Following the completion of the professional learning day, all schools will receive an EASY Minds equipment pack containing a selection of sporting and mathematical resources identified in the feasibility trial as being relevant for promoting movement-based learning. This includes, but is not limited to, stopwatches, tape measures, large dice, drill ladders, basketballs, skipping ropes, numbered beanbags, target mats and numbered flexi-domes (value A$800). All participating teachers will receive a CD-ROM with example movement-based activity descriptions developed by the research team at the culmination of the professional learning day to be used as a guide when integrating PA across their existing mathematics program. These activities are aligned with the current NSW mathematics syllabus. An important component of the program is a focus on teacher ownership and a tailored approach to meeting individual school requirements regarding each schools own specific unit of work and as such, the content of lesson material needs to be individually planned and prepared. The professional learning sessions will be delivered by academics (NR, KH and PJM) who are experienced researchers in the fields of physical activity promotion, mathematics education and primary school pedagogy and qualified teachers. Teachers will be encouraged to be creative and to develop their own lessons, thereby developing ownership of the program and increasing the likelihood of sustaining the program beyond the intervention period125.
A key principal of the EASY Minds program is the alignment of the program with the NSW Quality Teaching Framework\textsuperscript{135}. The NSW quality teaching framework encourages teachers to develop innovative skills that promote high levels of intellectual quality, establish a quality learning environment and generates significance by making learning meaningful and purposeful\textsuperscript{135}.

The intervention will run for six weeks during the schools’ regular timetabled mathematics sessions and will be delivered by the regular classroom teacher, who will translate their knowledge from the professional development training to create movement based learning activities for mathematics. Teachers will be encouraged to integrate PA in Mathematics sessions (60 minutes) on at least three occasions per week whilst maintaining the key focus on the desired mathematical outcomes from the current syllabus. The teachers will all receive a weekly email offering tips and strategies from the research team and a fortnightly fidelity check during weeks 1, 3 and 5 of the intervention.

**Outcomes**

Evaluation of the EASY Minds program will involve a variety of instruments and surveys to report on physical activity and key academic variables (on task behaviour, mathematical performance and attitude towards mathematics). All assessments will be conducted by trained research assistants and carried out in a sensitive manner. The collection of height and weight data will be measured behind a portable screen by gender-matched researchers. All PA and academic measures will be measured at baseline and post-test (six weeks).

**Physical Activity**

The primary outcome will be children’s school-based PA levels. Actigraph accelerometers (GT3X, Pensacola, USA) will be used to provide an objective measure of both PA intensity and duration\textsuperscript{78}. The Actigraph accelerometer has acceptable reliability and validity in both children and adolescents\textsuperscript{77}. Accelerometers will be worn Monday through to Friday, during school hours only. This will vary slightly for each school setting as the schools are likely to have different start and finish times. The classroom teachers will receive training in how to instruct students to wear accelerometers and be responsible for distributing and collecting the accelerometers on a daily basis. Accelerometers will be attached to an adjustable elastic belt and worn on the right hip. Raw data from the
accelerometer will be screened and analysed using Meter plus software version 4.7 which allows for time specific analysis to accurately analyse lesson- and school-time PA. Participants’ PA will be included for analysis if they wear the accelerometer for at least five school hours on any given day. Similarly, students will only be included in the analysis if they wear the accelerometer for 50 minutes of the 60 minute mathematic lessons. This time period may vary from school to school as a result of schools individual timetables. The Evenson cut-points will be used to classify activity as sedentary: (0 - 100 CPM, light (101 - 2295 CPM), moderate (2296 - 4011 CPM) , vigorous 4012 - ∞ CPM ) or MVPA. MVPA is a variable calculated by summing moderate and vigorous PA. Data will be collected in 15 second epochs and non-wear time will be defined as 20 minutes of consecutive zero’s.

**Academic Measures**

*On-task behaviour*

Children’s on-task behaviour will be observed using a momentary time sampling procedure. This observational tool has been adapted from the Behaviour Observation of Students in Schools and the Applied Behaviour Analysis for Teachers. Six students per class group of either sex will be selected and observed in 15 second intervals on a rotational basis over a 30 minute period in the allocated mathematics time slot. A cross-section of students with varying mathematical ability will be selected by the classroom teacher from those working above, those working at and those working below the class average as determined by exiting teacher assessments. On-task behaviour will include behaviour that could be categorised as being ‘actively engaged’ or ‘passively engaged’. Actively engaged refers to a child being actively engaged in academic responding, e.g. reading, writing, performing a set task. Passively engaged will be categorised as behaviour where the child is listening to the teacher or a fellow student but is not actively participating in a set task. Off-task behaviour includes behaviour that can be described as being one of: ‘off-task motor’ where a child moves in a manner not associated with the task, for example walking around the class; ‘off-task verbal’ includes non-work related talking or ‘off-task passive’ where a child is disengaged but passive, including staring into space. Two trained research assistant observers will observe simultaneously. This method of systematic observation has been recommended when seeking to simply...
describe the classroom behaviour of children. Classroom behaviour will be reported as a percentage of time.

**Attitude to Mathematics**

Participants’ attitudes to mathematics will be measured using a 24-item questionnaire containing two separate subscales: i) Confidence e.g. *I get good grades in maths*, and ii) Usefulness e.g. *Maths is a worthwhile necessary subject*. Each scale consists of 12 items with six items positively worded and six negative. Studies on the psychometric properties of the scale provide evidence for the reliability and validity of the subscales.

**Mathematic achievement**

Mathematics achievement will be measured using a Mathematics Progressive Achievement Test (PAT). For the purpose of this study cohort, PAT version 3 will be used. The PAT Mathematics test has 37 questions and takes 40 minutes to administer. The test will be administered by the classroom teacher under exam conditions as recommended by the Australian Curriculum for Educational Research (ACER). The 37 questions form separate items for individual mathematics sub-strands. These being number (n=14), Space (n=6), Measurement (n=6), Data (n=5) and Number (no calculator) (n=6). The test will provide evidence of students’ strengths and weaknesses and change over time.

Demographic information (i.e. age, sex, language, country of birth) will be collected at baseline via questionnaire alongside questionnaires of children’s preferred learning styles and intelligence strengths. These will be used to profile the children recruited in the study. Learning styles will be measured using the Barsch Learning Style Reference Form and students’ preferred perceptual modality will be determined. Preferred perceptual modality (learning style) has been defined as the conditions under which individuals concentrate process and internalise information. The Barsch learning style reference form defines three perceptual modalities. These are kinaesthetic (relating to body movement), visual (relating to the eyes) and auditory (relating to the ears). Students’ intelligence strengths will be assessed using a Multiple Intelligences Checklist for Upper Primary and Secondary (MICUPS).
Weight will be measured in light clothing without shoes using a portable digital scale (Seca 770, Wedderburn) to the nearest 0.1 kg and height will be measured to the nearest 0.1 cm using a portable stadiometer (Design No. 1013522, Surgical and Medical Products, Seven Hills, Australia). Height, weight, learning style and intelligence strengths will only be measured at baseline to profile the sample. No measures will be taken at follow up.

**Process Evaluation**

The overall feasibility of the EASY Minds program will be examined using a number of metrics to form a detailed process evaluation. Measures of recruitment, retention, adherence and satisfaction from teachers and students will be collected. We will also use a semi-structured discussion framework to conduct focus groups with students and one-on-one interviews with teachers. All questionnaires and focus group interviews for both students and teachers will be conducted by members of the research team. Teachers attending the professional learning session will complete a short evaluation questionnaire, which will assess teachers’ perceptions of the skills and ideas gained from the training, their satisfaction with the quality of the teacher training and their confidence to plan and deliver movement-based mathematics lessons across the study period. A five-point Likert scale will be used with responses ranging from ‘strongly disagree’ = 1 to ‘strongly agree’ = 5.

For example, i) the practical session improved my confidence to teach PA mathematics lessons; ii) the workshop provided me with useful information and skills that may improve my teaching. Additionally, participants will be asked for suggestions to improve the learning workshop or the program principles to assist further in the teaching of movement-based learning.

Throughout the intervention period, teachers will be asked to complete an activity evaluation log after each session and reflect on their lesson and rate their lesson using a five-point Likert scale. The teachers will all receive a weekly email offering tips and strategies from the research team and a fortnightly fidelity check via observation during weeks 1, 3 and 5 of the intervention. During this observation, a five minute discussion will take place where teacher and researcher will discuss a self-evaluation/activity log focussed on three items. These will be: 1) mathematical concepts (n=3), e.g. the key
mathematical concepts reinforced throughout the movement based activity; 2) activity levels (n=3) e.g. transitions were managed smoothly; and 3) engagement (n=3) e.g. students were engaged by the activities taught (see Table 4.3).

**Table 4.3: E.A.S.Y. Minds self-evaluation checklist**

<table>
<thead>
<tr>
<th>Mathematical concepts</th>
<th>(Please circle and provide comments)</th>
<th>(1 = Not at all true to 5 = Very true)</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Key mathematical concepts were reinforced throughout the movement-based activity</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>ii) Movement aided and promoted learning</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>iii) Students were given feedback to support their mathematical knowledge and understanding</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>iv) Transitions were managed smoothly</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>v) Students assisted in the set-up and collection of equipment</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>vi) Equipment used promoted physical activity</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>vii) Students were engaged by the activities taught</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>viii) Students remained on-task throughout the lesson</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>ix) Students enjoyed the movement-based mathematics lesson</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

Upon completion of the six-week program, all students will complete a process evaluation questionnaire. This questionnaire will be administered to determine students’ perceptions of integrating physical activity within the curriculum focussing on values of enjoyment and mathematical outcomes. A five-point Likert scale will be used with responses ranging from ‘strongly disagree’ = 1 to ‘strongly agree’ = 5. For example, ‘I liked being physically active in Maths outside the classroom’.

**Student focus groups and teacher interviews**

Focus group interviews will be conducted with the students and phone interviews will be carried out with participating teachers. For the focus groups, two groups of six students per class (mixed sex) will be selected based on a range of mathematical abilities
determined by the class teachers. Each teacher will be asked to select two children of higher, middle and lower ability for the class cohort. The 10–15 minute focus groups will use semi-structured questions. The focus group will be conducted by a researcher not directly involved in the current project.

The focus groups will be recorded and later transcribed by an independent third party. Specifically, the questions asked in the students’ groups will be designed to explore their perceptions of the EASY Minds outdoor mathematics lessons and associated activities, their mathematics lessons prior to and subsequent to their involvement in the program, as well as the students’ appraisal of how the EASY Minds lessons had influenced their perception of mathematics, and learning related to mathematical concepts. The focus group discussion framework was designed to elicit responses to the following questions: How would you describe your math’s classes before the EASY Minds program? Did you enjoy this? Did you enjoy the outdoor EASY Minds math’s lessons? Why? Can you give me an example? Did this make the math’s activities more interesting? What kinds of activities did you enjoy doing in the EASY Minds program? Can you tell me if being active in math’s classes helped you learn? Why/why not? If so can you give me an example?

Additionally, a one-on-one phone interview will be conducted with the teachers involved in the intervention group, after program completion. The 15 minute interview will be recorded and transcribed by an independent researcher. The interviews with teachers will be designed to elicit their perceptions of EASY Minds lessons compared to regular mathematics lessons. Teachers will also be asked to identify major challenges to the implementation of EASY Minds lessons, as well as their appraisal of learning outcomes and students’ enjoyment of the lessons, with particular emphasis on the role of physical activity in student engagement.

The following types of questions will be asked: Did you enjoy teaching an active mathematics session as opposed to a classroom based lesson? What were the major challenges to you as a teacher of active mathematics sessions? Do you think your students enjoyed the lessons/why/why not? How well do you they think the students understood the mathematics content in the physically active lessons? Can you give me a specific example? Do you think the PA aspect of the lesson contributed to greater engagement in the lesson compared to how that same mathematics content would usually be taught?
**Statistical Methods**

Statistical analysis of both the primary and secondary outcomes will be conducted with linear mixed models using SPSS statistics version 20 and alpha levels will be set at \( p > 0.05 \).

The models will be used to assess the impact of treatment (EASY Minds or control), time (baseline and post-test) and the group-by-time interaction, these three terms forming the base model. The models will be specified to adjust for the clustered nature of the data and will include all randomised participants in the analysis. Mixed models are robust to the biases of missing data and provide appropriate balance of Type 1 and Type 2 errors. Mixed model analyses are consistent with the intention-to-treat principle, assuming the data are missing at random. Sex and weight status (based on body mass index) will be included as covariates in the models. Further sub-group analysis will be conducted based on sex, weight status, mathematical ability, and enjoyment of mathematics and on-task behaviour.

The focus groups and interviews will be digitally recorded with the participants’ consent and transcribed verbatim. A computer program (NVIVO 10) will be used to assist with the organisational aspects of data analysis. Analysis will be conducted by an independent qualitative researcher. Analysis will be performed using a standard general inductive approach to qualitative analysis. Initially, inductively derived codes or labels will be formulated from the meaning units arising from the data. The developing coding scheme will be continually revised and further expanded after coding of additional transcripts. Following coding of all the transcripts, emerging themes will be identified and defined.

**4.4 Discussion**

The primary aim of this study is to evaluate the impact of a curriculum-based physical activity integration program known as EASY Minds on children’s daily school time PA levels. The secondary aim is to examine the impact of the program on student engagement and on-task behaviour in mathematics lessons and also determine program feasibility as it will be delivered by trained classroom teachers. The study will use a novel strategy in that it teaches current classroom practitioner’s to design their own lessons and integrate PA across the mathematics curriculum during traditional academic instruction time.
Previous school-based PA intervention studies have highlighted the importance of teacher behaviour on intervention outcomes\textsuperscript{164}. A critical aspect of this study is that classroom teachers will be taught to deliver the intervention in the professional learning day. Comprehensive professional development has been identified in previous studies as a critical factor in improving the effects of school-based interventions\textsuperscript{121}. Previous interventions have found teachers are willing to integrate PA into the academic subject, but lack the necessary skills and knowledge. Critically, this study is unique in that teachers will be given autonomy to plan and deliver their own lessons, using knowledge gained through the professional learning day. Teacher ownership of the program has the potential to lead to greater sustainability of the program and enable teachers to integrate PA across other curriculum areas.

A clear strength of this study is the rigorous process evaluation including quantitative and qualitative measures to explore program feasibility. Many other programs have reported issues with the intended delivery of the intervention as designed, thus affecting the true impact of the intervention\textsuperscript{118}. Our detailed process evaluation will help us examine the views of participants (teachers and students), and help distinguish between an intervention that is poorly designed and one that may be poorly delivered\textsuperscript{165}. This is necessary in this study due to the multi-site delivery.

Enhancing student engagement may be particularly important for mathematics, as studies have demonstrated that student interest and attitudes towards an academic subject are key predictors of academic success\textsuperscript{30}. Attitude towards mathematics plays a significant role in mathematics achievement\textsuperscript{128} and the development of negative attitudes has long been a concern in mathematics education\textsuperscript{27}. There is also growing evidence that subject boundaries within schools may act to inhibit innovation and the development of interdisciplinary skills such as problem solving, creativity, collaboration and self-regulation\textsuperscript{129}. Ultimately this can lead to student disengagement, particularly evident in traditional academic subject areas like mathematics\textsuperscript{130}. It is widely accepted that, by the end of Grade 6 (ages 12–13), students are developing lifelong attitudes towards mathematics\textsuperscript{131} and that disengagement in mathematics is considered a factor in the declining trend in mathematical performance among students internationally\textsuperscript{132}. Student enjoyment of mathematics is also recognised as a key ingredient for addressing student disengagement\textsuperscript{133} and that attitudes towards mathematics are not stable and fixed\textsuperscript{134},
therefore innovative interventions, such as PA integration, may have the potential to positively affect attitudes and engagement\textsuperscript{134}.

A recent review of classroom-based PA interventions found that they are usually infrequent and often presented and analysed alongside whole school PA interventions (e.g. interventions targeting recess and lunch-time)\textsuperscript{21}. This limitation has seen PA measures taken across the whole day and has not identified the specific impact during the actual intervention period. The need for well-designed interventions focusing on both health, PA and learning outcomes has been identified by the authors of the review, who also highlighted the need for teachers to act as agents of change and to be involved in the delivery of subsequent programs to improve the cost effectiveness, sustainability and feasibility of programs.

To our knowledge, no previous interventions have reported the effects of a classroom-based PA intervention on sedentary behaviour outcomes using accelerometry or examined sedentary time across the school day in mathematics. Significantly, our program will provide a unique approach as it uses PA within the curriculum to promote learning outcomes, provides objective measures of PA, while also measuring academic attitudes, on task behaviour and mathematical academic achievement. Furthermore, the program will be delivered by trained classroom teachers who will embed movement-based learning in their own classrooms in mathematics lessons. Other studies have provided actual materials to teachers to deliver\textsuperscript{118}. A unique aspect of this study is that it will allow scope for teachers to plan and deliver their own lessons using the training day as a stimulus.

An additional study strength is the use of an objective measure of PA and will report on both MVPA and sedentary time and will provide evidence of the program on three key academic variables (attainment, attitude, on task behaviour). Accelerometers are advantageous when working with children because unlike self-report measures of PA, they help eliminate language and literacy difficulties, recall bias and social desirability bias\textsuperscript{76}. Also as the monitors are to be worn across the school day, only compliance rates should be high, face-to-face distribution by the trained participating teacher will ensure the proper and consistent placing of the correct accelerometer on each participant\textsuperscript{166}, it is also likely that very few if any monitors will be lost. It has been reported that in previous
study up to five per cent of monitors may be lost if monitors are distributed by mail or worn across the whole day.\textsuperscript{166}

The findings of the EASY Minds RCT will provide valuable information for other research groups looking for evidence-based research on PA across the school day and other key educational outcomes associated with mathematics in the primary school. Classroom based PA interventions are infrequent, and seldom published in peer reviewed journals. Importantly it is important for school-based PA interventions to report on both health and educational outcomes. EASY Minds has the potential to change school policy and practice in relation to PA integration, increase school time physical activity levels and enhance a range of key educational outcomes relating to mathematics.

**Competing interests**

The authors declare that they have no competing interests.

**Authors’ contributions**

NR, DL, KH and PM obtained funding for the research. All authors contributed to developing the protocols and reviewing, editing and approving the final version of the paper. NR is the guarantor and accepts full responsibility for the conduct of the study. All authors have read and approved the final manuscript.

**Acknowledgements**

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Chapter Five

Findings from the EASY Minds cluster randomized controlled trial: evaluation of a physical activity integration program for mathematics in primary schools

This paper reports the findings of the EASY Minds cluster randomised controlled trial implemented in 2013. The results demonstrate significant improvements in physical activity across the school day, a reduction in sedentary time and improved on-task behaviour. The findings presented in this paper provide further evidence to support the effectiveness of the EASY Minds program for improving the physical activity levels of primary school-aged children and improving on-task behaviour. Significantly this paper highlights that increasing the amount of physical activity does not sacrifice academic performance. Furthermore, process evaluation results indicate that the intervention was feasible when delivered by classroom teachers for in the primary school setting.

This chapter addresses the following research questions:

1. What is the impact of the EASY Minds program on the physical activity levels of primary school-aged children when delivered by trained classroom teachers?
2. What are the effects of the program on a range of educational outcomes including on-task classroom behaviour, mathematical performance and mathematical attitude when delivered by trained classroom teachers?
3. What is the feasibility of the EASY Minds Program for improving physical activity and educational outcomes in the primary school when delivered by classroom teachers?

5.1 Abstract

*Background:* To evaluate the impact of a primary school-based physical activity integration program delivered by teachers on objectively measured physical activity and key educational outcomes.

*Methods:* Ten classes from eight Australian public schools were randomly allocated to treatment conditions. Teachers from the intervention group were taught to embed movement-based learning in their students’ (n=142) daily mathematics program in three lessons per week for six weeks. The control group (n=98) continued their regular mathematics program. The primary outcome was accelerometer-determined physical activity (PA) across the school day. Linear mixed models were used to analyse treatment effects.

*Results:* Significant intervention effects were found for PA across the school day (adjusted mean difference 103 CPM, 95% CI 36.5 to 169.7, \( p = 0.008 \)). Intervention effects were also found for PA (168 CPM, 95% CI 90.1 to 247.4, \( p=0.008 \)) and MVPA (2.6%, 95% CI 0.9 to 4.4, \( p=.009 \)) in mathematics lessons, sedentary time across the school day (-3.5%, 95% CI -7.0 to -0.13, \( p= 0.044 \)) and during mathematics (-8.2%, CI -13.0 to -2.0, \( p=0.010 \)) and on-task behaviour (13.8%, 95% CI 4.0 to 23.6, \( p = 0.011 \)) – but not for mathematics performance or attitude.

*Conclusion:* Integrating movement across the primary mathematics syllabus is feasible and efficacious

Trial Registration No: Australian and New Zealand Clinical Trials Register
ACTRN12613000637741

5.2 Introduction

Participation in physical activity by children is associated with a range of physiological and psychological benefits\(^{167}\) and it is recommended that children participate in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) each day\(^{31}\). In addition, there is an increasing body of literature demonstrating a positive association between physical activity and academic performance\(^{16,117}\). Physical activity is important for cognitive and brain health, particularly in childhood\(^{52}\). Participation in physical activity leads to a number of physiological effects on the brain including enhanced levels of neural
connections and heightened arousal, which is key to cognitive development. Worldwide, many children are not sufficiently active to accrue the associated health benefits.

While schools represent an ideal opportunity to provide young people with physical activity opportunities, the crowded curriculum, lack of teacher confidence and expertise, and restrictive school policies have influenced both the quality and quantity of physical activity opportunities within elementary schools. The Centers for Disease Control and Prevention (CDC) have identified a number of key strategies to promote physical activity in their Comprehensive School Physical Activity Program. Opportunities include recommendation’s to increase avenues to promote physical activity in schools through Physical Education lessons, active transportation initiatives, maximising opportunities at recess and lunch, after school clubs, taking physically active breaks in the classroom and integrating physical activity in classroom-based lessons.

Integrating physical activity within the existing curriculum is a potentially time and cost effective strategy that is currently under-researched. Most of the existing physical activity integration studies have promoted active breaks during class, while others have provided movement-based activities for teachers to deliver across the school curriculum to reinforce previously taught academic concepts. Whilst promoting physical activity breaks can be successful in increasing school time physical activity levels, this approach may in fact intensify the already crowded curriculum by placing further pressure on academic instruction time. The curriculum-based studies, whilst successful in increasing physical activity levels, have provided teachers with pre-prepared resources to deliver and teachers have not necessarily been directly involved in the planning and ownership of the activities or received appropriate professional development.

Previous school-based physical activity interventions have highlighted the importance of the participating teachers on intervention outcomes and professional development has been identified as a critical factor in improving the effects of such studies. Without direct teacher involvement and deeper engagement with intervention components, the sustainability of such programs becomes questionable beyond the study period. Indeed, a recent systematic review highlighted the need for teachers to act as ‘agents of change’ and to be involved in the design and delivery of subsequent programs. More research
on the effect of classroom-based physical activity interventions on both physical activity and learning and health outcomes is warranted as physical activity integration can potentially be an inexpensive and effective intervention for improving both learning and health outcomes for all learners\textsuperscript{20,21}.

Previous curriculum-based physical activity integration interventions have generally had a positive effect on educational and health outcomes\textsuperscript{16}. However, these have been characterised by a number of methodological limitations. For example, the majority of previous studies have used self-report measures or pedometers that do not provide an accurate assessment of time spent in sedentary, light, moderate and vigorous physical activity\textsuperscript{7,17}. This is a notable omission because activity of different intensities may have unique health and academic benefits. Only one previous study has attempted to embed physical activity solely across mathematics in the primary school\textsuperscript{119}. However, this trial did not have a control group. To our knowledge, no previous RCT has examined the effect of physically active integrated lessons solely in mathematics or reported on physical activity levels in mathematics or other key academic outcomes. The integration of PA into other subjects may also enhance connectedness by providing real life application of academic concepts to enable students to view learning as significant and meaningful\textsuperscript{135}.

For example, in mathematics, using real stimuli such as stopwatches, tape measures, and trundle wheels to gather data provides a real life context and interactive teaching methods that promote movement, which are associated with greater learning\textsuperscript{135}.

Whilst integration of physical activity across the curriculum is acknowledged as a key avenue for increasing school-based physical activity levels, this approach relies upon teachers being successfully recruited to deliver such programs. The single biggest barrier to physical activity promotion is teachers’ attitudes, beliefs and perceptions of physical activity\textsuperscript{84}. It is therefore necessary that to promote physical activity, researchers must develop programs that complement teachers’ values and beliefs about teaching and therefore physical activity is not seen as ‘something else to squeeze in’\textsuperscript{120,169}.

The EASY Minds (Encouraging Activity to Stimulate Young Minds) cluster RCT was informed by a pilot study, in which significant intervention effects were found for MVPA and reduced sedentary time during mathematics lessons and across the whole school day\textsuperscript{170}. Furthermore, children displayed significantly greater ‘on-task’ behaviour across the mathematics instruction period. However, this pilot study was carried out in a single
school and all sessions were planned and delivered by a member of the research team. Therefore the primary aim of this study was to evaluate the effects of the EASY Minds programs in a cluster randomised controlled trial when planned and delivered by trained classroom teachers.

5.3 Methods

Study design

The design, implementation and reporting of the EASY Minds study conforms to the Consolidated Standards of Reporting Trials (CONSORT) guidelines for clustered randomised controlled trials\(^\text{141}\) and the study methods are reported in detail elsewhere\(^\text{171}\). Ethics approval was sought and obtained from the University of Newcastle, New South Wales (NSW), Australia and the NSW Department for Education and Communities (SERAP: 2013011). The EASY Minds trial is registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12613000637741). Twenty schools were randomly selected from a list of government schools located within a 20 km radius of the University of Newcastle. The first eight schools to provide written informed consent from the school Principal participated in the study. Schools were then matched on size and demographics using the participating schools’ Index of Community Socio-Educational Advantage (ISCEA)\(^\text{172}\) and then randomised using a simple computer algorithm by an independent researcher, into the treatment or control groups following baseline assessments. Baseline assessments were conducted in March/April 2013. Post intervention assessments were carried out in July 2013. All assessments were conducted by trained research assistants who were blinded to treatment conditions at baseline only.

Power calculation

Power calculations were conducted to determine the sample size required to detect changes in the primary outcome of accelerometer-determined physical activity counts per minute (CPM)\(^\text{154}\). Accelerometer-determined activity counts per minute were selected as the primary outcome because the intervention was focused on increasing children’s total physical activity throughout the school day, regardless of intensity. Calculations assumed baseline-post-test correlation scores of \(r = 0.30\) and were based on 80% power, with alpha levels set at \(p < 0.05\). Using the standard deviation (SD) of change observed in the EASY Minds pilot study (SD = 200 CPM)\(^\text{170}\) and an intra-class correlation coefficient (ICC =
0.15), it was calculated that a study sample of \( N = 200 \), with eight clusters (i.e., schools) of 25 students would provide adequate power to detect a between group difference of 200 CPM across the school day.

**Intervention**

Briefly, the program involved classroom teachers adapting mathematics lessons over a six-week (3 x 60 min sessions per week) period to ensure students were involved in movement-based learning. All lesson content was generated from the NSW Mathematics syllabus\(^{29}\). The EASY Minds program involved a one-day teacher professional learning day, the provision of equipment and resources (e.g. stopwatches, tape measures, balls, markers) and example activities\(^{171}\) to encourage teacher-initiated adaptation of mathematics lessons to incorporate movement and email support for teachers during program implementation. The workshop included a rationale for PA integration, presentation of results from the feasibility trial, practical examples of PA integration and a peer-supported planning session.

All sessions of the professional learning day were delivered by the research team and the session was accredited with the NSW Institute of Teachers. A diffusion of innovations model was used for the professional learning. This model acknowledges that teachers are more likely to adopt a new innovation if they view it as relative to current practice, simple to understand, introduced gradually, and likely to produce observable results.

A key principle of the EASY Minds program is the alignment of the program with the NSW Quality Teaching Framework. The NSW quality teaching framework encourages teachers to develop innovative skills that promote high levels of intellectual quality, establish a quality learning environment and generates significance by making learning meaningful and purposeful\(^{135}\). Classroom teachers were responsible for the planning and the delivery of all movement-based lessons during the intervention. The control schools participated in their usual mathematics program delivered by their regular classroom teacher. Both groups continued to teach mathematics in their usual timetable slot for 60 minutes per day. The control group received the study resources after all assessments were completed in July 2013.
**Primary outcome**

The primary outcome of the EASY Minds program was CPM across the school day, assessed using GT3X Actigraph accelerometers (LLC, Fort Walton Beach, FL). Actigraph accelerometers were used as to provide a reliable and valid measure\(^78\) of physical activity and Evenson cut points were used to classify activity intensity\(^76,142\). In a validation study comparing five common accelerometer cut-points, the Evenson cut-points were found to be the most accurate at all intensities of physical activity in a sample of 206 children and adolescents\(^142\). Participants’ physical activity was only included for analysis if they wore the accelerometer for at least five school hours on any given day. Similarly, students were only included in the analysis if they wore the accelerometer for 50 minutes of the 60 minute mathematics lessons. All participating schools were asked to teach mathematics lessons as per their programmed timetable and notify the research team of any changes in delivery. Classroom teachers were responsible for distributing and collecting accelerometers on a daily basis.

**Secondary outcomes**

Secondary outcomes included CPM across the mathematics lessons, time spent in MVPA (minutes and percentage) and sedentary time across both mathematics lesson and school day, and a range of academic measures. Time spent on-task during the mathematics lesson was observed via momentary time sampling\(^157\) reported as a percentage of time. Six students per class group of either sex were selected and observed in 15 second intervals on a rotational basis over a 30-minute period in the allocated mathematics time slot. A cross-section of students with varying mathematical ability were selected by the classroom teacher from those working above, those working at, and those working below the class average, as determined by existing teacher assessments. On-task behaviour included behaviour that could be categorised as being ‘actively engaged’ or ‘passively engaged’. Actively engaged refers to a child being actively engaged in academic responding, e.g. reading, writing, performing a set task. Passively engaged was categorised as behaviour where the child is listening to the teacher or a fellow student but is not actively participating in a set task. Off-task behaviour included behaviour that can be described as being one of: ‘off-task motor’ where a child moves in a manner not associated with the task, for example walking around the class; ‘off-task verbal’ includes non-work related talking, or ‘off-task passive’ where a child is disengaged but passive,
including staring into space. Additionally students’ attitudes to mathematics, measured via two separate subscales of confidence (n=12) and perceived usefulness (n=12)\textsuperscript{158,159} and mathematics performance were measured using a standardised mathematics progressive achievement test\textsuperscript{160}. All demographic information (i.e. age, sex, language spoken at home, country of birth) was collected via a student questionnaire at baseline.

**Process evaluation**

Following the professional learning day teachers were asked to complete a nine item workshop evaluation questionnaire which assessed teachers’ perceptions of the skills and ideas gained from the training, their satisfaction with the quality of the teacher training and their confidence to plan and deliver movement-based mathematics lessons across the study period. A five-point Likert scale was used with responses ranging from ‘\textit{strongly disagree}’ = 1 to ‘\textit{strongly agree}’ = 5.

Throughout the intervention period, teachers were asked to complete an activity evaluation log after each session and reflect on their lesson and rate their lesson using a five-point Likert scale. The teachers all received a weekly email presenting tips and strategies from the research team and a fortnightly fidelity check via observation during weeks one, three and five of the intervention. During this observation, a five minute informal discussion took place where teacher and researcher discussed a three scale self-evaluation/activity log. These included: 1) mathematical concepts (n=3), e.g. the key mathematical concepts reinforced throughout the movement based activity; 2) activity levels (n =3) e.g. transitions were managed smoothly; and 3) engagement (n=3) e.g. students were engaged by the activities taught\textsuperscript{171}. Following the program, evaluation questionnaires were administered to determine students’ satisfaction with the program, for example, ‘I liked being physically active in Maths outside the classroom’ and mathematical outcomes, ‘My involvement in the program has increased my knowledge in maths’, using a five-point Likert scale with responses ranging from ‘\textit{strongly disagree}’ = 1 to ‘\textit{strongly agree}’ = 5.

**Statistical methods**

Statistical analysis of the primary and secondary outcomes was conducted using linear mixed models in SPSS statistics version 20 (2011 SPSS Inc., IBM Corp Armonk, NY) and alpha levels were set at p<0.05. The models were used to assess the impact of
treatment (EASY Minds or control), time (baseline and post-test) and the group-by-time interaction. The models were specified to adjust for the clustered nature of the data (i.e. class was included as a random intercept in the models) and included all randomised participants in the analysis. Mixed models are robust to the biases of missing data and provide appropriate balance of Type 1 and Type 2 errors\textsuperscript{163}. Mixed model analyses are consistent with the intention-to-treat principle, assuming the data are missing at random\textsuperscript{143}. Sex and weight status were included as covariates in the models. The data was screened for skewness and normality and six CPM outliers were retracted prior to analyses.

5.4 Results

The flow of participants through the trial is reported in Figure 5.1. From the 20 schools that were targeted, eight were recruited via an initial letter to the Principal and a follow-up email to the school. EASY Minds successfully recruited 240 participants from Stage 3 (Grade 5 and 6) (mean age 11.13 \pm .73, 59.1\% male). Participants were assessed at baseline in April 2013 and post-test in July 2013. Table 5.1 displays baseline demographic information. Following all baseline assessments schools and their students were randomised into control (n=98, 4 schools, six classes, six teachers) and intervention (n=142, 4 schools, 4 classes, 4 teachers) groups. Two of the intervention schools had double classes of Grade 5/6 students that worked together. Therefore both classes were included in the program.
Figure 5.1: Flow of participants through the study
Table 5.1: Baseline characteristics of students randomised to intervention and control groups

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Control (n = 98)</th>
<th>Intervention (n = 142)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Age (years)</td>
<td>11.1</td>
<td>.70</td>
</tr>
<tr>
<td>Height</td>
<td>150.8</td>
<td>6.9</td>
</tr>
<tr>
<td>Weight</td>
<td>44.3</td>
<td>10.1</td>
</tr>
<tr>
<td>English language spoken at home, n (%)</td>
<td>95.9</td>
<td>81.6</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>60.2</td>
<td>58.4</td>
</tr>
</tbody>
</table>

Changes in primary outcome

All baseline and post-test outcomes are presented in Table 5.2. Significant intervention effects were found for CPM across the school day (adjusted mean difference = 103 CPM to 95% CI 36.5 to 169.7, p=0.008)

Changes in secondary outcomes

Significant intervention effects were found for CPM during mathematics lessons (168 CPM, 95% CI 90.1 to 247.4, p=0.008), MVPA during mathematics (2.6 %, 95% CI 0.9 to 4.4, p=0.009) and sedentary time was also significantly reduced in the intervention group across the whole school day (-3.5%, 95% CI -7.0 to -0.1, p=0.044) and during mathematics (-8.2%, 95% CI -13.0 to -2.0, p=0.010). Significant intervention effects were also found for on-task behaviour (13.8%, 95% CI 4.07 to 23.6, p=0.011). There were no significant group-by time effects for mathematical attitude or performance across the study period.

Process evaluation

All teachers reported that they delivered the recommended three sessions per week of movement-based learning. A total of 18 fidelity checks were carried out over the evaluation period and teachers responded well to researcher feedback with mean scores for promoting mathematical concepts rising from 3.3 to 4.4, activity levels 3.4 to 4.1 and engagement 3.7 to 4.3. Teachers also reported that they were also now integrating
physical activity in other curriculum areas. For example, in mathematics students would recall multiplication tables whilst skipping, throwing and catching a ball or running through drill ladders. This was easily adapted to learning weekly spelling words in English. Teacher evaluation of the professional learning day was very positive with mean scores of 5.0 for all nine items on the survey. Teachers added additional written feedback commenting on the high level of engagement, real life practical participation and realistic expectations of the study. Mean scores from the student evaluation survey ranged from 3.4 to 4.7 out of 5 (1= strongly disagree to 5 strongly agree), indicating high to very high overall satisfaction rates for the EASY Minds program (See Table 5.3. For example students clearly enjoyed the program (4.46, SD .61), believed that being active made mathematics more enjoyable (4.60, SD .72) and really enjoyed working outside of the classroom (4.66, SD .62).
### Table 5.2: Intervention effects of the EASY Minds program

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline Mean (95% CI)</th>
<th>6 week Mean (95% CI)</th>
<th>Adjusted difference in change (95% CI)</th>
<th>Time</th>
<th>Group*Time P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Control Group</td>
<td>Intervention Group</td>
<td></td>
</tr>
<tr>
<td>CPM school day</td>
<td>505.2 (432.2, 587.1)</td>
<td>529.19 (461.4, 596.1)</td>
<td>499.84 (417.5, 587.1)</td>
<td>627.0 (559.3, 694.6)</td>
<td>103.1 (36.5, 169.7)</td>
</tr>
<tr>
<td></td>
<td>258.7 (187.1, 330.3)</td>
<td>284.4 (225.0, 343.8)</td>
<td>246.2 (174.2, 318.2)</td>
<td>440.7 (381.4, 500.0)</td>
<td>168.7 (90.1, 247.4)</td>
</tr>
<tr>
<td>Percent MVPA day</td>
<td>7.6 (5.9, 9.3)</td>
<td>8.1 (6.7, 9.5)</td>
<td>7.1 (5.4, 8.9)</td>
<td>9.3 (7.9, 10.7)</td>
<td>1.7 (0.01, 3.3)</td>
</tr>
<tr>
<td>Percent Sed day</td>
<td>58.7 (43.4, 74.1)</td>
<td>65.7 (50.4, 81.0)</td>
<td>67.8 (52.8, 82.8)</td>
<td>62.6 (47.7, 77.6)</td>
<td>-3.5 (-7.0, -0.13)</td>
</tr>
<tr>
<td>Percent Sed Math</td>
<td>78.1 (63.1, 93.0)</td>
<td>75.4 (60.4, 90.4)</td>
<td>78.3 (63.3, 93.3)</td>
<td>67.4 (52.5, 82.3)</td>
<td>-8.2 (-13, -2.0)</td>
</tr>
<tr>
<td>Percent light day</td>
<td>25.1 (20.2, 30.3)</td>
<td>26.3 (21.4, 31.2)</td>
<td>25.0 (20.1, 30.1)</td>
<td>28.1 (23.5, 32.7)</td>
<td>1.8 (0.1, 3.9)</td>
</tr>
<tr>
<td>Percent light Math</td>
<td>19.0 (15.2, 22.8)</td>
<td>21.2 (18.0, 24.3)</td>
<td>18.8 (15.0, 22.7)</td>
<td>26.6 (23.4, 29.7)</td>
<td>5.5 (1.5, 9.5)</td>
</tr>
<tr>
<td>Av min MVPA day</td>
<td>27.88 (20.8, 34.9)</td>
<td>30.94 (25.1, 36.7)</td>
<td>29.5 (22.5, 36.6)</td>
<td>33.31 (27.5, 39.1)</td>
<td>0.6 (-11.5, 12.9)</td>
</tr>
<tr>
<td>Av min MVPA Math</td>
<td>1.70 (0.9, 2.6)</td>
<td>2.23 (1.5, 2.9)</td>
<td>1.6 (0.8, 2.5)</td>
<td>3.59 (2.8, 4.2)</td>
<td>1.4 (0.1, 2.8)</td>
</tr>
<tr>
<td>On task behavior</td>
<td>79.9 (71.9, 87.8)</td>
<td>78.0 (71.5984.4)</td>
<td>80.0 (72.5, 88.3)</td>
<td>92.4 (86.6, 98.8)</td>
<td>13.8 (40.23, 1.6)</td>
</tr>
<tr>
<td>Math Performance</td>
<td>22.18 (15.4, 28.9)</td>
<td>22.9 (16.9, 29.0)</td>
<td>24.5 (17.7, 31.2)</td>
<td>24.3 (18.3, 30.4)</td>
<td>-91 (-3.9, 2.1)</td>
</tr>
<tr>
<td>Math Usefulness</td>
<td>47.61 (40.5)</td>
<td>48.9 (42.3, 55.4)</td>
<td>48.85 (41.7, 55.9)</td>
<td>52.6 (46.1, 59.1)</td>
<td>2.51 (-3.5, 8.5)</td>
</tr>
<tr>
<td>Math confidence</td>
<td>42.7 (35.2, 50.2)</td>
<td>44.1 (36.9, 51.3)</td>
<td>43.30 (35.8, 50.8)</td>
<td>48.3 (41.1, 55.5)</td>
<td>3.6 (-0.8, 8.0)</td>
</tr>
<tr>
<td>Overall Attitude</td>
<td>90.4 (76.9, 103.9)</td>
<td>93.0 (80.3, 105.8)</td>
<td>92.24 (78.7, 105.7)</td>
<td>101.0 (88.3, 113.7)</td>
<td>6.1 (-4.2, 16.5)</td>
</tr>
</tbody>
</table>

Abbreviations:
- CI, confidence interval
- CPM, counts per minute
- MVPA, Moderate-vigorous physical activity
- sed, sedentary
- Av min, average minutes
5.5 Discussion

The primary aim of this study was to evaluate the impact of a novel movement-based intervention within the primary school mathematics curriculum. Intervention effects were found for overall physical activity across the whole school day and mathematics lessons. Intervention effects were also found for sedentary time (school day and mathematics lessons) and on-task behaviour.

The increase in CPM across the whole school day is also consistent with other physical activity interventions that have reported increases in CPM in the primary school and those that have embedded physical activity across the curriculum. Of note, previous studies have used a sub-sample of participants, due to limitations in the number of available accelerometers and not the full study cohort. Our study provides a unique contribution to the literature. It provides objective measures of PA across both the whole school day and also during primary school mathematics lessons. Previous studies have highlighted that teachers are critical to the success of school-based interventions. In our study, teachers were given autonomy to embed movement-based learning activities in their mathematics lessons using the professional learning development workshop as a stimulus, as opposed to other interventions where pre-prepared materials have been provided. This teacher ownership, high level of engagement and subsequent teacher reflection on their involvement has the potential to contribute to program sustainability and may explain our positive findings. Professional learning was therefore fundamental to classroom teachers adopting the initiative. As in other successful studies, a diffusion of innovations model was used. The EASY Minds intervention significantly reduced sedentary behaviour. Primary school students spend a large portion of their school day in the classroom with their teacher, and it is generally believed this time should be tapped as a resource for promoting and increasing physical activity. Notably, a recent study found that children spend the majority of their time in school in an academic classroom setting yet this contributes less than 5% of a student’s daily physical activity. At baseline, students in the eight study schools spent 66.4% of their time in sedentary behaviour across the whole school day including recess and lunch. During mathematics lessons 76.5% of the time was spent being sedentary. Therefore, children’s mathematics lessons represent a particularly sedentary period of the day. The evidence on the health and developmental effects of reducing sedentary behaviour in children is currently...
inconsistent, but changes in sedentary behaviour and a corresponding increase in light physical activity might contribute to increased energy expenditure\textsuperscript{144}, metabolic health\textsuperscript{11}, and cognitive functioning\textsuperscript{145}. Our process evaluation revealed that teachers had already started to embed physical activity across other curriculum areas whilst continuing this approach in mathematics.

The potential advantages of the curriculum approach to physical activity promotion may well lie in the additional academic benefits that may ensue. Similar to other physical activity classroom-based interventions\textsuperscript{17,18}, there was a significant increase in on-task behaviour observed. In previous studies, this on-task behaviour was recorded following the physical activity as opposed to during the activity in this study. In our study, the observation was carried out during mathematics lessons only. EASY Minds demonstrated a significant improvement in on task behaviour and thus movement-based learning may potentially result in increased time on task. Furthermore, these reductions in sitting time may partly explain why students were more on task during class time as previous studies have demonstrated the importance of activity breaks in increasing students on-task behaviour\textsuperscript{18}. Whilst little is known about students’ perceptions of sitting for prolonged periods throughout the school day, a recent primary school physical activity intervention on sedentary time has observed a significant intervention effect on child-reported enjoyment of standing in the classroom during the school day\textsuperscript{174}.

It is important to highlight that this time on task is time spent engaged in academic learning not simply time spent ‘behaving’. On-task behavior has been shown to be a key predictor of academic success\textsuperscript{9}. We are unable to determine if improvements in students’ on-task behavior was a result of increased physical activity or the innovative approach to learning\textsuperscript{146}. For example, the integration of physical activity into other subjects may actually enhance connectedness for students by providing real life applications of academic concepts to enable students to view learning as significant and meaningful\textsuperscript{135}. Whilst our results are promising, and in the hypothesised direction for measures of mathematical attitude (6.1, CI -4.2 to 16.5, \(p=.212\)), our analysis did not show a statistically significant effect for mathematic performance (-.91, CI -3.9 to 2.1, \(p=.509\)). It is worth noting here that the increase in physical activity and lesson time spent outside in mathematics and the change in delivery did not have a detrimental effect on academic performance. It is widely accepted that students are developing lifelong attitudes towards
mathematics in Grade 6 (ages 12–13)\textsuperscript{132}. Fortunately, students’ attitudes towards mathematics are not fixed\textsuperscript{175} and therefore innovative interventions, such as the EASY Minds program have the potential to positively influence students’ attitudes and subsequently lead to increased enjoyment of mathematics, which may be a key strategy for addressing student disengagement\textsuperscript{133}. Of note, a standardised instrument was used to assess the impact of the intervention on mathematics and as such, its content was not specifically matched to the content that was addressed over the six-week study period. Student and teacher evaluations indicated enjoyment of the lessons and suggested that being physically active led to greater enjoyment in mathematics lessons. This could be crucial in a subject area such as mathematics as the development of negative attitudes has long been a concern in mathematics education\textsuperscript{27}.

Based on students’ responses on the process evaluation questionnaire, it appears that they preferred working outside of the classroom (4.66, SD 0.62) as opposed to inside the classroom (3.43, SD 1.18). Teachers generally used the school playgrounds and adjoining school ovals to work mathematically. For example students estimated and measured the outdoor school netball court markings when learning about perimeter, area, circumference and diameter. This may have implications for program adoption, scalability, and sustainability as evidence has already been gathered on teachers’ perceptions and barriers when working outside of the confines of the classroom\textsuperscript{86}. Therefore it is likely that a key part of future professional learning may well need to focus on up-skilling teachers in working outside the classroom. Furthermore, teachers are more likely to be persuaded to embed movement across the curriculum if evidence can be shared on how physical activity can enhance student engagement and/or at least not detract from academic performance\textsuperscript{120}. 
Table 5.3: Participant process evaluation questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoyed the EASY Minds program</td>
<td>4.46</td>
<td>.61</td>
</tr>
<tr>
<td>Being active made Maths more enjoyable</td>
<td>4.60</td>
<td>.72</td>
</tr>
<tr>
<td>I liked being physically active in Maths <strong>outside</strong> the classroom</td>
<td>4.66</td>
<td>.62</td>
</tr>
<tr>
<td>I liked being physically active in Maths <strong>inside</strong> the classroom</td>
<td>3.43</td>
<td>1.18</td>
</tr>
<tr>
<td>I looked forward to EASY Minds lessons</td>
<td>4.34</td>
<td>.72</td>
</tr>
<tr>
<td>My teacher enjoyed the lessons</td>
<td>4.44</td>
<td>.79</td>
</tr>
<tr>
<td>I liked EASY Minds lessons more than Maths in the classroom</td>
<td>4.44</td>
<td>.93</td>
</tr>
<tr>
<td>After participating in E.A.S.Y. Minds I have more positive feelings about</td>
<td>4.04</td>
<td>.85</td>
</tr>
<tr>
<td>Maths</td>
<td>3.76</td>
<td>.93</td>
</tr>
<tr>
<td>After participating in an E.A.S.Y. Minds lesson I found it easier to concentrate in class</td>
<td>3.93</td>
<td>.91</td>
</tr>
<tr>
<td>My involvement in the program has increased my knowledge in maths</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Likert scores: 1=strongly disagree; 2=disagree; 3= neutral; 4= agree; 5= strongly agree

Study strengths and limitations

Strengths of the current study include the cluster RCT design and the use of accelerometers to provide an objective measure of physical activity. As accelerometers were distributed each morning and collected in the afternoon, compliance with accelerometer protocol was high and no accelerometers were lost at any of the time-points. Evaluative data collected from students involved in the program is novel as to the authors’ knowledge; no other curriculum-based physical activity intervention has sought to gather data on students’ perceptions of integrating physical activity across the curriculum.

Despite these strengths; there are some limitations that should be noted. First, our intervention was only delivered over a six week period and we did not collect follow-up data to determine if outcomes were maintained beyond the study period. Second, the teachers recruited for the study were committed to the program and were given support via email and fortnightly fidelity checks. We do not know what may have occurred without this support from the research team. Third, whilst it is recommended that schools provide as many of the recommended 60 minutes of MVPA during school hours as possible, only a small increase in MVPA was noted in the actual mathematics lessons. It may well be that the promotion of MVPA in a subject such as mathematics is an unrealistic expectation as they are not PE lessons. Therefore, teachers in this study may or may not have planned activities that promoted MVPA but rather they may have
focused on embedding movement-based learning across the curriculum without focussing on the intensity of the movement. At no point in the professional learning workshop was physical activity intensity discussed or highlighted.

5.6 Conclusion

The EASY Minds intervention has highlighted that integrating physical activity across the curriculum in a subject area like mathematics is a viable option for classroom teachers to increase the amount of physical activity undertaken at school while not sacrificing academic performance and increasing students’ on-task behaviour. Teachers of primary school children should be encouraged to embed movement-based learning across the curriculum. EASY Minds offers a practical solution to the constraints to children’s school-based physical activity levels brought on by a crowded school curriculum. It may well be that future attempts to change school policy and practice in regard to physical activity intervention need to focus on the academic benefits of such an approach to change teachers attitudes and beliefs. Unfortunately, worldwide studies have identified a decline in mathematics achievement among middle school-aged children\(^{133}\) and disengagement in mathematics is considered a factor in this decline\(^{176}\). Therefore it is important to arrest this disengagement and look at innovative methods that challenge, but compliment traditional teacher approaches.

Conflicting Interest Statement

The authors declare that they have no conflicts of interest.

Authors’ contributions

NR, DRL, KH and PM obtained funding for the research. All authors contributed to developing the protocols and reviewing, editing and approving the final version of the paper. NR is the guarantor and accepts full responsibility for the conduct of the study. All authors have read and approved the final manuscript.

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Chapter Six

Movement-based mathematics: Enjoyment and engagement without compromising learning through the EASY Minds program

This paper reports the qualitative findings of the EASY Minds cluster RCT. Children’s focus groups and teacher interviews were used to inform both student and teacher perceptions of the EASY Minds study. This paper highlights that movement-based mathematics is an effective pedagogical tool for enhancing both student and teacher enjoyment of mathematics, links are made to the NSW quality teaching model and the paper provides evidence that embedding physical activity in mathematics does not compromise learning.

This chapter addresses the following research question:

1. What are student and teacher perceptions of the EASY Minds program?

This paper has been submitted to the Eurasia Journal of Science, Mathematics and Technology Education. It is currently under review.

6.1 Abstract

There has been a worldwide decline in interest and achievement in mathematics by young people. Despite the extensive benefits of physical activity, the majority of children are not sufficiently active. Schools have the potential to arrest both concerns through innovative teaching that challenges and complements traditional approaches. The aim of this paper is to report student and teacher perceptions of the Encouraging Activity to Stimulate Young Minds program, a school-based physical activity integration intervention designed to enhance learning and engagement in mathematics and increase physical activity levels in children using movement-based learning experiences. Four classroom teachers were interviewed and 66 students participated in focus groups following the six-week intervention. The program provided positive experiences for teachers and students, both in terms of enjoyment and engagement, while ensuring high quality learning experiences. Embedding movement-based learning across mathematics, had a significant positive effect on children’s enjoyment and engagement without compromising the quality of learning.

Key words: Engagement, mathematics, primary school, physical activity, quality teaching
State of the literature

- Low level of student engagement in mathematics is an area of concern globally;
- Innovative interventions have the potential to positively affect student’s attitudes and engagement;
- Embedding movement in mathematics may promote aspects of quality teaching and enhance learning experiences.

Contribution of this paper to the literature

- Embedding movement-based learning throughout the school day, across mathematics, had a significant positive effect on children’s enjoyment and engagement in mathematics and physical activity levels;
- Embedding physical activity in mathematics does not appear to compromise the quality of learning;
- This is the first paper to focus on students’ and teachers’ perceptions of physical activity integration strategies and report on or investigated the quality of the pedagogy employed.

6.2 Introduction

A low level of student engagement in mathematics has been an area of great concern to mathematics educators and researchers in recent years. In Australia and internationally, there has been a steady decline in the mathematical achievement of students in the middle school years. Whilst the causes of this decline may be varied, disengagement with the subject has long been considered a factor. The most widely established factors that have been found to be associated with student engagement in mathematics include the influence of teachers and the pedagogies employed in mathematics. It is also recognised that these middle school years are the time period where students’ behaviours, emotions and attitudes towards mathematics are formed with important implications for future study and academic performance. For many students, the use of traditional teacher-centred approaches in mathematics has been recognised as disengaging. A longitudinal study has reported that students often view mathematics as a set of isolated procedures, failing to see real-life applications of their learning outside of the classroom. Mathematical enjoyment is considered particularly significant for addressing student disengagement. However, researchers have found that mathematics classrooms and the
individualistic nature of mathematics, whereby students work independently, actually discourages both social interaction and learning, which could reduce engagement and understanding. Improving student enjoyment of mathematics is therefore, a key strategy to address subject disengagement. Innovative teaching methods that provide positive mathematical learning experiences could help to enhance students’ experiences and outcomes in mathematics.

In this paper we focus on the outcomes of a program that integrated physical activity into mathematics lessons as a novel pedagogical strategy for teachers to improve the engagement levels of students in mathematics. In addition to being a potentially innovative and appealing pedagogical approach to improve engagement in mathematics, increasing physical activity was also a program aim, given the multiple benefits for a child’s physical, mental and cognitive health. Traditionally, schools have used physical education (PE) as the primary vehicle for promoting physical activity within the school day. However, the crowded school curriculum and school policy pressures have contributed to a decline in the quality and quantity of PE delivered in primary schools. In this context, schools need to explore novel strategies to promote PA throughout the school day. The integration of PA across the school curriculum is one recommended strategy.

Previous studies have demonstrated that embedding physical activity across the school day not only increases children’s physical activity levels, but also improves children’s learning outcomes. School-based curriculum interventions have highlighted the important role teachers play in their delivery; however, they have also found that teachers, whilst willing to integrate physical activity into other subjects, often lack the necessary skills and knowledge to do so. It is therefore paramount that comprehensive professional development be provided to assist in the delivery of school-based physical activity curriculum interventions. Whilst previous studies have embedded physical activity across the curriculum and have reported on physical activity levels and various academic measures, none, to the authors’ knowledge, has focussed on students’ and teachers’ perceptions of physical activity integration strategies or reported on or investigated the quality of the pedagogy employed which is the focus of this chapter.
6.3 Methods

The EASY Minds program

The Encouraging Activity to Stimulate Young Minds (EASY Minds) program is designed to increase physical activity levels in children through movement-based mathematics learning experiences in primary schools. The EASY Minds cluster randomised controlled trial (RCT) was preceded by a successful efficacy trial\textsuperscript{170}. In the efficacy trial a member of the research team delivered the intervention. In the cluster RCT, classroom teachers were trained during one day of professional learning to deliver the six-week intervention in order to build capacity among teachers and enhance the likelihood of the sustainability of the program. The professional learning day promoted two types of mathematical lessons developed using the NSW Quality Teaching model as the theoretical basis: i) activities that used physical activity as a platform for the development of procedural fluency of fundamental number operations\textsuperscript{29}, for example, students recall multiplication tables whilst skipping, throwing and catching a ball or running through drill ladders; and ii) activities focused on looking at mathematics in the world around the school, for example, estimating and measuring distance, finding shapes and identifying their properties in the natural environment, data collection and representation involving the fundamental movement skills of kicking, throwing and striking. The results for the primary and secondary outcomes have been reported elsewhere\textsuperscript{180}. In the cluster RCT, there were significant intervention effects found for the primary outcome of mean activity counts per minute (CPM) across the whole school week. Intervention effects were also found for CPM across mathematics lessons and reduced sedentary time across the school week and during mathematics. In addition there was an increase in moderate-to-vigorous physical activity across the designated mathematics lessons. A significant intervention effect was also found for students’ on-task behaviour\textsuperscript{180}. The EASY Minds program demonstrated that integrating movement across the primary mathematics syllabus was feasible and efficacious for enhancing school-based PA and improving on-task behaviour in mathematics lessons when delivered by classroom teachers. What is likely to persuade teachers to implement a curriculum, whereby physical activity is used in the learning process, is if we can demonstrate the potential of such an approach to not only positively influence children’s health but also enhance student engagement and/or performance in key learning areas such as mathematics while ensuring high quality teaching and learning experiences. Previous research has demonstrated teachers’ willingness to participate in
reform is enhanced if they can see benefits for their students. Hence, the aim of this chapter is to explore both students’ and teachers’ perceptions of a physically active program of mathematics lessons in the primary school and take a closer look at the pedagogy employed.

**Pedagogical Model**

Pedagogical models provide a framework through which educationalists can describe effective teaching. In Australia, as in many other Western nations there has been a series of initiatives to raise teaching quality and enhance professional standards. One such example of a pedagogical framework is the NSW Quality Teaching model. The NSW Quality Teaching model was designed to improve pedagogy and hence student learning. The model supports teachers to develop their capacity to deliver lessons that promote high levels of intellectual quality (IQ), establish a quality learning environment (QLE) and generate significance (SIG) by making learning meaningful for students.

Like many other teaching models, this particular model is based on research showing that of all the things that schools can control, it is the teacher and quality of the pedagogy employed that most directly and most powerfully affects the quality of learning outcomes that students demonstrate. Each of the three dimensions (IQ, QLE, and SIG) of the Quality Teaching model is comprised of six elements that have been linked to improved student outcomes (Table 6.1). This model was chosen to both guide the professional learning day, to frame the feedback for observations, guide the development of teaching resources and provide a framework for the interviews and focus groups. All of the study schools are NSW public schools and the model was originally developed in conjunction with the NSW public school system. As such the teachers in the study cohorts were familiar with the model from either or both their pre-service training and additional in-service professional learning, given the model has been in use since 2003.

**Table 6.1: Dimensions and elements of NSW model of pedagogy**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Intellectual Quality</th>
<th>Quality Learning Environment</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep knowledge</td>
<td>Deep knowledge</td>
<td>Explicitly quality criteria</td>
<td>Background knowledge</td>
</tr>
<tr>
<td>Deep understanding</td>
<td>Deep understanding</td>
<td>Engagement</td>
<td>Cultural knowledge</td>
</tr>
<tr>
<td>Problematic knowledge</td>
<td>Problematic knowledge</td>
<td>High Expectations</td>
<td>Knowledge integration</td>
</tr>
<tr>
<td>Higher-order thinking</td>
<td>Higher-order thinking</td>
<td>Social support</td>
<td>Inclusivity</td>
</tr>
<tr>
<td>Metalanguage</td>
<td>Metalanguage</td>
<td>Students’ self-regulation</td>
<td>Connectedness</td>
</tr>
<tr>
<td>Substantive communication</td>
<td>Substantive communication</td>
<td>Student direction</td>
<td>Narrative</td>
</tr>
</tbody>
</table>

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Subjects and Recruitment

Ethics approval was sought and obtained from the University of Newcastle, NSW, Australia and the New South Wales Department for Education and Communities (SERAP: 2013011). The methodology and outcomes of the EASY Minds cluster RCT have been reported elsewhere171,180. In summary, grade 5/6 classes from eight public schools in New South Wales, Australia, were randomly allocated to intervention (n=6) or control (n=4) groups. Teachers from the intervention group received one day of professional learning, a resource pack (physical activity promoting equipment) and a small example of lesson ideas from each strand (number and algebra, measurement and geometry and statistics and probability) of the NSW mathematics syllabus and were asked to adapt their lessons to embed movement-based learning in their daily mathematics program in at least three lessons per week over a six week period. Teachers were only given a small sample of lesson ideas to encourage creativity, autonomy and ownership of lesson content. Intervention support was provided via a weekly email offering ideas and strategies and three lesson observations were made by members of the research team following which an informal discussion took place where teacher and researcher discussed a three scale self-evaluation/activity log. These were: 1) mathematical concepts (n=3), e.g. the key mathematical concepts reinforced throughout the movement based activity; 2) activity levels (n =3), e.g. transitions were managed smoothly; and 3) engagement (n=3), e.g. students were engaged by the activities taught. Classes in the control group continued with their regular mathematics program. The primary outcome was children’s physical activity levels across both the school day and during mathematics lessons while moderate-to-vigorous physical activity and sedentary time, children’s on-task behaviour, enjoyment of mathematics and mathematics attainment were also assessed as secondary outcomes the completion of the intervention, class teachers were asked to nominate six children, two each of higher, middle and lower mathematical attainment (as determined by the class teacher based on students’ previous attainment) to take part in the focus groups. Only students who had parental consent took part in the focus groups, each of which consisted of six students (three girls, three boys) from the same class. Both interviews with teachers and student focus groups were conducted approximately two weeks after completion of the program.
Data collection

A focus group methodology was utilised for the student sample, partly due to time constraints, but also due to group interaction being capable of eliciting information and insights that are less accessible during individual interviews. This is particularly beneficial in groups in which members possess a high level of group affinity and connection\textsuperscript{192}, as was the case in this study.

The semi-structured discussion frameworks were designed and developed by the research team for the student focus groups and teacher interviews. They were developed to elicit responses and to facilitate discussion around each participant’s perception of the program. Specifically, the questions asked in the student focus groups were designed to explore their perceptions of the EASY Minds mathematics lessons, and the nature and quality of their mathematics lessons prior to and subsequent to their involvement in the program (Table 6.2). Additionally, views were sought relating to the students’ appraisal of how the EASY Minds lessons had influenced their perceptions of mathematics and learning related to mathematical concepts.
Table 6.2: Student focus group questions

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Can you tell me what the EASY Minds program is all about?</td>
</tr>
<tr>
<td>2. How would you describe your math’s classes before the EASY Minds</td>
</tr>
<tr>
<td>program? Did you enjoy this?</td>
</tr>
<tr>
<td>3. Did you enjoy the outdoor EASY Minds math’s lessons? Why? Can you give</td>
</tr>
<tr>
<td>me an example?</td>
</tr>
<tr>
<td>4. Did you enjoy moving in the classroom? Did this make the math’s activities more interesting?</td>
</tr>
<tr>
<td>5. What kinds of activities did you enjoy doing in the EASY Minds program?</td>
</tr>
<tr>
<td>6. What kinds of activities didn’t you enjoy doing in the EASY Minds program?</td>
</tr>
<tr>
<td>7. Can you tell me if being active in math class helped you learn? Why/why not? If so can you give me an example? Was it fun and enjoyable?</td>
</tr>
</tbody>
</table>

Suggestions for Improvement

8. What was the best thing about being involved in EASY Minds?

9. Is there anything that could be changed to make EASY Minds better?

10. Do you have anything else to say about EASY Minds?

The interviews with teachers were designed to elicit their perceptions of EASY Minds lessons compared to regular mathematics lessons. Teachers were also asked to identify any challenges to the implementation of EASY Minds lessons, as well as their appraisal of learning outcomes and students’ enjoyment of the lessons, with particular emphasis on the role of physical activity in student engagement (Table 6.3). In both interviews and focus groups, views were sought from participants as to the potential strengths of the program, as well as areas for improvement. Prompts were used as needed to explore topics in depth.
Table 6.3: Teacher interview questions

1. Can you tell me about your experiences with the EASY Minds program?
2. Did you enjoy teaching an active Math’s session as opposed to a classroom based lesson?
3. What were the major challenges to you as a teacher of active math sessions?
4. Do you think your students enjoyed the lessons/why/why not? Have you noticed any changes with your students?
5. What do you think were the benefits of an active math class for you and your students?
6. How well do you they think the students understood the math content in the physically active lessons? Can you give me a specific example?
7. Do you think the PA aspect of the lesson contributed to greater engagement in the lesson compared to how that same math content would usually be taught?

Suggestions for Improvement

8. Is there anything that could be changed to improve EASY Minds?
9. What was the best thing about being involved in EASY Minds?
10. Do you have anything else to say about EASY Minds?
11. Are you likely to continue with this approach after the study?
12. Have you disseminated this information to other staff members?
13. How did students contribute to the lesson activities? Was this successful?

A total of 66 Grade 5/6 students participated in 11 focus groups. The students ranged in age from 10 to 13 years (mean = 11.2 years ± SD), with half (50%) being male. The focus groups were conducted in a separate classroom during school hours, while the telephone interviews were conducted with four teachers from two of the four schools involved in the EASY Minds program (due to teacher unavailability in two schools). Interviews were conducted with two consenting teachers from the same school in attendance at the same time (n=4). All focus groups and interviews were conducted by a research team member not directly involved in the delivery of the EASY Minds program, with interviews lasting between 15 and 17 minutes and the students’ focus groups being of somewhat shorter duration ranging from between eight to 14 minutes.
Analysis

The focus groups and interviews were digitally recorded with the participants’ consent and transcribed verbatim. A computer program (NVIVO 10) was used to assist with the organisational aspects of data analysis. Analysis was conducted by an independent researcher not previously involved in the program or data collection. Analysis was performed using a standard general inductive approach to qualitative analysis. Initially, inductively derived codes or labels were formulated from the data. The developing coding scheme was continually revised and further expanded after coding of additional transcripts. Following coding of all the transcripts, emerging themes were identified and defined.

6.4 Results

The thematic analysis of the student data revealed a number of themes representing their perceptions of the program and its impact and changes to their perceptions and experience of mathematics. The themes arising from the teacher data related to perceptions of the program, reflections on their own teaching, as well as their views on the benefits for students of the EASY Minds program. The findings have been grouped into: i) enjoyment and engagement of mathematics lessons; and ii) the quality of the learning experiences.

Student and teacher perceptions of the program

Students and teachers had positive perceptions of the program. A key theme that emerged from both groups was that of increased enjoyment and engagement in mathematics lessons.

Enjoyment and engagement of movement-based learning

The majority of students found the EASY Minds program was enjoyable and engaging. While students had enjoyed a wide range of different activities, the following were some of the more commonly preferred; rotating activities – hop, skip and jump – recording and calculating averages; ‘times tables’ while jumping though ladders or bouncing/throwing ball; measuring the playground; throwing beanbags onto a target (Table 6.4). Most reported having enjoyed learning mathematics in a different way.

I liked pretty much everything. It was all entertaining. You could find out something that you didn’t know before … then you could
do maths with that and figure out your average and just manipulate simple things and just help you learn in a different way.

Being outside and away from the confines of the classroom was in itself considered to be conducive to learning, and mentioned by most students as being the main attraction of the program – ‘being free’, ‘having fun’, and given ‘freedom to learn’ were ideas commonly raised. ‘I like doing sport and being active and when you combine that with maths it makes it much more enjoyable.’

Expending energy was a common theme among the students when talking about the benefits to learning. Students not only reported being able to concentrate and focus better, but also commented that it had acted to reduce talking, off-task time and other distractions. Many students could not specifically identify what aspect of the program had helped them learn mathematics better, but simply felt that it was being outside in the fresh air and having more fun.

Those with more advanced maths attainment, reported that the benefit of EASY Minds was ‘taking maths to a new level’ – making it more exciting. Not surprisingly, it was equally or perhaps even more beneficial to those who were struggling with mathematical concepts. The more exciting hands-on instructional format provided all students with opportunities to grasp such concepts. Many students reported with some level of surprise, that mathematics now was a subject they were looking forward to.

EASY Minds stands for its name. It lets your mind relax and go through things, as you’re doing fitness, or you’re doing something else, that you actually like and you’re mixing it with mathematics. That just makes it a whole lot different to what we normally do.

Before EASY minds, many students reported that their mathematics lessons predominantly involved paper and worksheet-based activities. Not being able to move around, being inside, and simply being exposed to didactic teaching methods (copying work off the board, writing answers to questions in their books, completing worksheets were perceived as dull, boring, repetitive, and uninteresting. Students reported not learning well because they would get distracted, and ‘drift off’. Many students reported
more hands-on activities since involvement in the program, and many reported that their teacher was now more innovative using varied and interesting activities to improve their learning.

One child described his usual mathematics lessons as ‘rinse and repeat’. He went on to say,

Before we had the EASY Minds program it was boring. One group goes on the computer and another group does a worksheet that we don’t all understand. It’s very boring and one group goes with Mr X which is even more boring.

Most students perceived their teacher as having enjoyed the program either due to having liked to ‘try something a bit different’, teaching in new ways, or (more commonly mentioned) not having had to attend to so many discipline problems (e.g. students talking and being off-task, general behaviour problems) both during outside and classroom time.

I think Mrs G has enjoyed it too because … she’s not so stressed because we’re doing something we enjoy, not something that we’re going to run off and talk if she’s not looking at us. So I reckon she’s pretty happy with that. We’re not making so much noise and stuff inside the classroom.

Indeed, many students commented that their teacher appeared to enjoy teaching the EASY Minds program. Reasons given focused on students’ obvious enjoyment of the program, and that students were now actually looking forward to their mathematics lessons, making it more enjoyable for the teacher.
### Table 6.4: Example activities

<table>
<thead>
<tr>
<th>Mathematics content</th>
<th>Using an empty number line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students are encouraged to use a number line drawn in chalk outside and utilise the jump strategy.</td>
</tr>
<tr>
<td></td>
<td>Present the students with a number problem; e.g. 8000–673.</td>
</tr>
<tr>
<td></td>
<td>Students should try to complete the number line in the most efficient way.</td>
</tr>
<tr>
<td></td>
<td>Students assign each “jump” a physical activity. Students can create their own movements</td>
</tr>
<tr>
<td></td>
<td>For example; 1000=Squat, 100=jump, 10’s =lunge, 1’s = bottom kicks.</td>
</tr>
<tr>
<td></td>
<td>In this case the answer would be 7327. Students would perform 7 squats, 3 jumps, 2 lunges and 7 bottom kicks.</td>
</tr>
<tr>
<td></td>
<td>Students can be presented with a series of operations and be encouraged to use an empty number line.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number and algebra</th>
<th>Netball court Maths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Working in small groups students are to classify all shapes they can identify on a netball court.</td>
</tr>
<tr>
<td></td>
<td>Students are to then draw and measure all key parts. Students can choose formal or informal measurements to measure area and perimeter.</td>
</tr>
<tr>
<td></td>
<td>Students may decide to include length, width, radius, diameter, circumference, semi-circle and diagonals.</td>
</tr>
<tr>
<td></td>
<td>Using appropriate scale students are to draw an accurate scaled diagram</td>
</tr>
<tr>
<td></td>
<td>Estimating and measuring 2 D shapes</td>
</tr>
<tr>
<td></td>
<td>Students challenge each other to make 2 D shapes using marker cones.</td>
</tr>
<tr>
<td></td>
<td>Students then have to place the markers in the correct shape and then measure.</td>
</tr>
<tr>
<td></td>
<td>For example: An irregular pentagon with a perimeter of 22.5m</td>
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</tbody>
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<tr>
<th>Measurement and geometry</th>
<th>Target maths</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Students are to take turns to throw 3 koosh balls on to the target. Students can draw their own target in chalk and write in their own numbers.</td>
</tr>
<tr>
<td></td>
<td>Students can choose to throw underarm, overarm or use a shot put technique.</td>
</tr>
<tr>
<td></td>
<td>Total up your score and multiply your score by the number you roll on the dice. (Provide a variety of dice for students 1–6, 1–12, 1–20)</td>
</tr>
<tr>
<td></td>
<td>Have 3 attempts.</td>
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<tr>
<td></td>
<td>Work out your total and your mean score, median and mode.</td>
</tr>
<tr>
<td></td>
<td>Students could then create their own tables and analyse and interpret</td>
</tr>
</tbody>
</table>

All four teachers interviewed had perceived the program as highly enjoyable and engaging, with particularly positive views of the initial training day. The aims of the program were clear, intuitive and easy to carry out in practice.
I found the program to be highly engaging; we just thoroughly enjoyed the whole process. From the start the training day, the initial training orientation day with you guys at the University was probably the best day we’ve had as professional development.

All four teachers felt their students had gained immense enjoyment from the EASY Minds lessons, with this also being true of students who previously had not enjoyed mathematics. It was perceived as making difficult concepts more ‘ accessible’, allowing normally disengaged students to ‘ have a go ’, and also students were found to be more focussed during and after EASY Minds lessons. ‘ I think that the kids definitely were able to understand and maybe a few of those kids that were disengaged, having a go, whereas they normally wouldn’t attempt anything that’s written or explicit in the classroom.’

**The quality of the learning experience**

In this section key elements from the dimensions of the NSW Quality Teaching model have been identified (Table 6.1). In this section Quality Teaching dimensions are provided in italics and brackets.

These statements begin to address the impact of the EASY Minds program as a learning experience for students.

**Promoting Intellectual Quality**

‘ Intellectual quality ‘ recognises that high quality student outcomes result from ‘pedagogy that is focussed on producing deep understanding of important concepts, skills and ideas. Pedagogy that treats knowledge as something that requires active construction and requires students to engage in higher order thinking ‘188. Example elements include activities that promote a deep understanding, and tasks that promote higher order thinking where students are engaged in activities that are multifaceted.

The EASY Minds lessons were reported by students to have ‘ helped learning in a different way ‘. Many students commented that they had found the mathematics easier once they returned to the classroom, as they had ‘ done the maths with [their] bodies ‘. Students felt that their improved learning was due to having had the material presented in a different way often gathering their own data, which the students would then analyse and interpret (higher order thinking) with the activities also having aided verbal explanations, which
sometimes were not easily understood. These characteristics of EASY Minds lessons were felt to have prevented the students from ‘drifting off’ which, teachers reported was often the case with a more didactic and traditional teaching style. One example of learning benefits frequently mentioned was a better handle on concepts such as averages with which they had previously struggled (deep understanding), using data they had generated themselves. Quite a few students appeared to take a great deal of pride in their new found skills and the processes through which they had acquired them.

Well, with me especially, sometimes in maths, I tend to drift off into my own little world because I don’t always understand it when it’s just on a sheet. But after doing the stuff in person, and her explaining to us what it is, I’ve learnt about averages and all that.

Additionally, procedural fluency type learning (e.g. times tables) had particularly, been found to be subject to improvement.

When I first started I wasn’t very good at my times tables but with the timetable game that we played, you had to concentrate on two things. You had to concentrate on the numbers and moving your feet so it helped a lot.

For those with more advanced maths attainment, the benefit of EASY Minds was that it was ‘taking maths to a new level’ – making it more exciting (deep understanding/higher order thinking). Students in one particular group emphasised enjoyment creating their own mathematics problems for each other. For example one group of students had to challenge each other to estimate and measure the perimeter of irregular shapes using cones (Table 6.4). ‘When I first started I wasn’t very good at estimating distance but with the measuring game that we played, you had to concentrate on two things. You had to concentrate, on the shape and the distance’.

Only a few students (n=5) had critical comments about the EASY Minds program. Criticisms were mainly about the amount of time provided to work out the mathematics problems. For example one student felt that one of the activities had been particularly frustrating, a place value activity (where students had to throw numbered bean bags into
 hoops marked with hundreds, tens and units) (‘the one with the different colours’) and felt that the frustration of not being able to ‘get it’ (throw the bean bag accurately into the hoop) distracted from learning the mathematical concept.

**Providing a quality learning environment**

Quality learning environments provide high levels of support for students in their learning. A quality learning environment refers to a pedagogy that creates an environment that is clearly focussed on learning and develops positive relationships between teachers and students and among students\

Elements include social support where peers are encouraged to support each other, student direction whereby students exercise some degree of influence over what they will do and engagement demonstrated by students displaying sustained interest and attention.

The program was seen as alleviating the boredom associated with indoor, worksheet-type activities. As one student said: ‘[it’s about] using maths in a fun way’. For some it was the perceived freedom to choose how to learn which made EASY Minds an enjoyable program (self-direction). Students were encouraged to investigate their own mathematics problems. For example, groups could decide to work out the area or perimeter covered by certain positions in a netball game. Students in this activity were able to choose to use either formal measurements (metres and centimetres) or in-formal (for example: two footed jumps).

A few students mentioned that the social aspect of EASY Minds was particularly positive. For example, students liked talking to their peers about their work and working together on group-based activities (social support). More generally, students liked that the program combined two subjects in one – ‘getting fit and active while learning’ was considered by the students as a double benefit.

One of the main comments which teachers volunteered during the interview related to how it had prompted renewed reflection on their own teaching style. Questions such as ‘am I being as creative as possible with my mathematics lessons?’ and ‘are the kids really engaged?’ were being asked.
It just gave me a fresh approach. You get a little bit stuck in your ways I think sometimes with the longer you teach. And if something works for you, you probably just keep repeating it.

EASY Minds had prompted a desire to be more innovative in terms of incorporating physical activity and outdoor activities into their lessons and made the teachers re-evaluate how they taught all the core subjects, not just mathematics, as well as prompting ideas of alternative ways to teach concepts.

The benefit I think as a teacher is it makes you re-evaluate what you’re doing. So it makes you stop and think about how you’re teaching and whether there’s a different way that you can do it.

Teachers volunteered examples of how their EASY Minds lessons had worked and reported, with some pride, positive results such as instances of enhanced student learning (AHA! moments) and peer learning.

We’re also surprised by the level of support the other kids actually gave each other, whereas maybe sitting down in the class they wouldn’t really help each other too much. But when they were actually out there in their groups, doing a physical activity, working through the mathematics, they actually supported each other a lot. And obviously any kid that can help another kid, they’re self-empowered… (social support)

The group-based activities of the EASY Minds program were found to facilitate more peer learning, support and engagement, providing scope to incorporate students’ different interests and abilities, in ways that benefitted all students. Indeed, one teacher commented that he had been surprised to see his students ‘taking ownership’ of the program and excited to help set it up, design the activities and so on.

It just evolved that the kids were literally asking us, requesting to do things, wanting to be a part of it, wanting to organise it, wanting to set it up (engagement), wanting to actually take control of what sort of lessons they wanted to do and how they wanted to
do it. So for me personally I thought it was a great program. (self-direction)

Enhancing opportunities for significance

To achieve high quality learning outcomes, students need to understand why their learning matters. Teachers need to ensure that lessons have links to contexts outside of the classroom. Elements of significance include knowledge integration where lessons demonstrate links with other key learning areas, and connectedness whereby lesson activities promote real-life experiences.

Quite a few students commented on ‘multi-tasking’ (doing mathematical and physical activities), noting that being presented with an additional challenge aided in their learning. Students used different ways to explain these benefits; ‘the exercise makes the brain work clearer’; ‘because your mind has been doing exercise, it kind of gets it ready for mathematics’. One important concept, which quite a few students alluded to however, was that it was the physical activity ‘before’ doing mathematics which was felt to have aided their learning. Many students reported ‘getting fit’ as a second but equally important outcome of the program, and this appeared to be an important motivator for some, as it was acknowledged as an important goal (knowledge integration). Learning the more practical aspects of mathematics and its real life applications (connectedness) were considered an attractive feature of EASY Minds by many. Teachers commented that students would make connections with real jobs that would need a grasp of concepts. One teacher commented on student’s amazement that Olympic athletes could jump so far when estimating their distance travelled in a hop, step jump activity.

Movement-based lessons

While all the teachers reported having enjoyed teaching the EASY Minds lessons more than regular classroom based lessons, they all acknowledged that the preparation took more time and effort because it involved teaching concepts in a new and practical way, away from the ‘safe’ confines of the classroom, ‘requiring [one] to be more organised’. This appeared mainly to be due to EASY Minds lessons requiring something other than simply pulling together familiar material from stable concepts such as fractions, area etc. and presenting it in the usual and traditional way. However, the teachers perceived that this extra effort would only be required until they ‘got the hang of it’.
The teachers also talked of EASY Minds having forced them to be more creative and forward thinking as well as having to structure their planning to get EASY Minds aligned with the scope and sequence of the existing curriculum. However, this was discussed as a positive with much potential gain at the end.

I think it really forced us to actually be a little bit more creative and forward thinking about, ‘okay this is actually the scope and the sequence of the school. How can we incorporate some physicality into that, make it engaging’?

All teachers interviewed were confident that they would continue with the EASY Minds approach after completion of the study, and the two schools represented in the interviews were, to varying degrees, in the process of adopting the initiatives on the level of whole school programming, allowing teachers to implement it in their own way. One teacher in particular commented on the financial and logistic benefits of having been provided with an EASY Minds ‘tool kit’. ‘But I think the thing that really probably benefited us was having those exceptionally large bags full of [gear] and you didn’t have to run around half the day trying to organise equipment for an activity.’

Teachers commented that they would have liked to see the program extended to other subjects as well (i.e. English), while others thought it should be made available at a whole-school level. Other suggestions, which were testament to its popularity, were requests to extend the program duration and make EASY Minds lessons longer. One teacher suggested that a potential avenue for disseminating the program further would be for ideas from all involved teachers to be pulled together and made accessible to everyone, allowing sharing of lesson plan ideas.

6.5 Discussion

The aim of this chapter was to examine students’ and teachers’ perceptions of the EASY Minds program to gain insights into the potential, the challenges and impact of integrating physical activity in primary school mathematics lessons. Key benefits perceived by both students and teachers were increased enjoyment and enthusiasm for mathematics and enhanced opportunities for students’ social, emotional, physical, and cognitive development.
These positive perceptions of the EASY Minds program demonstrate the potential of using a movement-based approach to teach mathematical concepts. Quality learning experiences have the potential to develop learners not only cognitively but also socially, emotionally and physically. The quality of the pedagogy employed is fundamental in the provision of quality learning experiences.

Before EASY minds, most students reported mainly doing paper- and worksheet-based activities as part of their maths lessons. Not being able to move around, being inside and simply being exposed to didactic teaching methods were perceived as dull, boring, repetitive, and uninteresting. Many students reported not learning well because they would get distracted, and not be able to concentrate. This not only confirms the findings from our RCT that demonstrated a 14% increase in on-task behaviour during active mathematics lessons\textsuperscript{180} but helps to explain why. Many students reported more hands-on activities since involvement in the program, and many reported their teacher now being more innovative with more varied and interesting activities to enrich their learning. Without exception, all teachers felt their students had gained immense enjoyment from the EASY minds lessons, with this also being true of students who previously had not enjoyed maths.

Research has previously found that towards the end of primary school, expressions of boredom from children in mathematics are indicative of lack of stimulation, lack of challenge and a lack of direction over learning\textsuperscript{194}. It is clear from the students’ perspective that the EASY Minds lessons were more engaging and enjoyable than typical mathematics lessons. Moreover, it is clear from both the student and teacher comments that the quality of mathematical learning was not compromised by this movement-based approach but rather learning was actually enhanced.

It has been suggested that the most powerful influence on a student’s attitude towards mathematics is the pedagogical repertoire of their teacher\textsuperscript{26}. A study investigating students’ perceptions of mathematics teaching and learning in the upper primary school classroom found that the notion of ‘fun’ was a dominant feature and engagement was therefore deemed likely to be more associated with fun activities\textsuperscript{27}. Similarly, teachers’ own enthusiasm fosters a positive attitude towards mathematics among students. In our analysis students believed that their teachers actually enjoyed the lessons, because there were fewer discipline issues and students were more on-task\textsuperscript{170}. Additionally, the
pedagogies that are most likely to engage students are those that promote active participation, social interaction and highlight the relevance of mathematics\textsuperscript{27}.

The engaging pedagogies that the EASY Minds study appear to promote closely align with the NSW Quality Teaching model\textsuperscript{136}. This was an expected and positive outcome as the model was integrated into both the professional learning and observation sessions and may explain the positive student and teacher outcomes. Intellectual Quality, for example, was evident as mathematical concepts and ideas were central to all of the activities and the resources provided were carefully chosen to promote mathematical understanding and physical activity. Also, all activities were carefully aligned with the NSW Mathematics curriculum\textsuperscript{29}. Social support is one of the key elements in establishing a quality learning environment. Teacher responses highlighted the importance of peer-support in the program. Previous studies have highlighted the role of peer-assisted and peer-supported learning as being key to both engagement and motivation in the primary classroom\textsuperscript{195}. Movement-based mathematics lessons offer great potential to promote peer-assisted learning. Indeed a key component of the program was student autonomy. Students were encouraged to have control over their physical activity, by choosing both the nature of the actual physical activity and often the intensity and subsequent level of exertion as well as their learning (self direction). Research has highlighted that students highly value this approach\textsuperscript{196}. A key concept of the program was also ensuring the significance of the activities. Students clearly enjoyed working outside the confines of the classroom and being exposed to real life implications of mathematics such as estimating and measuring areas within the school grounds and drawing scale diagrams.

Teachers in the study had attended a professional development day prior to the intervention. The one day workshop included a rationale for PA integration, presentation of results from a feasibility trial, practical examples of PA integration and a peer supported planning session. Teachers were encouraged to be creative and to develop their own lessons, thereby developing ownership of the program and increasing the likelihood of sustaining the program beyond the intervention period\textsuperscript{125}. The teachers interviewed in this study indicated that they were keen to continue with the program and assist in implementing whole school training. This level of commitment to the program may contribute to sustainable changes whereby integrating PA in mathematics becomes part of a whole school policy.
Limitations

Despite the positive findings of this intervention it is not without its limitations. Teachers highlighted the professional learning as a catalyst for their commitment to the study and the provision of the resource bag containing key mathematical physical activity promoting equipment such as stopwatches, tape measures, target mats, numbered bean bags etc. being fundamental to the program. The success of the intervention was also associated with the recruitment of teachers who were prepared to embrace the concept of movement-based learning. Previous studies have highlighted the importance of teacher behaviour on intervention outcomes\textsuperscript{164}. Previous curriculum-based PA intervention studies have provided actual materials for teachers to deliver\textsuperscript{118}. A unique aspect of this study is that it allowed scope for teachers to plan and deliver their own lessons, thus making the possibility of future sustainability more likely. Previous research has highlighted that teachers own interest in physical activity may affect their competence in delivering movement-based lessons\textsuperscript{86}. The professional learning day in this study was delivered by researchers specialising in physical activity or mathematics. Therefore future replication, translation and sustainability of the program may have financial constraints that will need to be addressed at a school policy level.

6.6 Conclusion

The impact of the EASY Minds program has demonstrated the potential of movement-based lessons and has encouraged the schools involved to change school policy and practice regarding the integration of physical activity across the school mathematics curriculum. Student enjoyment of mathematics is also recognised as a key ingredient for addressing student disengagement\textsuperscript{133} and, given that attitudes towards mathematics are not stable and fixed\textsuperscript{134}, innovative interventions, such as PA integration, have the potential to positively affect attitudes and engagement\textsuperscript{134}. The NSW Auditor General’s report (2012)\textsuperscript{88} highlighted, as one of its recommendations, the need to improve children’s physical activity levels through the integration of physical activity within the existing curriculum. Whilst this recommendation was in response to many children in NSW not meeting the recommended guidelines of 60 minutes of moderate to vigorous physical activity per day\textsuperscript{197}, embedding movement-based learning across the school day, as demonstrated here in the EASY Minds program may have a significant positive effect on
children’s attitude and engagement in mathematics as well as promoting quality teaching and enhancing the overall learning experience.

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Chapter Seven
Discussion

7.1 Introduction

In this chapter, an overview and synthesis of the key findings of the thesis and series of published papers will be presented. The detailed results of the EASY Minds pilot study and cluster RCT have been previously presented and discussed in Chapters Three, Four, Five and Six. Therefore, this chapter will provide a collective overview and interpretation and presentation of the implications and recommendations. The chapter begins with a summary of the main findings and an overview of how the EASY Minds program was evaluated from conception to pilot study to cluster RCT. Study strengths and limitations are then presented, implications for professional practice, pre-service education and teacher training in schools, and recommendations for future research are discussed.

Research Questions

*Pilot RCT*

1. What is the impact of a school-based intervention (EASY Minds) on the school physical activity levels of primary school-aged children when delivered by an experienced physical activity researcher?

2. What is the feasibility of the EASY Minds Program for improving physical activity and educational outcomes in the primary school when delivered by an experienced physical activity researcher?

*Cluster RCT*

3. What is the impact of the EASY Minds program on the physical activity levels of primary school-aged children when delivered by trained classroom teachers?

4. What are the effects of the program on a range of educational outcomes including on-task classroom behaviour, mathematical performance and mathematical attitude when delivered by trained classroom teachers?

5. What is the feasibility of the EASY Minds Program for improving physical activity and educational outcomes in the primary school?
6. What are student and teacher perceptions of the EASY Minds Program?

7.2 Summary of study purpose

The aim of this study was to investigate the effectiveness of a school-based program (EASY Minds), that was designed to improve both the physical activity levels and key educational outcomes of primary school-aged children. The EASY Minds program was a novel school-based physical activity program designed to embed physical activity within the existing school mathematics curriculum. The program was designed in response to both Australian and global concerns regarding declining physical activity levels\textsuperscript{32}, increased sedentary behaviour\textsuperscript{41}, as well as declining student interest, achievement\textsuperscript{132} and engagement\textsuperscript{26} in mathematics. Schools have been identified as important institutions for the promotion of physical activity among children\textsuperscript{7}; however the crowded school curriculum coupled with competing school demands and restrictive school policies have had an impact on both the quality and quantity of physical activity opportunities within the primary school\textsuperscript{140}. As such, teachers need to explore novel strategies for the promotion of physical activity throughout the school day. Previous research has associated physical activity with a range of improved academic outcomes\textsuperscript{18,55,62,117}. Therefore, integrating physical activity within the school mathematics curriculum could potentially be a novel strategy to enhance student outcomes both from a health and educational perspective.

7.3 Summary of EASY Minds Pilot Study findings

The EASY Minds pilot study\textsuperscript{170} was conducted in 2012 to assess the feasibility and preliminary efficacy of the EASY Minds program for improving physical activity and on-task behaviour in mathematics for children. Conducting this preliminary trial was an important step to determine whether the EASY Minds program produced the intended effect under ideal circumstances, as the entire program was planned and delivered by the PhD candidate, a physical activity researcher and qualified teacher, to a small sample of children in one school. This was an important stage to determine the potential benefits of the EASY Minds program and establish areas of the program structure, implementation and evaluation that may require modification before conducting a large-scale trial. The pilot study produced some positive results with significant intervention effects found for MVPA, sedentary behaviour and children’s on-task behaviour. Importantly, the process evaluation results indicated that EASY Minds was a feasible and efficacious school-based
physical activity program that was highly valued by both participating teachers and children. Our findings clearly illustrated the potential of movement-based learning in the primary school setting.

The process evaluation from the teachers involved in the intervention group, who had observed all sessions, found that the movement involved was not disruptive to learning but clearly enhanced the student experience. As such, it was important to upskill teachers to enable them to incorporate movement into learning opportunities across the school day. Whilst the results of the study were very positive, it is worth noting that the program was delivered by the researcher. It was decided that future studies would need to evaluate the effectiveness of classroom teachers in delivering the program to assess both the sustainability and usability of the program in the school setting. Although results were significant for ontask behaviour, the results were limited by the small sample size.

Accordingly, the findings of the pilot study served to guide the development and implementation of the revised EASY Minds program in a cluster RCT conducted in 2013. To improve the EASY Minds program and strengthen its study design and potential impact, a number of refinements were made, including the strengthening of the trial to a cluster RCT with eight schools. Key refinements to both the delivery and outcome measures included the following three components (sections 7.3.1–7.3.3):

7.3.1 School delivery

Researchers have suggested that the single biggest barrier to classroom physical activity integration is likely to be teachers own beliefs, perceptions and attitude towards physical activity. It was therefore imperative that teachers would not only need to be involved in the planning phase of subsequent studies, they would also need to be given the responsibility to deliver the program in the school setting. For this to occur, comprehensive professional development would be required. Likewise previous school-based physical activity interventions have highlighted the importance of teachers and the pedagogy employed in intervention outcomes. For this reason, the professional learning was aligned with the NSW quality teaching framework, with which teachers in the study area were already familiar, and the professional learning workshop was also registered and accredited with the NSW Institute of Teachers. This acted to provide an additional motivation for teachers to participate. The NSW framework like most
pedagogical models encourages teachers to develop innovative skills to promote intellectual quality, establish a quality learning environment and make learning purposeful and meaningful. In the subsequent cluster RCT, classroom teachers were responsible for all movement-based lessons during the intervention.

### 7.3.2 Evaluation

A key refinement made for the cluster RCT was the introduction of a rigorous process evaluation including both quantitative and qualitative measures to explore program feasibility including the perceptions of teachers and students and levels of satisfaction. Many other programs have reported issues with the intended delivery of interventions as designed, thus affecting the true impact of the intervention. A detailed process evaluation was conducted to identify the views of participants (teachers and students), in phase 1 to help gather data on the feasibility of the program and in phase 2 to look at the sustainability of movement-based mathematics. In both phases the evaluation would help distinguish between an intervention that was poorly designed and one that may be poorly delivered. This process was necessary in this study due to the nature of multisite delivery. The evaluation for this phase included both teacher interviews and student focus groups as well as an evaluation of the professional learning component via field survey questionnaires.

### 7.3.3 Outcome measures

Additional measures were included to assess children’s attitudes, engagement and achievement in mathematics. Included in the cluster RCT were measures of academic performance using a standardised progressive achievement test and attitude towards mathematics. No previous study has looked at the impact of movement-based learning on these two outcomes in mathematics only interventions. These were considered crucial measures as prior research had highlighted that more research was needed on the effects of physically active academic lessons on actual academic performance. The long-term sustainability of the program would be enhanced if the benefits of moving in maths could be demonstrated in terms of both learning and health outcomes.

All other program components remained unchanged for the second trial of the EASY Minds program. The program remained at six weeks duration, the aim was to deliver these
sessions for sixty minutes, three times per week and on-task behaviour was again measured via momentary time sampling.

7.4 The EASY Minds Cluster Randomized Controlled Trial

The cluster RCT of the EASY Minds program was conducted in 2013\textsuperscript{171,180}. This trial confirmed the benefits of the program for increasing school-based physical activity levels and reducing sedentary behaviour when taught by trained classroom teachers. Whilst this increase of health enhancing physical activity (MVPA) of 4 minutes per day is unlikely to be clinically significant the results closely align with a recent systemic review by Metcalfe et al of physical activity interventions in youth. In addition, the program demonstrated the impact of movement-based learning on increasing children’s on-task behaviour. Significantly, results showed that academic performance was not compromised by integrating physical activity within the school curriculum.

This second trial had a much larger sample size of children (n = 240 vs 54), involved teachers planning and delivering the intervention and had a more rigorous process evaluation. Whilst no significant results were found for mathematical attitude, the results were promising and in the hypothesised direction. Previously research had highlighted teacher’s perceptions and barriers to working outside the classroom when integrating physical activity within the curriculum\textsuperscript{86}. This trial highlighted the importance of comprehensive professional development in upskilling generalist primary teachers in physical activity promotion. This was accomplished by structuring the professional learning day to provide a strong rationale for movement-based learning using the results of the feasibility trial and other current research, demonstrating practical activities, providing teaching opportunities and offering peer-supported planning to enhance teacher confidence.

It has been reported that the single biggest barrier to physical activity promotion in schools are teachers’ attitudes, beliefs and perceptions of physical activity\textsuperscript{84}. Therefore, a crucial part of this second trial was to collect evidence of the benefits of movement-based learning, in particular in terms of how such an approach can engage students in mathematics.

Our comprehensive evaluation included both questionnaires, focus groups and interviews. The data from the student focus groups and teacher interviews demonstrated
successfully the program’s potential for such an approach. The program provided positive experiences for both teachers and students in terms of enjoyment and engagement in mathematics. It has been suggested that the most powerful influence on a student’s attitude towards their mathematics is the pedagogical repertoire of the teacher\textsuperscript{26}. It was promising that the program also highlighted movement-based mathematics as promoting an engaging pedagogy. Movement-based mathematics lessons display many attributes of pedagogical models on quality teaching without compromising learning.

7.5 Study strengths and significance

7.5.1 Strengths

EASY Minds was a school-based program that is unique in that it demonstrated effectiveness in improving a range of health-related and academic outcomes. Importantly the EASY Minds program fits into the existing school-curriculum without adding to the over-crowded teaching program experienced by many primary school teachers\textsuperscript{84}. The program simultaneously addresses mandatory syllabus requirements from the school mathematics program\textsuperscript{29} whilst promoting school-based physical activity. Of note, the program addressed many of the limitations of previous programs by integrating physical activity into the school curriculum.

The strengths of the EASY Minds cluster randomised controlled trial included the following elements.

First, the EASY Minds program was evaluated using rigorous study designs (RCT and cluster RCT) and intervention fidelity was high. The design, implementation and reporting of the study conformed to the Consolidated Standards of Reporting trials (CONSORT) guidelines for RCTs and cluster RCTs\textsuperscript{141}. Randomised control trials are considered to be the ‘gold standard’ for evaluating interventions\textsuperscript{198,199}. The inclusion of a control group allows researchers to compare changes in study outcomes between participants who received the intervention (treatment group) and those who did not (control group)\textsuperscript{198}.

Second, all primary and secondary outcomes were measured by trained research assistants who were blinded to treatment conditions at baseline. All assessments were conducted using validated assessments for both physical activity measures (accelerometry) and
educational outcomes (on-task behaviour, mathematical attitude and mathematical attainment). Additional steps were also taken to minimise the risk of bias with all statistical analyses of both primary and secondary outcomes conducted using linear mixed models which are robust to the biases of missing data and provide appropriate balance of Type 1 and Type 2 errors\textsuperscript{163}.

Third, all process evaluation measures from both trials indicated that the program was delivered as intended. In the feasibility trial 17 of the planned 18 sessions were delivered and in the clustered RCT all teachers reported that they had delivered the recommended three sessions per week of movement-based mathematics.

Finally, unique to this study was the inclusion of both focus group interviews with the students and teacher interviews. Both these were conducted by a researcher not directly involved in the project and transcribed by an independent third party. All analyses were conducted by an independent qualitative researcher.

The two trials have thus provided a strong evidence base for larger-scale implementation.

\textbf{7.5.2 Significance}

Increasing physical activity levels of children and reducing sedentary time are important health priorities globally. Schools have been identified as one of the best environments to implement physical activity interventions as they are a primary location to reach the majority of children. Ironically it would appear that schools internationally are one of the predominant environments for promoting sedentary behaviour, in particularly class time\textsuperscript{204}. Coupled with a growing concern amongst mathematics educators for student disengagement in mathematics, the integration of physical activity within mathematics is a novel strategy that can have multiple benefits from both a health and educational perspective. However, few studies have specifically aimed to improve student engagement in mathematics whilst increasing physical activity and reducing sedentary time of children using the school setting, especially in Australia.

Schools play an integral part in contributing to the quality and quantity of physical activity opportunities available for children. A recent (2015) NSW Department of Education physical activity policy has stated that schools need to provide 150 minutes of weekly physical activity which is 50\% of the 300 minutes recommended by the world health
organisation\textsuperscript{31}. Therefore, the implementation of an evidence-based physical activity intervention that meets the requirements of the mathematics curriculum may well provide an excellent strategy for facilitating both enhanced educational and physical activity outcomes.

### 7.6 Study limitations

Whilst EASY Minds has many significant strengths there are also a number of limitations that should be acknowledged. Several of the limitations from the feasibility trial were taken into account in the design of the clustered RCT.

First, both trials were delivered over a six week period. They were both relatively short-term and did not include a follow-up to specifically determine if the teachers would continue with this approach, once support was withdrawn following the completion of the intervention. Variation in the quality of teachers delivering the intervention is also a potential limitation. The teachers who volunteered for this study were committed to the program and were given support via weekly emails and fortnightly fidelity checks. However we do not know what would have occurred without the additional support provided by the research team. Similarly the fact that these teachers were willing to participate in the research suggests they were open to ideas and may have had positive attitudes, beliefs and perceptions regarding physical activity. Future studies may also need to include classroom observations of the control group to gather additional insight into classroom pedagogy.

The short-term nature of the program is another study limitation. In order to determine maintenance effects over the long-term, it has been recommended that studies include a one- to two-year follow-up period\textsuperscript{108,200}. It would also be useful to extend the program to include children from Kindergarten through to Grade 6, to not only build the knowledge and skills of teachers across all school years, but to ensure that both the physical and academic benefits of such an approach to mathematics becomes inherent across the whole primary school. Additionally future studies may need to recruit a larger sample size so analysis by gender is possible. Analysis by gender was not possible in this study as the power calculation would have been compromised.
7.7 Recommendations for research and practice

1. Integrating physical activity in the mathematics curriculum is an area that needs to be targeted via comprehensive professional development for teachers. This professional development needs to build on the lessons learnt in the EASY Minds trial. This will obviously need the support of the major stakeholders. Internationally this will include Departments of Education and national professional associations. In NSW schools, this will be The Department of Education, the School Sport unit and the NSW branch of the Australian Council for Physical Education Health and Recreation (ACHPER). The School Sport Unit provides a range of teacher professional development activities across NSW. These courses are NSW Institute of Teacher registered and also provide sport/activity-specific accreditation. ACHPER provide a series of one day workshops for primary school teachers focussing on current issues and initiatives relevant to primary schools.

2. As in the professional learning for the Cluster RCT a model of innovation diffusion will need to be used for all sessions. The model of innovation diffusion acknowledges that teachers themselves are more inclined to adopt a new initiative or change their pedagogical approach if they view it as relative to current practice, simple and easy to understand and implement and likely to produce observable results. Therefore the day will need to very similar in format to the model outlined in the study protocol chapter.

3. To support the dissemination of the study and to enable teachers to further spread the message, a website containing a few example sessions and a video explaining the potential of the concept would be beneficial. Teachers could then contribute to this by planning activities as part of ongoing professional learning.
4. Previous research has found that pre-service teachers are willing to integrate physical activity across the curriculum\textsuperscript{125,126}. However these studies have also reported that newly qualified teachers can lack the necessary skills, confidence and perceived competence to promote physical activity\textsuperscript{201}. Given that this study had positive effects on key health-enhancing and academic variables it is recommended that movement-based learning is embedded within pre-service teacher education courses.

5. Current practice in many Australian universities is for pre-service teachers to undertake only one Physical Education class out of thirty two courses. As such it could be argued that the place for physical activity integration across the mathematics curriculum does not fit in these already crowded courses, but also in the Mathematics pedagogy courses.

6. Integrating physical activity across the mathematics curriculum has proven to promote aspects of quality teaching and does not compromise learning. As such, it is recommended that teachers in primary schools embrace movement-based learning as an effective pedagogical approach.

7. A future goal of the EASY Minds program would be to expand the program across all stages of learning (i.e. Kindergarten through to Grade 10) and have the program readily accessible to all classroom teachers.

8. Future replications of studies such as EASY Minds should be of a longer duration (24 months). This would give a better indication of the academic effects of the program. Measures of academic performance could include standardised instruments such as NAPLAN in Australian schools.

7.8 Future research recommendations for the EASY Minds Program

The comprehensive evaluation of the EASY Minds program has provided valuable information to inform future research in this area. Both RCTs provided evidence for the feasibility, efficacy and effectiveness of the program for improving the physical activity levels of primary school-aged children. This study will also contribute to the limited existing literature regarding the impact of curriculum-specific physical activity integration in Primary Schools. The study clearly demonstrated the potential of a movement-based learning approach in mathematics.
The next phase for the EASY Minds study is to disseminate the program on a larger scale. This will be necessary to explore the generalisability of the results for a broader population. This transitional trial will be based on the RE-AIM framework\textsuperscript{202}. RE-AIM is a conceptual model that has been used to plan, evaluate, review and report a variety of health promotion interventions, and emphasises the reach and representativeness of both participants and settings in conducting and evaluating controlled trials\textsuperscript{202}. The RE-AIM trial will include a one day professional learning day; dimensions will include reach, effectiveness, adoption, implementation and maintenance. Measures of reach will include the number of teachers, schools and students. Effectiveness, adoption, implementation and maintenance will all be measured via questionnaires.

Finally, a growing body of literature links physical activity with improvements in brain function and cognition\textsuperscript{52,56,203} and recent research in humans resulting from advances in neuroimaging techniques indicates that exercise leads to changes in both brain structure and functioning. The next stage for EASY Minds is to examine the effect of active mathematics lessons on cognitive/executive functioning.

Both quantitative and qualitative data from the EASY minds study indicate that there is great potential in movement-based learning. The intervention has highlighted that not only is integrating physical activity in mathematics a feasible option for schools and teachers to increase school-based physical activity and reduce sedentary time, it does not compromise academic performance. In fact, the intervention led to an increase in on-task behaviour in mathematics lessons. The pedagogy involved in the teaching of movement-based mathematics lessons can significantly and positively influence a child’s attitude and engagement in mathematics. This movement-based pedagogy may enhance children’s overall learning experiences and promotes quality teaching. The teacher and the quality of the pedagogy employed have been identified as the single biggest influence on a student’s learning\textsuperscript{146,189}.

7.9 Conclusions

The aim of this study was to investigate the effectiveness of a school-based physical activity program (EASY Minds) for improving the physical activity and key educational outcomes for primary school-aged children. The findings from our research are consistent with previous literature that has highlighted the potential in integrating physical activity
across the curriculum. The study is one of the first in the world and is the first in Australia to specifically target the curriculum area of mathematics. Worldwide primary school teachers have reported a range of barriers (e.g. lack of training, crowded curriculum, lack of confidence and lack of interest) affecting their ability to maximise opportunities for physical activity promotion. The EASY Minds program was both an innovative and engaging school-based program. The program has the potential to increase the amount of physical activity undertaken at school while not sacrificing academic performance. The program challenged but also complemented traditional teacher approaches to learning. The EASY Minds program has proven to be both feasible and effective for improving physical activity and educational outcomes of children, and has shown to be highly regarded by both teachers and students. To support the generalisability of the current findings, future large scale roll outs and evaluation of the EASY Minds program are required.
Appendices

Appendix 1: Supervisors’ Acknowledgement of Contribution

As co-supervisors of Nick Riley for the entirety of his PhD study, we, Professor Philip, J. Morgan and Professor David, R. Lubans, acknowledge that Nick’s contribution to the EASY Minds study (as outlined on pages 6 & 7) is accurate and true to the best of our knowledge.

Professor Philip, J. Morgan
Date: 06/01/16

Professor David, R. Lubans
Date: 06/01/16
Appendix 2: Published Paper 1
Appendix 3: Published Paper 2
Appendix 4: Published Paper 3

"Findings From the EASY Minds Cluster Randomized Controlled Trial: Evaluation of a Physical Activity Integration Program for Mathematics in Primary Schools" by Riley N, Laban R, Holmes K, Morgan PJ
Journal of Physical Activity & Health
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Note: This article will be published in a forthcoming issue of the Journal of Physical Activity & Health. This article appears here in its accepted, peer-reviewed form, as it was provided by the submitting author. It has not been copy edited, proofed, or formatted by the publisher.

Section: Original Research

Article Title: Findings From the EASY Minds Cluster Randomized Controlled Trial: Evaluation of a Physical Activity Integration Program for Mathematics in Primary Schools

Authors: Nicholas Riley, David R. Laban, Kathryn Holmes, and Philip J Morgan

Affiliations: Priority Research Centre in Physical Activity and Nutrition, School of Education, University of Newcastle, Callaghan Campus, Australia.

Running Head: Findings from EASY Minds RCT

Journal: Journal of Physical Activity & Health

Acceptance Date: May 31, 2015

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DOI: http://dx.doi.org/10.1123/jpah.2015-0046
Appendix 5: Published Paper 4
Appendix 6: The University of Newcastle Ethics Approval

HUMAN RESEARCH ETHICS COMMITTEE

Notification of Expedited Approval

To Chief Investigator or Project Supervisor: Associate Professor Philip Morgan
Cc Co-investigators / Research Students: Doctor David Lubans
                                             Mr Nicholas Riley
Re Protocol:                                     E.A.S.Y Minds (Encouraging Activity to
                                             Stimulate Young Minds)
Date:                                            09-Sep-2010
Reference No:                                    H-2010-1183
Date of Initial Approval:                        09-Sep-2010

Thank you for your Response to Conditional Approval submission to the Human Research Ethics Committee (HREC) seeking approval in relation to the above protocol.

Your submission was considered under Expedited review by the Chair/Deputy Chair.

I am pleased to advise that the decision on your submission is Approved effective 09-Sep-2010.

In approving this protocol, the Human Research Ethics Committee (HREC) is of the opinion that the project complies with the provisions contained in the National Statement on Ethical Conduct in Human Research, 2007, and the requirements within this University relating to human research.

Approval will remain valid subject to the submission, and satisfactory assessment, of annual progress reports. If the approval of an External HREC has been "noted" the approval period is as determined by that HREC.

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal Certificate of Approval will be available upon request. Your approval number is H-2010-1183.

If the research requires the use of an Information Statement, ensure this number is inserted at the relevant point in the Complaints paragraph prior to distribution to potential participants. You may then proceed with the research.
Conditions of Approval

This approval has been granted subject to you complying with the requirements for Monitoring of Progress, Reporting of Adverse Events, and Variations to the Approved Protocol as detailed below.

PLEASE NOTE:
In the case where the HREC has “noted” the approval of an External HREC, progress reports and reports of adverse events are to be submitted to the External HREC only. In the case of Variations to the approved protocol, or a Renewal of approval, you will apply to the External HREC for approval in the first instance and then Register that approval with the University’s HREC.

- Monitoring of Progress

Other than above, the University is obliged to monitor the progress of research projects involving human participants to ensure that they are conducted according to the protocol as approved by the HREC. A progress report is required on an annual basis. Continuation of your HREC approval for this project is conditional upon receipt, and satisfactory assessment, of annual progress reports. You will be advised when a report is due.

- Reporting of Adverse Events

1. It is the responsibility of the person first named on this Approval Advice to report adverse events.
2. Adverse events, however minor, must be recorded by the investigator as observed by the investigator or as volunteered by a participant in the research. Full details are to be documented, whether or not the investigator, or his/her deputies, consider the event to be related to the research substance or procedure.
3. Serious or unforeseen adverse events that occur during the research or within six (6) months of completion of the research, must be reported by the person first named on the Approval Advice to the (HREC) by way of the Adverse Event Report form within 72 hours of the occurrence of the event or the investigator receiving advice of the event.
4. Serious adverse events are defined as:
   - Causing death, life threatening or serious disability.
   - Causing or prolonging hospitalisation.
   - Overdoses, cancers, congenital abnormalities, tissue damage, whether or not they are judged to be caused by the investigational agent or procedure.
   - Causing psycho-social and/or financial harm. This covers everything from perceived invasion of privacy, breach of confidentiality, or the diminution of social reputation, to the creation of psychological fears and trauma.
   - Any other event which might affect the continued ethical acceptability of the project.
5. Reports of adverse events must include:
   - Participant’s study identification number;
   - date of birth;
   - date of entry into the study;
   - treatment arm (if applicable);
   - date of event;
   - details of event;
   - the investigator’s opinion as to whether the event is related to the research procedures; and
   - action taken in response to the event.
6. Adverse events which do not fall within the definition of serious or unexpected, including those reported from other sites involved in the research, are to be reported in detail at the time of the
annual progress report to the HREC.

- Variations to approved protocol

If you wish to change, or deviate from, the approved protocol, you will need to submit an Application for Variation to Approved Human Research. Variations may include, but are not limited to, changes or additions to investigators, study design, study population, number of participants, methods of recruitment, or participant information/consent documentation. Variations must be approved by the (HREC) before they are implemented except when Registering an approval of a variation from an external HREC which has been designated the lead HREC, in which case you may proceed as soon as you receive an acknowledgement of your Registration.

**Linkage of ethics approval to a new Grant**

HREC approvals cannot be assigned to a new grant or award (ie those that were not identified on the application for ethics approval) without confirmation of the approval from the Human Research Ethics Officer on behalf of the HREC.

Best wishes for a successful project.

Professor Alison Ferguson  
Chair, Human Research Ethics Committee

*For communications and enquiries*  
**Human Research Ethics Administration**

Research Services  
Research Office  
The University of Newcastle  
Callaghan NSW 2308  
Tel +61 2 492 18919  
Fax +61 2 492 17164  
human.ethics@newcastle.edu.au

**Linked University of Newcastle administered funding:**

<table>
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<th>Funding body</th>
<th>Funding project title</th>
<th>First named investigator</th>
<th>Grant Ref</th>
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</table>
Appendix 7: The Newcastle / Maitland Catholic Schools Ethics Approval

13 December 2010

Mr Nicholas Riley
HPE 3.3
School of Education
University of Newcastle
University Drive
Callaghan, NSW 2308

Dear Mr Riley

Thank you for your application to conduct research in Diocese of Maitland-Newcastle which we received on 19 November 2010. I am happy for you to approach the following schools in the diocese in order to carry out research to evaluate the impact of a school based program (E.A.S.Y. Minds) that integrates physical activity into the primary curriculum for students in Stage 3.

1. Our Lady of Lourdes Primary School, Tamworth.
2. St Therese's Primary School, New Lambton.
3. St Benedict's Primary School, Edgeworth.

We always stress the following points in relation to research requests:

- It is the school principal, who gives final permission for research to be carried out in their school.
- Confidentiality needs to be observed in reporting and must comply with the requirements of the Commonwealth Privacy Amendment (Private Sector) Act 2000.
- There should be some feedback to schools and a copy of the findings of the research forwarded to this office.
- This letter of approval should accompany any approach to schools.

I look forward to the results of this study and wish you the best over the coming months. If you would like to discuss any aspect of this research in our diocese, please do not hesitate to contact me on 02 4978 1201 or vicky.sheriff@nsw.catholic.edu.au

Yours sincerely,

Vicky Sheriff
Professional Assistant to the Director
Catholic Schools Office
Diocese of Maitland-Newcastle
Appendix 9: EASY Minds Principal / Teacher / Parent & Child Information Package (Phase 1)

A/Professor Philip Morgan
School of Education
The University of Newcastle
University Drive,
Callaghan 2308.
0249217265
Philip.Morgan@newcastle.edu.au

Principal information Sheet

Document Version [2]; dated [29/07/11]
E.A.S.Y. (Encouraging Activity to stimulate Young) Minds.

Dear Principal,
Your school is invited to participate in the research project identified above which is being conducted by Nick Riley from the University of Newcastle. The research will be part of Nick’s research higher degree studies at the University and will be supervised by Associate Professor Philip Morgan and Dr David Lubans from the School of Education.

**Why is the research being done?**

The purpose of the research is to determine the feasibility of a school-based program called E.A.S.Y. Minds (Encouraging Activity to Stimulate Young Minds). E.A.S.Y. Minds is a program that integrates physical activity into the delivery of the school curriculum. Based on previous studies, increased participation in Physical Activity (PA) may improve cognitive functioning and academic achievement. Movement can actually aid learning and the integration of physical activity has the potential to enhance learning and student engagement in other curriculum areas. E.A.S.Y. Minds also has a home-based component designed to reinforce educational concepts taught in school and promote further physical activity and learning at home.

**Who can participate in the research?**

If you and two participating teachers agree, students in a nominated class from Stage 3 will participate in the University of Newcastle E.A.S.Y Minds program. Two classes will be involved in the E.A.S.Y. Minds program, but will be randomly allocated to either complete the program in Term 1 2012 or Term 3 2012. You will not be able to select which term as this needs to be allocated by us. However both classes will receive the E.A.S.Y. Minds program.
The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for six weeks starting week 5 of term 1, 2012.

All students in the class will participate in the program, however, only the students who provide signed consent letters will contribute to the study data.

**What choice do you have?**

Participation in this research is entirely your choice and only schools where both the principals and teachers have agreed to participate will be included in this study. If you do agree to your school’s participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with the University of Newcastle. Similarly, students in your school will be included in the study only after a consent form has been signed by the students and their parents/guardians. If they initially agree to participate, they can choose to withdraw from the study at any time without giving a reason.

**What would you be asked to do?**

E.A.S.Y Minds will involve the modification of lessons from a Stage 3 unit of work that will be developed from the NSW Board of Studies K-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for their child’s education.

**Teachers**

The researcher will be primarily responsible for the delivery of the program during normal lessons. E.A.S.Y. Minds will involve the modification of a stage 3 unit of work that will be developed from the NSW Board of Studies K-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. Qualified staff from the University of Newcastle will be involved in the administration of all questionnaires and the observations of pupils. Nick Riley will work in close collaboration with the classroom teacher to integrate physical activity into already planned learning experiences whilst keeping both subject matter and learning outcomes consistent.

The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for one school term (6 weeks) starting week 4 of term 1, 2012.

**Program overview:**

- Teachers unit of work-6 weeks, 3 lessons of 60 minute duration/week
- Lesson activities
- Student work books
- Student certificates and reward systems
Parents

A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for children’s education.

Students

Students will be asked to complete a Learning styles inventory, a multiple intelligences checklist and wear an accelerometer throughout the school day (Mon- Fri Weeks 3-10). Baseline and post test data will be collected from all participants. All participants will complete a range of assessments.

Measures

**Height and Weight:** height will be measured using a portable stadiometer and weight will be measured using calibrated weight scales.

**Learning Styles:** will be measured using the Barsch Learning Style Reference Form. From this, an indication of a student’s preferred perceptual modality will be determined. Student’s intelligence strengths will be assessed using a Multiple Intelligences Checklist for Upper Primary and Secondary (MICUPS).

**On task behaviour:** will be observed using a momentary time sampling procedure adapted from Behaviour Observation of students in Schools and Applied Behaviour Analysis for Teachers. Students will be chosen at random and will be observed in 15 second intervals over a 30 minute period pre, during and post intervention.

**Physical activity (PA):** Accelerometers will be used to provide an objective measure of both PA intensity and duration. Accelerometers are light instruments, small and robust that measure physical activity. Accelerometers will be worn throughout the school day.

Any personal information provided by parents/guardians and students will be confidential to the researchers. The results of the study will be published in general terms and will not allow the identification of individuals or schools. Once the data has been collected and entered into an electronic data file and verified, the questionnaires will be destroyed. The electronic data files will be retained for at least 5 years but no person will be identifiable in the data files or published reports.

**How will the information collected be used?**

The data collected from this study will be used for Nick Riley’s Research Higher Degree studies. It may also be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs. Data will be stored in a locked filing cabinet to ensure its security and the confidentiality of any identified data. Only the student researcher and the chief investigator will have access to the raw data. Only data in the form of de-identified SPSS files will be stored. This data will be kept for at least five (5) years beyond the completion of the project.
What do you need to do to participate?

If you are willing for your school to participate in this study, could you please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided.

Upon receipt of your consent, Nick Riley will contact you to organise a time to visit the school and provide yourself, teachers, students with information about the study. If you would like to organise a different route for the dissemination of the Information Sheet and Consent Form to students, please let Nick Riley know. All students will be required to return a Consent Form, which the student and parents/guardians have signed before the study starts.

Further information

Following the completion of the study, the school will be sent a dissemination report describing the findings of the study. It is suggested that the findings are disseminated to students and their parents/guardians via a school newsletter or similar method. If you would like further information please do not hesitate to contact Nick Riley.

Thank you for considering this invitation.

A/Prof Philip Morgan  Dr David Lubans  Nick Riley

A/Prof Philip Morgan  Dr David Lubans  Nick Riley

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<thead>
<tr>
<th>A/Prof Philip Morgan</th>
<th>Dr David Lubans</th>
<th>Nick Riley</th>
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<tr>
<td><a href="mailto:Philip.Morgan@newcastle.edu.au">Philip.Morgan@newcastle.edu.au</a></td>
<td><a href="mailto:David.Lubans@newcastle.edu.au">David.Lubans@newcastle.edu.au</a></td>
<td><a href="mailto:Nicholas.Riley@newcastle.edu.au">Nicholas.Riley@newcastle.edu.au</a></td>
</tr>
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</table>

This project has been approved by the University’s Human Ethics Committee, Approval No. H-2010-1183. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 49216333, email Human-Ethics@newcastle.edu.au
Teacher Information Sheet

Document Version [2]; dated [29/07/11]

E.A.S.Y. (Encouraging Activity to stimulate Young) Minds.

Dear Teacher,

Physical fitness and physical activity are associated with improved test scores in children. Unfortunately opportunities for children’s physical activity have decreased. Innovative ways to get children active are needed.

You are invited to participate in the research project identified above which is being conducted by Nick Riley from the University of Newcastle. The research will be part of Nick’s research higher degree at the University and will be supervised by Associate Professor Philip Morgan and Dr David Lubans from the School of Education.

Why is the research being done?

The purpose of the research is to determine the feasibility of a school-based program called E.A.S.Y. minds (Encouraging Activity to Stimulate Young Minds). E.A.S.Y. Minds is a school-based program that integrates physical activity into the delivery of the school curriculum. Based on previous studies, increased participation in PA may improve cognitive functioning and academic achievement. Movement can actually aid learning and the integration of physical activity has the potential to enhance learning in other curriculum areas. E.A.S.Y. Minds has a home-based component designed to engage parents and reinforce educational concepts taught in school and promote further physical activity at home.

Who can participate in the research?

If you agree, students in a nominated class from Stage 3 will participate in the University of Newcastle E.A.S.Y. Minds program, which will be based at your school. Two classes will be involved in the E.A.S.Y. Minds program, but will be randomly allocated to either complete the program in Term 1 2012 or Term 2 2012. You will not be able to select which term as this needs to be allocated by us. However both classes will receive the E.A.S.Y. Minds program.
The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for six weeks starting week 5 of term 1, 2012. All students in the class will participate in the program, however, only the students who provide signed consent letters will contribute to the study data.

**What choice do you have?**

Participation in this research is entirely your choice and only schools where both the principals and teachers have agreed to participate will be included in this study. If you do agree to your participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with the University of Newcastle. Similarly, students in your school will be included in the study only after a consent form has been signed by the students and their parents/guardians. If they initially agree to participate, they can choose to withdraw from the study at any time without giving a reason.

**What would you be asked to do?**

*E.A.S.Y. Minds* will involve the modification of a Stage 3 unit of work that will be developed from the NSW Board of Studies k-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for their child’s education.

**Teachers**

You will be primarily responsible for the delivery of the program during normal lessons. *E.A.S.Y. Minds* will involve the modification of a stage 3 unit of work that will be developed from the NSW Board of Studies k-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. Qualified staff from the University of Newcastle will be involved in the delivery of all assessments and the observations of pupils. Nick Riley will work in close collaboration with the classroom teacher to integrate physical activity into already planned learning experiences whilst keeping both subject matter and learning outcomes consistent. The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for six weeks starting week 5 of term, 2012.

**Program design**

- Teachers unit of work-6 weeks 3 lessons of 60 minutes duration/week
- Lesson activities
- Student work books
- Student certificates and reward systems

All students in the class will participate in the program, however, only the students who provide signed consent letters will complete the assessments.
Parents

A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for children’s education.

Students

Students will be asked to wear an accelerometer throughout the school day (Mon- Fri Weeks 4-10).
Baseline and post test data will be collected from all participants. All participants will complete a range of assessments.

Measures

Height and Weight: height will be measured using a portable stadiometer and weight will be measured using calibrated weight scales.
Learning Styles: will be measured using the Barsch Learning Style Reference Form. From this an indication of a student’s preferred perceptual modality will be determined. Student’s intelligence strengths will be assessed using a Multiple Intelligences Checklist for Upper Primary and Secondary (MICUPS).
On task behaviour: will be observed using a momentary time sampling procedure) adapted from Behaviour Observation of students in Schools and Applied Behaviour Analysis for Teachers. Students will be chosen at random and will be observed in 15 second intervals over a 30 minute period pre, during and post intervention.
Physical activity (PA): Accelerometers will be used to provide an objective measure of both PA intensity and duration. Accelerometers are light instruments, small and robust that measure physical activity. Accelerometers will be worn throughout the school week.

How will your privacy be protected?

Any personal information provided by parents/guardians and students will be confidential to the researchers. The results of the study will be published in general terms and will not allow the identification of individuals or schools. Once the data has been collected and entered into an electronic data file and verified, the questionnaires will be destroyed. The electronic data files will be retained for at least 5 years but no person will be identifiable in the data files or published reports.

How will the information collected be used?

The data collected from this study will be used for Nick Riley’s Research Higher Degree studies. It may also be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs. Data will be stored in a locked filing cabinet to ensure its security and the confidentiality of any identified data. Only the student researcher and the chief investigator will have access to the raw data. Only data in the form of de-identified SPSS files will be stored. This data will be kept for at least five (5) years beyond the completion of the project.

What do you need to do to participate?
If you are willing for your school to participate in this study, could you please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided. Upon receipt of your consent, Nick Riley will contact you to organise a time to visit the school and provide yourself, and students with information about the study. If you would like to organise a different route for the dissemination of the Information Sheet and Consent Form to students, please let Nick Riley know. All students will be required to return a Consent Form, which the student and parents/guardians have signed before the study starts.

Further information

Following the completion of the study, the school will be sent a dissemination report describing the findings of the study. It is suggested that the findings are disseminated to students and their parents/guardians via a school newsletter or similar method. If you would like further information please do not hesitate to contact Nick Riley. Thank you for considering this invitation.

A/Prof Philip Morgan Dr David Lubans Nick Riley

<table>
<thead>
<tr>
<th>A/Prof Philip Morgan</th>
<th>Dr David Lubans</th>
<th>Nick Riley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty of Education &amp; Arts</td>
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</tr>
<tr>
<td>School of Education</td>
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</tr>
<tr>
<td>Phone: (02) 4921 7265</td>
<td>Phone: (02) 4921 2049</td>
<td>Phone: (02) 49854254</td>
</tr>
<tr>
<td><a href="mailto:Philip.Morgan@newcastle.edu.au">Philip.Morgan@newcastle.edu.au</a></td>
<td><a href="mailto:David.Lubans@newcastle.edu.au">David.Lubans@newcastle.edu.au</a></td>
<td><a href="mailto:Nicholas.Riley@newcastle.edu.au">Nicholas.Riley@newcastle.edu.au</a></td>
</tr>
</tbody>
</table>

This project has been approved by the University’s Human Ethics Committee, Approval No.H-2010-1183. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 49216333, email Human-Ethics@newcastle.edu.au
Parent/Student Information Sheet

E.A.S.Y. (Encouraging Activity to stimulate Young) Minds.

Dear Parent,

Please read this letter with your child.

Your child is invited to participate in the research project identified above which is being conducted by Nick Riley from the University of Newcastle. The research will be part of Nick’s studies at the University and will be supervised by Associate Professor Philip Morgan and Dr David Lubans from the School of Education.

Why is the research being done?

The purpose of the research is to determine the feasibility of a school-based program called E.A.S.Y. Minds (Encouraging Activity to Stimulate Young Minds). E.A.S.Y. Minds is a school-based program that integrates physical activity into the delivery of the school curriculum. Based on previous studies, increased participation in PA may improve cognitive functioning and academic achievement. Movement can actually aid learning and the integration of physical activity has the potential to enhance learning in other curriculum areas. E.A.S.Y. Minds also has a home-based component designed to reinforce educational concepts taught in school and promote further physical activity at home.

Who can participate in the research?

If you agree your child will participate with other students in their class in the E.A.S.Y. Minds program that will be based at your school. Two classes will be involved in the E.A.S.Y. Minds program, but will be randomly allocated to either complete the program in Term 1 2012 or Term 2 2012.

The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for 6 weeks starting week 5 of term 1, 2012. Students will have three lessons per week adapted to increase physical activity.
All students in the class will participate in the program, however, only the students of parents who provided signed consent letters will contribute to data collection.

**What would you and your child be asked to do?**

All student participants will complete a range of assessments. Tests will be conducted before and after the program.  
**Height and Weight:** height will be measured using a portable stadiometer and weight will be measured using calibrated weight scales.  
**Learning Styles:** will be measured using the Barsch Learning Style Reference Form. From this, an indication of a student's preferred way of learning will be determined. Student’s intelligence strengths will be assessed using a Multiple Intelligences Checklist for Upper Primary and Secondary (MICUPS). This is not a test and there are no right or wrong answers. The checklist identifies what children like and what they are particularly good at.  
**On task behaviour:** Students will be chosen at random and will be observed in 15 second intervals over a 30 minute period pre, during and post intervention.  
**Physical activity (PA):** Accelerometers will be used to provide an objective measure of both PA intensity and duration. Accelerometers are light instruments, small and robust that measure physical activity. Accelerometers will be worn throughout the school day.

**Who will be responsible for delivering and administering the program?**

The researcher will be primarily responsible for the delivery of the program during normal lessons. Qualified staff from the University of Newcastle will be involved in the delivery of all assessments and the observations of pupils. Nick Riley will work in close collaboration with the classroom teacher to integrate physical activity into already planned learning experiences whilst keeping both subject matter and learning outcomes consistent.

**What choice do you have?**

Participation in this research is entirely your choice and only schools where both the principals and teachers have agreed to participate will be included in this study. If you do agree to your child’s participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with the University of Newcastle. Similarly, students in your school will be included in the study only after a consent form has been signed by the students and their parents/guardians. If they initially agree to participate, they can choose to withdraw from the study at any time without giving a reason.

**What are the risks and benefits of participating?**

The observations will be conducted by trained research assistants and the activity sessions will be developed by the research team and delivered alongside the classroom teacher.

**How will your privacy be protected?**

Any personal information provided by parents/guardians and students will be confidential to the researchers. The results of the study will be published in general terms and will not
allow the identification of individuals or schools. Once the data has been collected and entered into an electronic data file and verified, the questionnaires will be destroyed. The electronic data files will be retained for at least 5 years but no person will be identifiable in the data files or published reports.

**How will the information collected be used?**

The data collected from this study will be used for Nick Riley’s Research Higher Degree studies. It may also be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs. Data will be stored in a locked filing cabinet to ensure its security and the confidentiality of any identified data. Only the student researcher and the chief investigator will have access to the raw data. Only data in the form of de-identified SPSS files will be stored. This data will be kept for at least five (5) years beyond the completion of the project.

**What do you need to do to participate?**

If you are willing for your child to participate in this study, could you please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided.

**Further information**

Following the completion of the study, the school will be sent a dissemination report describing the findings of the study. It is suggested that the findings are disseminated to students and their parents/guardians via a school newsletter or similar method. If you would like further information please do not hesitate to contact Nick Riley.

Thank you for considering this invitation.

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Principal Consent Form for the Research Project:

E.A.S.Y. Minds

Researcher: Associate Professor Philip Morgan

I have been given information about the project identified above. I understand that if I consent to my school’s involvement in this project, selected students will participate in the program. Students will also be observed in selected lessons. Students will also complete a learning style inventory, a multiple intelligences checklist and wear an accelerometer at school.

I have had an opportunity to ask the research team questions about the research. I understand that my school’s participation in this research is voluntary and that my school and my students are free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Newcastle.

By signing below I am indicating my consent for my school to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ______________________________

Teacher’s name: _____________________________

Signature: ____________________________ Date: ________________

Please return the completed consent form to school in the envelope enclosed. Your cooperation is greatly appreciated.
Teacher Consent Form for the Research Project:

E.A.S.Y. Minds

Researcher: Associate Professor Philip Morgan

I have been given information about the project identified above. I understand that if I consent to my involvement in this project, selected students will participate in the program. Students will also be observed in selected lessons. Students will also complete a learning style inventory, multiple intelligences checklist and wear an accelerometer at school.

I have had an opportunity to ask questions about the research to I understand that my participation in this research is voluntary and that my school and my students are free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Newcastle.

By signing below I am indicating my consent for my school to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ________________________________________________

Teacher’s name: ________________________________________________

Signature: __________________________ Date: _________________

Please return the completed consent in the prepaid envelope enclosed. Your cooperation is greatly appreciated.
Parent Consent Form for the Research Project:

E.A.S.Y. Minds

Researcher: Associate Professor Philip Morgan

I have discussed the research project with my child and have had an opportunity to ask the research team questions about the research. I understand that my child’s participation in this research is voluntary and my child is free to withdraw from the research project at any time. My refusal to consent to my child participating or withdrawal of consent will not affect my relationship with the University of Newcastle or the school. My withdrawal will not result in any disciplinary action against me, nor will it affect my child’s academic grades, given that this is a purely voluntary research task.

Students will also be observed in selected lessons. Students will also complete a learning style inventory and multiple intelligences checklist and wear an accelerometer at school. By signing below I am indicating my consent for my child to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ____________________

Parent’s name: ___________    Parent’s signature: _________________

Student’s name: ______________   Student’s signature: _______________

Please return the completed consent form in the envelope provided. Your cooperation is greatly appreciated.
Student Assessment
Encouraging Activity to Stimulate Young Minds

(E.A.S.Y. Minds)

Student Name: _____________________________

School____________________________________

Your name will be removed from this form by the researcher when it has been completed

Researcher:

Nick Riley

Faculty of Education & Arts
School of Education
Phone: (02) 49854254

Nicholas.Riley@newcastle.edu.au

Participant Number_______ (Leave blank)
Thank you for being involved in E.A.S.Y. Minds.

- Please answer ALL questions
- This is not a test - there are no right or wrong answers.
- Your name will not be recorded and no-one except the researchers will see your answers.

**Section 1**

**Questions**                          **Answers- Please circle**

<table>
<thead>
<tr>
<th>What is your age?</th>
<th>9  10  11  12  13</th>
</tr>
</thead>
<tbody>
<tr>
<td>What year group are you in at school?</td>
<td>5  6</td>
</tr>
<tr>
<td>What is your date of birth?</td>
<td><strong><strong><strong><strong><strong>/</strong></strong></strong></strong></strong>/__________</td>
</tr>
<tr>
<td></td>
<td>Day  Month  Year</td>
</tr>
<tr>
<td>Are you male or female?</td>
<td>Male  Female</td>
</tr>
<tr>
<td>What language do you usually speak at home?</td>
<td>English  Other ______________________</td>
</tr>
<tr>
<td>In which country were you born?</td>
<td>Australia  Other______________________</td>
</tr>
</tbody>
</table>
**MICUPS**

(Multiple Intelligences Checklist for Upper Primary and Secondary – Years 4-10)

Please circle the most appropriate response for each question.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Always</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I like making and doing word puzzles</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I can usually learn new maths work easily</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I usually don’t take very long to learn new sports and exercises</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I like to try and fix things with small parts which aren’t working well</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I enjoy doing maths problems and puzzles</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I enjoy gardening and being with nature</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I can decide what I want, work out how to get it, and then do what I need to do</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I enjoy drawing and artwork</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>People have commented that I sing well</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I enjoy writing stories</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I have an interest in the natural environment and try to recycle as much as possible</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>I enjoy playing a musical instrument</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I often see clear pictures in my head when I close my eyes</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>I sing and hum a lot during the day</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>I have a good sense of direction and rarely get lost</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>I enjoy bushwalking and going on nature walks</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>I can judge well what I am good at and not so good at</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>I prefer to do things with other people rather than be by myself</td>
<td>5 4 3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>I like to read books a lot</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>I like making up and doing experiments to find out about things</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>I am concerned about the protection of our natural environment</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>I often have good ideas for what to play or do that other kids follow</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td>I like playing games like chess or draughts where you have to use clever thinking to win</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>I am sensitive to other people’s feelings</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>I am very interested in Australian native plants and animals</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>26</td>
<td>After something has happened to me I like to think about my reactions to it</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td>I always try to think about the effect my behaviour will have on other people’s feelings</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>I think a lot about myself and why I am the way I am</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td>I can recognize and remember songs and music easily</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td>I’m good at remembering jokes, rhymes and stories to tell</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>31</td>
<td>I often find it easier to say what I want to communicate by using a drawing or a diagram</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>32</td>
<td>I like playing ball games and computer games where I have to react fast</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>33</td>
<td>I’m good at imagining how things will look before I make them</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>34</td>
<td>When I meet new people I feel confident that I will be able to get along well with them</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>35</td>
<td>I am confident that I can make my body do what I want it to do</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td>I really enjoy dancing and moving to music</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>37</td>
<td>I can usually find the right words to communicate what I want to say</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>38</td>
<td>I am very curious about how things work</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>39</td>
<td>I like listening to music a lot</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td>Often</td>
<td>Seldom</td>
<td>Sometimes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------</td>
<td>-------</td>
<td>--------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I usually know what kind of mood I am in and why</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>I can remember more about a subject through listening than reading</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I follow written directions better than oral directions</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I like to write things down or take notes for visual review</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I bear down extremely hard with pen or pencil when writing</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I require explanations of diagrams, graphs or visual directions</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I enjoy working with tools</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I am skilful and enjoy developing and making graphs and charts</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I can tell if sounds match when presented with pairs of sounds</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I remember best by writing things down several times</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I can better understand and follow directions using maps</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I do better at academic subjects by listening to lectures and tapes</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>I play with coins and keys in pockets</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I learn to spell better by repeating the letters than by writing the word on paper</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>I can better understand a news article by reading about it in the paper than listen to the radio</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>I chew gum, snack during studies</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>I feel the best way to remember a picture is in my head</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>I learn spelling by ‘finger spelling’ the words</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>I would rather listen to a good lecture or speech than read the same material</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>I am good at working and solving jigsaw puzzles and mazes</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>I grip objects in my hand during learning periods</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Score 1</td>
<td>Score 2</td>
<td>Score 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer listening to the news on the radio than reading about it in a newspaper</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I obtain information on an interesting subject by reading relevant materials</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel very comfortable touching others, hugging, handshaking, etc</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I follow oral directions better than written ones</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing this assessment.
Appendix 10: Example Activities (Phase 1)

Physically Active Numeracy ideas (warm up ideas)

1) Number Up

Students move around in the grid performing various locomotor activities (e.g. run, skip, hop, side gallop)
- The teacher will call a number and students will move quickly into groups of the specified number

Maths Integration: The teacher will call mathematics equations / operations (depending on age) and the students will form groups according to the answer.

Example Questions
How many sides has a triangle?
What is the remainder when we divide 20 by 3?
How many vertices on a triangular prism?

2) Ladder Activities

- Students perform various agility runs through the ladder (e.g. one step, double step, side-step, in & out) and then sprint forward to the end marker.
- Ball passing can be added to extend the skill, as can additional maths equations

Maths Integration: tasks added (e.g. Multiplication tables)
Allow students to choose their own maths tables

3) Greedy Birds

* Split the class into 4 even groups (6-8 groups for large classes)
* Each group lines up on a corner of a square grid approx. 20m x 20m (or 1/3 netball court)
* 20-30 beanbags are placed in the middle of the grid inside a hoola hoop
* On ‘go’ one player from each team runs to the middle to collect a bean bag
* Once the bean bag is placed on the ground at the team corner then the next runner goes
* Rules: one runner from each time only, no guard the bean bags, collect only one bean bag at a time, once all bean bags have been taken from the middle then teams may steal from other team’s collections, play for 3 minutes, team with the most bean bags wins.
* Maths Integration: give each colour a point value (e.g. red = 1 point blue = 2 points). The team with the greatest points wins. Play with numbered bean bags for older children.

4) Skipping activities
Students can ask each other the algorithms e.g. How many more to 10, if I have got 5. Students in Stage 2 and 3 can complete problem solving questions, for example: 76% of students like weekends, what percentage do not like weekends.

Fractions- what is 3/7 of 21 etc. Partner A skips the number of Skips from the answer. Partner B skips the other fraction. Eg, 3/5 of 20. Then discuss their answers.

<table>
<thead>
<tr>
<th>Partner A</th>
<th>Partner B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number to skip</td>
<td>How many to skip?</td>
</tr>
<tr>
<td>2/5 of 20</td>
<td></td>
</tr>
<tr>
<td>3/4 of 12</td>
<td></td>
</tr>
<tr>
<td>3/8 of 24</td>
<td></td>
</tr>
<tr>
<td>6/10 of 30</td>
<td></td>
</tr>
<tr>
<td>2/9 of 18</td>
<td></td>
</tr>
</tbody>
</table>

5) **Area**
- students are to estimate and measure the area of selected areas using standard and non-standard measures.

<table>
<thead>
<tr>
<th>Location:</th>
<th>Units used:</th>
<th>Estimated Measurements:</th>
<th>Actual measurements:</th>
<th>Overall Area difference:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Length:</td>
<td>Breath:</td>
<td>Overall Area:</td>
</tr>
<tr>
<td>Area :</td>
<td>My unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 footed jumps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side gallop</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape Measure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6) **Find the number**
Place numbers 1-20 around the grid. Best to have several copies of each number. The teacher calls out an instruction such as “Run to a number that is greater than 6”, “Skip to a multiple of 3,” “Crab walk to an odd number”. Remember to ask children regularly why they went to a particular number.
1. How many in 30 seconds?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimation</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest passes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5m shuttles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bounce passes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Use your answers to predict and work out how many you can complete in 60 seconds?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimation</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest passes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5m shuttles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bounce passes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. How far can you travel in 30 seconds?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimated distance</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprint run</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skipping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side galloping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hopping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Use a stopwatch to time how long it takes you to complete the following activities.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimated time</th>
<th>Actual time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprint 20 metres(m)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest pass 20 times</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power walk 20 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skip 20 times</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REMEMBER: You will need to take turns with your group and convert your measurements.
Eg: 25m = 2500 cm  
25m=0.025km

1. How far can you throw?

<table>
<thead>
<tr>
<th>Object</th>
<th>Estimation(M)</th>
<th>Actual distance(M)</th>
<th>Actual distance(cm)</th>
<th>Actual distance(km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennis ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bean bag</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam javelin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your choice(Non dominant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Totals

2. How far can you kick?

<table>
<thead>
<tr>
<th>Object</th>
<th>Estimation(M)</th>
<th>Actual distance(M)</th>
<th>Actual distance(cm)</th>
<th>Actual distance(km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer Ball- Foam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFL Ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Football foam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your choice(Non dominant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Totals
3. How far can you strike?

<table>
<thead>
<tr>
<th>Object</th>
<th>Estimation (M)</th>
<th>Actual distance(M)</th>
<th>Actual distance(cm)</th>
<th>Actual distance(km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cricket ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tennis ball</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your choice(Non dominant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total

What is the difference between the totals for:

A) Kicking and Striking

B) Throwing and striking

C) Kicking and throwing

Today I have learnt that:

Steps taken:
**Week 2 Lesson 3  Using a Compass  Name____________**

Today we will use a compass to navigate our way round our oval/playground. How you travel is up to you. Power walking is a good option!!

<table>
<thead>
<tr>
<th>Clue Number</th>
<th>Bearings</th>
<th>Total of bearings</th>
<th>code</th>
<th>Total value of letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>#66</td>
<td>E 125,26,292,222,106,</td>
<td>671</td>
<td>EALOIZ</td>
<td>58</td>
</tr>
</tbody>
</table>

| Totals      | ###                        | ######              |
Can you create your own task cards?

<table>
<thead>
<tr>
<th>Clue Number</th>
<th>Bearings</th>
<th>Total of bearings</th>
<th>code</th>
<th>Distance travelled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ask other students to solve these problems.

Today I have learnt that:

Steps taken:

A=1  B=2  C=3
J=10  P=16  Z=26
Week 3 Lesson 2   Food Values   Name__________________________

Stride Length =
Weight=

<table>
<thead>
<tr>
<th>Activity</th>
<th>Estimated ranking (1-5)</th>
<th>Energy expended</th>
<th>X4 Kj</th>
<th>Kj 30 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hopping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skipping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jumping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jogging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Label the y axis Kilojoules and the x axis Activity. Draw a bar graph showing the kilojoules used whilst performing 30 minutes of each activity.
### Week 3 Lesson 3

#### Heart Rate

<table>
<thead>
<tr>
<th>Name</th>
<th>RHR</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearty</td>
<td>72</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>130</td>
<td>160</td>
<td>150</td>
<td>145</td>
<td>135</td>
<td>120</td>
<td>90</td>
</tr>
</tbody>
</table>

Plot the results of today’s physical activity on the graph. An imaginary one has been done for you. Remember to use a different colour for each person. Use the legend/key to illustrate each person. Use a ruler to mark the x axis.

![Graph showing heart rate changes over time for Hearty](image)
**Week 4 Lesson 1  Co-ordinates  Name_______________**

**When using co ordinates/ grid references (GR). Remember to go along the corridor and then up the stairs.**

<table>
<thead>
<tr>
<th>Question</th>
<th>GR</th>
<th>Answer</th>
<th>What can I see if I look in this direction?</th>
</tr>
</thead>
<tbody>
<tr>
<td>When was this school opened?</td>
<td>GR:5K</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>How many birds are on the mural?</td>
<td>GR:14L</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>What is missing?</td>
<td>GR13G</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>What colour are the signs?</td>
<td>GR:13L</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>What starts here?</td>
<td>GR:12K</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>What day and time are the P and F meetings?</td>
<td>GR:9F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>What is missing?</td>
<td>GR:6N</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>What’s new?</td>
<td>GR:7E</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>What two animals can you see?</td>
<td>GR:14K</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>How much money did the Australian government provide?</td>
<td>GR:6J</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>What company secures the premises?</td>
<td>GR8F</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>
Revision

How do you set a compass to find out which way is South?

Answer:

Scale

<table>
<thead>
<tr>
<th>Location</th>
<th>Length according to scale 1mm=1m 1cm=10m</th>
<th>Actual length with trundle wheel</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of COLA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of COLA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of school grounds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width of the Oval</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of Netball area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of school Hall</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Orienteering
Use your map of the school to find the clues. Record the letter and answer the question.

<table>
<thead>
<tr>
<th>Clue Number</th>
<th>Grid Reference</th>
<th>Letter</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use the stapler to show you have visited the correct checkpoint. Make sure your clue matches the correct box.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>
Appendix 11: EASY Minds Principal / Teacher / Parent & Child
Information Package (Phase 2)

6th March 2013

Dear Principal,

Please find enclosed an invitation to take part in a research project entitled, “EASY Minds: A curriculum-based Physical Activity in the primary school”. The overall aim of the study is to design and evaluate a school-based program to increase physical activity, reduce sedentary behaviours and improve on task behaviour in mathematics. This project is based on a successful pilot study conducted by our research team. The proposed project is highly significant and the integration of physical activity across the curriculum was indeed highlighted in the Auditor Generals Report June 2012.

Our research team has engaged a range of stakeholders in the design of this project, including the School Sport Unit, current primary teachers and students. In our meeting with the School Sport Unit we discussed the feasibility of the project, the potential for program dissemination in NSW schools. We aim to register the professional learning component of the intervention with the NSW Institute of Teachers, to ensure that teachers are recognised for their participation in the study.

In summary, the proposed project has the potential to improve physical activity levels, reduce sedentary time, enhance on task behavior and increase enjoyment of mathematics both for those in the intervention group and those in the control group, who will receive the program at the end of the study period. If you would like to take part in the program please accept this invitation via email. The study is limited at this stage to the first 10 schools.

Baseline measures will be conducted in the week beginning 8th April. Randomization of schools will take place following baseline assessment. A professional development workshop will follow and the program will run for the rest of Term 2.

Yours Sincerely,

Nick Riley
Lecturer
PhD candidate
University of Newcastle, Australia
Email: Nicholas.Riley@newcastle.edu.au
Ph: 02 48954254
Principal information Sheet

E.A.S.Y. (Encouraging Activity to stimulate Young) Minds.

Dear Principal,

Your school is invited to participate in the research project identified above which is being conducted by Nick Riley from the University of Newcastle. The research will be part of Nick’s research higher degree at the University and will be supervised by Professor Philip Morgan and Associate Professor David Lubans from the School of Education.

Why is the research being done?

The purpose of the research is to determine the translation of a school-based program called E.A.S.Y. (Encouraging Activity to Stimulate Young) Minds. E.A.S.Y. Minds is a program that integrates physical activity into the delivery of the school curriculum. Based on a successful Feasibility Trial involvement in the study may increase student’s physical activity levels, reduce sedentary time and increase academic on task behaviour. E.A.S.Y. Minds also has a home-based component designed to reinforce educational concepts taught in school and promote further physical activity at home. This study is a randomised control trial (RCT) conducted in ten schools. Five schools will be randomly assigned to the treatment condition and five schools will be randomly assigned to the control condition.

The treatment schools will also have the ‘E.A.S.Y. Minds’ intervention delivered at the school. The control schools will participate in the pre- and post-intervention assessments and questionnaire. The control school will use their existing program during the intervention period.
Who can participate in the research?

If you and a participating teacher agree, students in a nominated class from Stage 3 will participate in the University of Newcastle E.A.S.Y. Minds program in Term 2 2013 which will be based at your school. The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for eight weeks starting week 1 of term 2, 2013.

All students in the class will participate in the program, however, only the students who provide signed consent letters will contribute to the study data.

What choice do you have?

Participation in this research is entirely your choice and only schools where both the principals and teachers have agreed to participate will be included in this study. If you do agree to your school’s participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with the University of Newcastle. Similarly, students in your school will be included in the study only after a consent form has been signed by the students and their parents/guardians. If they initially agree to participate, they can choose to withdraw from the study at any time without giving a reason.

What would you be asked to do?

E.A.S.Y Minds will involve the modification of lessons from a Stage 3 unit of work that will be developed from the NSW Board of Studies k-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for their child’s education.

Teachers

The Classroom Teacher will be primarily responsible for the delivery of the program during normal lessons. E.A.S.Y. Minds will involve the modification of a stage 3 unit of work that will be developed from the NSW Board of Studies k-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning.

Qualified staff from the University of Newcastle will be involved in the delivery of all questionnaires and the observations of pupils. Nick Riley will work in close collaboration with the classroom teacher to integrate physical activity into already planned learning experiences whilst keeping both subject matter and learning outcomes consistent.

The program will combine a curriculum-based program with the integration of physical activity at school and at home.

Program overview:

- Teachers unit of work-8 weeks
- Lesson activities
- Student work books
- Student certificates and reward systems
• Weekly home fun tasks

Parents

A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for children's education.

Students

Students will be asked to complete a Learning styles inventory, a multiple intelligences checklist, a mathematics achievement test and wear an accelerometer throughout the school day (Mon- Fri Weeks 1-8).

Baseline and post test data will be collected from all participants. All participants will complete a range of assessments.

Measures

Height and Weight: height will be measured using a portable stadiometer and weight will be measured using calibrated weight scales.

On task behaviour: will be observed using a momentary time sampling procedure adapted from Behaviour Observation of students in Schools and Applied Behaviour Analysis for Teachers. Students will be chosen at random and will be observed in 15 second intervals over a 30 minute period pre, during and post intervention.

Physical activity (PA): Accelerometers will be used to provide an objective measure of both PA intensity and duration. Accelerometers are light instruments, small and robust that measure physical activity. Accelerometers will be worn throughout the school day.

Academic performance: Academic performance in Mathematics will be measured using an ACER Progressive Achievement test in Mathematics delivered by the classroom teacher. Mathematical attitude will be measured using a mathematical attitude scale.

Evaluation: All teachers and Students will be asked to complete an evaluation survey at the completion of the program.

Any personal information provided by parents/guardians and students will be confidential to the researchers. The results of the study will be published in general terms and will not allow the identification of individuals or schools. Data will be stored in a locked filing cabinet to ensure its security and the confidentiality of any identified data. Only the student researcher and the chief investigator will have access to the raw data. Only data in the form of de-identified SPSS files will be stored. This data will be kept for at least five (5) years beyond the completion of the project.

How will the information collected be used?

The data collected from this study will be used for Nick Riley’s Research Higher Degree studies. It may also be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs.
**What do you need to do to participate?**

If you are willing for your school to participate in this study, could you please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided.

Upon receipt of your consent, Nick Riley will contact you to organise a time to visit the school and provide yourself, teachers, students with information about the study. If you would like to organise a different route for the dissemination of the Information Sheet and Consent Form to students, please let Nick Riley know. All students will be required to return a Consent Form, which the student and parents/guardians have signed before the study starts.

**Further information**

Following the completion of the study, the school will be sent a dissemination report describing the findings of the study. It is suggested that the findings are disseminated to students and their parents/guardians via a school newsletter or similar method. If you would like further information please do not hesitate to contact Nick Riley.

Thank you for considering this invitation.

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Prof Philip Morgan  A/Prof David Lubans  Nick Riley

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<tr>
<th>Prof Philip Morgan</th>
<th>Dr David Lubans</th>
<th>Nick Riley</th>
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<td><a href="mailto:Nicholas.Riley@newcastle.edu.au">Nicholas.Riley@newcastle.edu.au</a></td>
</tr>
</tbody>
</table>

This project has been approved by the University’s Human Ethics Committee, Approval No. H-2010-1183. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 49216333, email Human-Ethics@newcastle.edu.au
Dear Teacher,

Physical fitness and physical activity are associated with improved test scores in children. Unfortunately opportunities for children’s physical activity have decreased. Innovative ways to get children active are needed. You are invited to participate in the research project identified above which is being conducted by Nick Riley from the University of Newcastle. The research will be part of Nick’s research higher degree at the University and will be supervised by Professor Philip Morgan and Associate Professor David Lubans from the School of Education.

Why is the research being done?

The purpose of the research is to determine the translation of a school-based program called E.A.S.Y. (Encouraging Activity to Stimulate Young) Minds. E.A.S.Y. Minds is a school-based program that integrates physical activity into the delivery of the school curriculum. Based on a successful Feasibility Trial involvement in the study may increase student’s physical activity levels, reduce sedentary time and increase academic on task behaviour. E.A.S.Y. Minds has a home-based component designed to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This study is a randomised control trial (RCT) conducted in ten schools. Five schools will be randomly assigned to the treatment condition and five schools will be randomly assigned to the control condition. The treatment schools will also have the ‘E.A.S.Y. Minds’ intervention delivered at the school. The control schools will participate in the pre- and post-intervention assessments.
and questionnaire. The control school will use their existing program during the intervention period.

**Who can participate in the research?**

If you agree, students in a nominated class from Stage 3 will participate in the University of Newcastle E.A.S.Y. Minds program, which will be based at your school. The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for eight weeks starting week 1 of term 2, 2013. All students in the class will participate in the program, however, only the students who provide signed consent letters will contribute to the study data.

**What choice do you have?**

Participation in this research is entirely your choice and only schools where both the principals and teachers have agreed to participate will be included in this study. If you do agree to your participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with the University of Newcastle. Similarly, students in your school will be included in the study only after a consent form has been signed by the students and their parents/guardians. If they initially agree to participate, they can choose to withdraw from the study at any time without giving a reason.

**What would you be asked to do?**

*E.A.S.Y. Minds* will involve the modification of a Stage 3 unit of work that will be developed from the NSW Board of Studies k-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for their child’s education.

**Teachers**

You will be primarily responsible for the delivery of the program during normal lessons. *E.A.S.Y. Minds* will involve the modification of a stage 3 unit of work that will be developed from the NSW Board of Studies k-6 syllabi to maximise and create opportunities to integrate physical activity and enhance learning. Qualified staff from the University of Newcastle will be involved in the delivery of all assessments and the observations of pupils. Nick Riley will work in close collaboration with the classroom teacher to integrate physical activity into already planned learning experiences whilst keeping both subject matter and learning outcomes consistent. The program will combine a curriculum-based program with the integration of physical activity at school and at home.

**Program design**
• Teachers unit of work-8 weeks
• Lesson activities
• Student work books
• Student certificates and reward systems
• Weekly home fun tasks

All students in the class will participate in the program, however, only the students who provide signed consent letters will complete the assessments.

Parents

A key component of the program will be home-based activities to engage parents and reinforce educational concepts taught in school and promote further physical activity at home. This will also promote social support for children’s education.

Students

Students will be asked to wear an accelerometer throughout the school day (Mon- Fri Weeks 1-8). Baseline and post test data will be collected from all participants. All participants will complete a range of assessments.

Measures

Height and Weight: height will be measured using a portable stadiometer and weight will be measured using calibrated weight scales.

On task behaviour: will be observed using a momentary time sampling procedure adapted from Behaviour Observation of students in Schools and Applied Behaviour Analysis for Teachers. Students will be chosen at random and will be observed in 15 second intervals over a 30 minute period pre, during and post intervention.

Physical activity (PA): Accelerometers will be used to provide an objective measure of both PA intensity and duration. Accelerometers are light instruments, small and robust that measure physical activity. Accelerometers will be worn throughout the school week.

Academic performance: Academic performance in Mathematics will be measured using an ACER Progressive Achievement test in Mathematics delivered by you as the classroom teacher. Mathematical attitude will be measured using a mathematical attitude scale.

Evaluation: All teachers and Students will be asked to complete an evaluation survey at the completion of the program.

How will your privacy be protected?

Any personal information provided by parents/guardians and students will be confidential to the researchers. The results of the study will be published in general terms and will not allow the identification of individuals or schools. Data will be stored in a locked filing cabinet to ensure its security and the confidentiality of any identified data. Only the
student researcher and the chief investigator will have access to the raw data. Only data in the form of de-identified SPSS files will be stored. This data will be kept for at least five (5) years beyond the completion of the project.

**How will the information collected be used?**

The data collected from this study will be used for Nick Riley’s Research Higher Degree studies. It may also be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs.
What do you need to do to participate?

If you are willing for your school to participate in this study, could you please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided.

Upon receipt of your consent, Nick Riley will contact you to organise a time to visit the school and provide yourself, and students with information about the study. If you would like to organise a different route for the dissemination of the Information Sheet and Consent Form to students, please let Nick Riley know. All students will be required to return a Consent Form, which the student and parents/guardians have signed before the study starts.

Further information

Following the completion of the study, the school will be sent a dissemination report describing the findings of the study. It is suggested that the findings are disseminated to students and their parents/guardians via a school newsletter or similar method. If you would like further information please do not hesitate to contact Nick Riley.

Thank you for considering this invitation.

Prof Philip Morgan    A/Prof David Lubans    Nick Riley

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E.A.S.Y. (Encouraging Activity to stimulate Young) Minds.

Dear Parent,

Please read this letter with your child.

Your child is invited to participate in the research project identified above which is being conducted by Nick Riley from the University of Newcastle. The research will be part of Nick’s studies at the University and will be supervised by Associate Professor Philip Morgan and Associate Professor David Lubans from the School of Education.

Why is the research being done?

The purpose of the research is to determine the translation of a school-based program called E.A.S.Y. (Encouraging Activity to Stimulate Young) Minds. E.A.S.Y. Minds is a school-based program that integrates physical activity into the delivery of the school curriculum. Based on a successful Feasibility Trial involvement in the study may increase student’s physical activity levels, reduce sedentary time and increase academic on task behaviour. E.A.S.Y. Minds also has a home-based component designed to reinforce educational concepts taught in school and promote further physical activity at home.

Who can participate in the research?

If you agree your child will participate with other students in their class in the E.A.S.Y. Minds program that will be based at your school. The program will combine a curriculum-based program with the integration of physical activity at school and at home. The program will run for 8 weeks starting week 1 of term 2 2013. Students will have one lesson per day adapted to increase physical activity. This study is a randomised control trial (RCT) conducted in ten schools. Five schools will be randomly assigned to the treatment condition and five schools will be randomly assigned to the control condition. The treatment schools will also have the ‘E.A.S.Y. Minds’ intervention delivered at the
school. The control schools will participate in the pre- and post-intervention assessments and questionnaire. The control school will use their existing program during the intervention period.

All students in the class will participate in the program, however, only the students of parents who provided signed consent letters will contribute to data collection.

What would you and your child be asked to do?

All student participants will complete a range of assessments.

**Height and Weight:** height will be measured using a portable stadiometer and weight will be measured using calibrated weight scales.

**On task behaviour:** Students will be chosen at random and will be observed in 15 second intervals over a 30 minute period pre, during and post intervention.

**Physical activity (PA):** Accelerometers will be used to provide an objective measure of both PA intensity and duration. Accelerometers are light instruments, small and robust that measure physical activity. Accelerometers will be worn throughout the school day.

**Academic performance:** Academic performance in Mathematics will be measured using an ACER Progressive Achievement test in Mathematics delivered by the classroom teacher. Mathematical attitude will be measured using a mathematical attitude scale.

**Evaluation:** All teachers and Students will be asked to complete an evaluation survey at the completion of the program.

Who will be responsible for delivering and administering the program?

The classroom teacher will be primarily responsible for the delivery of the program during normal lessons. Qualified staff from the University of Newcastle will be involved in the delivery of all assessments and the observations of pupils. Nick Riley will work in close collaboration with the classroom teacher to integrate physical activity into already planned learning experiences whilst keeping both subject matter and learning outcomes consistent.

What choice do you have?

Participation in this research is entirely your choice and only schools where both the principals and teachers have agreed to participate will be included in this study. If you do agree to your child’s participation, you may withdraw from the study at any time without giving a reason. A decision not to participate or discontinuation of involvement in the study will not jeopardise your relationship with the University of Newcastle. Similarly, students in your school will be included in the study only after a consent form has been signed by the students and their parents/guardians. If they initially agree to participate, they can choose to withdraw from the study at any time without giving a reason.

What are the risks and benefits of participating?

The observations will be conducted by trained research assistants and the activity sessions will be developed by the research team and delivered by the classroom teacher.
How will your privacy be protected?

Any personal information provided by parents/guardians and students will be confidential to the researchers. The results of the study will be published in general terms and will not allow the identification of individuals or schools. Data will be stored in a locked filing cabinet to ensure its security and the confidentiality of any identified data. Only the student researcher and the chief investigator will have access to the raw data. Only data in the form of de-identified SPSS files will be stored. This data will be kept for at least five (5) years beyond the completion of the project.

How will the information collected be used?

The data collected from this study will be used for Nick Riley’s Research Higher Degree studies. It may also be used for journal publications and conference presentations and to inform future practice for the design of valuable, evidence-based school physical activity programs.

What do you need to do to participate?

If you are willing for your child to participate in this study, could you please complete the accompanying Consent Form and return it to the researchers in the reply paid envelope provided.

Further information

Following the completion of the study, the school will be sent a dissemination report describing the findings of the study. It is suggested that the findings are disseminated to students and their parents/guardians via a school newsletter or similar method. If you would like further information please do not hesitate to contact Nick Riley. Thank you for considering this invitation.
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This project has been approved by the University’s Human Ethics Committee, Approval No. H-2010-1183. Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the researcher, or, if an independent person is preferred, to the Human Research Ethics Officer, Research Office, The Chancellery, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 49216333, email Human-Ethics@newcastle.edu.au
Principal Consent Form for the Research Project:

E.A.S.Y. Minds- A pilot randomized controlled trial

Researcher: Professor Philip Morgan

I have been given information about the project identified above. I have been given information about the project identified above. I understand that if I consent to participate in this project, I will participate in one of two programs, a control group or an intervention group program. I understand that if I consent to my school’s involvement in this project, selected students will participate in the program. Students will also be observed in selected lessons. Students will also complete a learning style inventory, a multiple intelligences checklist, a mathematics progress test and wear an accelerometer at school.

I have had an opportunity to ask the research team questions about the research. I understand that my school’s participation in this research is voluntary and that my school and my students are free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Newcastle.

By signing below I am indicating my consent for my school to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ______________________________

Teacher’s name: _____________________________

Signature: _________________________________ Date: ________________

Please return the completed consent in the prepaid envelope enclosed.

Your cooperation is greatly appreciated
Teacher Consent Form for the Research Project:

E.A.S.Y. Minds- A pilot randomized controlled trial

Researcher: Professor Philip Morgan

I have been given information about the project identified above. I understand that if I consent to my involvement in this project, selected students will participate in the program. I will participate in one of two programs, a control group or intervention group program. Classes will be randomly allocated to a program. Students will also be observed in selected lessons. Students will also complete a learning style inventory, multiple intelligences checklist a mathematics progress test and wear an accelerometer at school.

I have had an opportunity to ask questions about the research to I understand that my participation in this research is voluntary and that my school and my students are free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Newcastle.

By signing below I am indicating my consent for my school to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ________________________________________________

Teacher’s name: ________________________________________________

Signature: ____________________________ Date: ________________

Please return the completed consent in the prepaid envelope enclosed.
Your cooperation is greatly appreciated
Parent Consent Form for the Research Project:

E.A.S.Y. Minds- A pilot randomized controlled trial

Researcher: Professor Philip Morgan

I have discussed the research project with my child and have the opportunity to ask the research team questions about the research. I understand that if I consent to participate in this project, I will participate in one of two programs, a control group or intervention group program. I understand that my child’s participation in this research is voluntary and my child is free to withdraw from the research project at any time. My refusal to consent to my child participating or withdrawal of consent will not affect my relationship with the University of Newcastle or the school. My withdrawal will not result in any disciplinary action against me, nor will it affect my child’s academic grades, given that this is a purely voluntary research task.

Students will also be observed in selected lessons. Students will also complete a learning style inventory and multiple intelligences checklist, a mathematics progress test, and wear an accelerometer at school.

By signing below I am indicating my consent for my child to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: __________________

Parent’s name: ______________ Parent’s signature: _________________

Student’s name: ______________ Student’s signature: _________________

Please return the completed consent form to your child’s teacher. Your cooperation is greatly appreciated
Principal Consent Form for the Research Project:

E.A.S.Y. Minds- Teacher Interview and Focus groups

Researcher: Professor Philip Morgan

I have been given information about the project identified above. I understand that if I consent to my school’s involvement in this aspect of the project, selected students will participate in the sessions.

I have had an opportunity to ask the research team questions about the research. I understand that my school’s participation in this research is voluntary and that my school and my students are free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Newcastle.

By signing below I am indicating my consent for my school to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ______________________________

Teacher’s name: _____________________________

Signature: _________________________________ Date: ________________

Please return the completed consent in the prepaid envelope enclosed. Your cooperation is greatly appreciated.
Teacher Consent Form for the Research Project:

E.A.S.Y. Minds- Teacher Interview and Focus groups

Researcher: Professor Philip Morgan

I have been given information about the project identified above. I understand that if I consent to my involvement in this project, selected students will participate in this aspect of the program.

I have had an opportunity to ask questions about the research. I understand that my participation in this research is voluntary and that my school and my students are free to withdraw from the research project at any time. My refusal to participate or withdrawal of consent will not affect my relationship with the University of Newcastle.

By signing below I am indicating my consent for my school to participate in this stage of the research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ________________________________________________

Teacher’s name: ________________________________________________

Signature: ___________________________ Date: _________________

Please return the completed consent in the prepaid envelope enclosed. Your cooperation is greatly appreciated.
I have discussed the research project with my child and have the opportunity to ask the research team questions about the research. I understand that my child’s participation in this research is voluntary and my child is free to withdraw from the research project at any time. My refusal to consent to my child participating or withdrawal of consent will not affect my relationship with the University of Newcastle or the school. My withdrawal will not result in any disciplinary action against me, nor will it affect my child’s academic grades, given that this is a purely voluntary research task.

Students will be selected at random to take part in a group 15 minute focus group where they will be asked questions in relation to the study they have participated in. Not all children in the class will be selected.

By signing below I am indicating my consent for my child to participate in this research project as it has been described to me in the Information Statement, a copy of which I have retained.

Name of school: ____________________

Parent’s name: _______________ Parent’s signature: _______________

Student’s name: _____________ Student’s signature: _____________

Please return the completed consent form to your child’s teacher. Your cooperation is greatly appreciated.
### Appendix 12: Example Activities (Phase 2)

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<th>Activity: Find the answer</th>
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<td>Mathematics Strand:</td>
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<tr>
<td>Number and Algebra: Whole Numbers 1</td>
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<tr>
<td>Outcomes:</td>
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<tr>
<td>• MA1-WM: Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions</td>
</tr>
<tr>
<td>• MA1-NA: Orders, reads and represents integers of any size and describe properties of whole numbers.</td>
</tr>
<tr>
<td>Indicator:</td>
</tr>
<tr>
<td>Directly applicable to MA1-NA:</td>
</tr>
<tr>
<td>• Determine the factors of a given whole number</td>
</tr>
<tr>
<td>• Find multiples of a given number</td>
</tr>
<tr>
<td>• Identify the lowest common multiple</td>
</tr>
<tr>
<td>Resources:</td>
</tr>
<tr>
<td>1 set of flexidomes with the numbers marked 1-20 on the flexidomes</td>
</tr>
<tr>
<td>Instructions:</td>
</tr>
<tr>
<td>1) Arrange the flexidomes throughout the area with the numbers in random order</td>
</tr>
<tr>
<td>2) Students run/skip/hop/side gallop etc. to the flexidome applicable when the scenario is given.</td>
</tr>
<tr>
<td>3) When giving students the next scenario, they move to the answer from the flexidome that they are currently at.</td>
</tr>
<tr>
<td>Questioning:</td>
</tr>
<tr>
<td>Ask students to answer questions one at a time:</td>
</tr>
<tr>
<td>• What is one factor of 40? Repeat this question but change the number e.g. 75, 16, 84 etc</td>
</tr>
<tr>
<td>• Show me a factor of 24, and then hop to the pair of the factor i.e students at number 2 then hop to 12. Inable this to be repeated, create different numbers that students have to find the factor to e.g. 15 and also change the action e.g. from hop to skip etc.</td>
</tr>
<tr>
<td>• Find the multiples of the number 3. Repeat this question but change the number e.g. 2, 4, 5 etc.</td>
</tr>
<tr>
<td>• Find a prime number</td>
</tr>
<tr>
<td>• Find an odd number that is not a prime number.</td>
</tr>
<tr>
<td>Mathematics Standard</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
</tbody>
</table>
| Outcomes             | • MA3-3WM → Gives a valid reason for supporting one possible solution over another  
|                      | • MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions  
|                      | • MA3-4NA → Orders, reads and represents numbers of any size and describes properties of whole numbers. |
| Indicators           | Directly applicable to all outcomes listed above:  
|                      | • Determine whether a number is prime, composite, square and triangular numbers. |
| Resources            | • A straight line that is long enough so the whole class can stand on the line and have space to jump on either side of the line |

**Instructions:**

1) Students stand with feet together on the line all facing vertically and front on to the teacher.
2) Teacher calls out different scenarios and students have to answer the scenario by jumping onto one side of the line. One side of the line is true, the other side of the line is False. Enable students to process the question and think about their answer before completing the next step. To enable thinking time for students, each student must complete a repetitive exercise for example: elbow to knee, jogging on the spot. When this is happening the teacher counts down slowly, students must select their answer by jumping to the side of the line. Change the action regularly that students have to complete whilst the teacher is counting down.
3) Ask selected students to justify their answer.
4) Once on one side of the line for example on the False side, if the next answer to the question is still false, students remain where they are but still complete the repetitive exercise as stated in step 2.
5) Repeat steps 2-4 for every question.

**Questioning:**

* True or False, the number 64 is a square number? Repeat this question but change the number to allow for different answers to occur e.g. 9, 16, 81, 100 etc.
* True or False, the number 28 is a triangular number? Repeat this question but change the number to allow for different answers to occur e.g. 3, 15, 97 etc.
* True or False, 51 is a prime number? Repeat this question but change the number to allow for different answers to occur e.g. 9, 85, 17 etc.
* Also include base facts e.g. 17 × 3 = 51, etc.
### Activity: Skip the properties of 3D shapes

<table>
<thead>
<tr>
<th>Mathematics Strand:</th>
<th>Measurement and Geometry: Three Dimensional Space I</th>
</tr>
</thead>
</table>
| **Outcome:**        | • MA3-1 WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions  
                     • MA3-3 WM → Gives a valid reason for supporting one possible solution over another  
                     • MA3-1MG → Identifies three-dimensional objects on the basis of their properties, and visualises, sketches and constructs them given drawings of different views  
                     • **Indicator:**  
                       • Directly applicable to MA3-1MG  
                       • Identify and describe the properties of three-dimensional objects, for example number of faces, apex of a pyramid, number of edges etc. |
| **Resources:**      | • **Worksheets**  
                     • An Individual PVC Skipping Rope for each student  
                     • 3D shapes models, for example a model of a cube, a sphere, a cone etc. (optional) |
| **Instructions:**   | 1. The teacher is to read out from sheet, a property of a 3D shape. For example “How many vertices does a cube have?”. Students are to answer by skipping the required amount, in order to answer the question. For the above example, students would skip 8 times on the spot. This is repeated for each shape, when reading the question or the shape property, read it in random, for example students complete the number of skips for the faces of the shape, then the vertices, then the edges etc.  
                     2. When back in the classroom, students are to complete the worksheet. Here they are recording the properties of the shapes as well as drawing the shape.  
                     3. The teacher also may need to carry the models of the 3D shapes, this is for the students who are struggling to visualise the shape, and then count the edges or vertices etc. |
<table>
<thead>
<tr>
<th>Shape:</th>
<th>Faces:</th>
<th>Edges:</th>
<th>Vertices:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube:</td>
<td>6</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Cone:</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hexagonal Pyramid:</td>
<td>7</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Triangular Prism:</td>
<td>5</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Octagonal Prism:</td>
<td>10</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>Rectangular pyramid:</td>
<td>5</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Shape</td>
<td>Faces</td>
<td>Edges</td>
<td>Vertices</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Cylinder:</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Triangular pyramid:</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Sphere:</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pentagonal Pyramid:</td>
<td>6</td>
<td>10</td>
<td>6</td>
</tr>
</tbody>
</table>

Shape: Cube  
Faces:  
Edges:  
Vertices:
<table>
<thead>
<tr>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone</td>
</tr>
<tr>
<td>Hexagonal Pyramid</td>
</tr>
<tr>
<td>Triangular Prism</td>
</tr>
<tr>
<td>Octagonal Prism</td>
</tr>
<tr>
<td>Rectangular pyramid</td>
</tr>
<tr>
<td>Cylinder</td>
</tr>
<tr>
<td>Triangular pyramid:</td>
</tr>
<tr>
<td>--------------------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sphere:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pentagonal Pyramid:</th>
</tr>
</thead>
</table>
**Activity: Netball Court Maths**

<table>
<thead>
<tr>
<th>Mathematics Strand</th>
<th>Measurement and Geometry: Two Dimensional Space 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome:</strong></td>
<td>• MA3-1WM describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions</td>
</tr>
<tr>
<td></td>
<td>• MA3-2 WM selects and applies appropriate problem-solving strategies, including the use of digital technologies in understanding investigations.</td>
</tr>
<tr>
<td></td>
<td>• MA3-15 G manipulates, classifies and draws two-dimensional shapes, including equilateral, isosceles and scalene triangles, and describes their properties.</td>
</tr>
<tr>
<td><strong>Indicator:</strong></td>
<td>• Identify and name parts of a circle, including the centre, radius, diameter, circumference, sector, semi-circle and quadrant.</td>
</tr>
</tbody>
</table>

**Resources:** Netball court or other marked pitch.  
**Instructions:** Tape measure, transil wheel.  
1) Working in small groups students are to classify all shapes they can identify on a netball court.  
2) Students are to then draw and measure all key parts.  
3) Students need to include length, width, radius, diameter, circumference, semi-circle and diagonals.  
4) Using appropriate scale students are to draw an accurate scaled diagram.
**Activity: Find a partner**

<table>
<thead>
<tr>
<th>Mathematics Strand:</th>
<th>Number and Algebra: Fractions and Decimals 2</th>
</tr>
</thead>
</table>
| **Outcome:**        | • MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions  
                      • MA3-2 WM → Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations  
                      • MA3-3 WM → Gives a valid reason for supporting one possible solution over another  
                      • MA3-7 NA → Compares, orders and calculates with decimals, simple fractions and simple percentages |
| **Indicator:**       | • Represent simple fractions as decimals and as percentages. |
| **Resources:**       | Class set of laminated cards included |
| **Instructions:**    | 1) Students are randomly assigned a fraction, percentage or decimal card.  
                      2) Students are to randomly move around designated area and on instruction find an equivalent card e.g.) 50%, 0.5 etc  
                      3) Students can record answers or justify explanation to teacher.  
                      4) Students could try to find partners to make one whole one.  
                      5) Students can form groups and arrange themselves in order from lowest to highest  
                      Students can be involved in choosing cards and questions prior to lesson. |
Activity: Empty number line

Mathematics Strand: Number and Algebra: Addition and Subtraction 1

Outcome:
- MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions
- MA3-2WM → Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations
- MA3-3WM → Gives a valid reason for supporting one possible solution over another
- MA3-5NA → Selects and applies appropriate strategies for addition and subtraction with counting numbers of any size

Indicator: Directly applicable to MA3-5NA
- Use estimation to check the reasonableness of answers to addition and subtraction calculations.

Resources: Outdoor area

Instructions:
Students are encouraged to use a number line and the jump strategy.
1) Present the students with a number problem. E.g. 8000 - 673.
2) Students should try to complete the number line in the most efficient way.
3) Assign each jump a physical activity. Students can create their own movement:
1000 - Squat, 100 - jump, 10's - hunch, 1's - bum kicks.
4) In this case the answer would be 7327. Students would perform 7 squats, 3 jumps, 2 hunches and 7 bum kicks.

5) Students can be presented with a series of operations and be encouraged to use an empty number line.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Number line</th>
<th>Physical Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000 - 2345</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
<table>
<thead>
<tr>
<th>Mathematics Strand: Number and Algebra: Patterns and Algebra 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome:</strong></td>
</tr>
<tr>
<td>• MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions</td>
</tr>
<tr>
<td>• MA3-2WM → Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations</td>
</tr>
<tr>
<td>• MA3-3WM → Gives a valid reason for supporting one possible solution over another</td>
</tr>
<tr>
<td>• MA3-8NA → Analyses and creates geometric and number patterns and constructs and completes number sentences involving the four operations</td>
</tr>
<tr>
<td><strong>Indicator:</strong></td>
</tr>
<tr>
<td>Directly applicable to MA3-8 NA:</td>
</tr>
<tr>
<td>• Identify and describe a simple number pattern involving one operation</td>
</tr>
<tr>
<td><strong>Resources:</strong></td>
</tr>
<tr>
<td>• 4 Skill step ladders. If ladders are not available use flexi domes to create a 'ladder' or use chalk and draw the 'ladder' on the ground</td>
</tr>
<tr>
<td><strong>Instructions:</strong></td>
</tr>
<tr>
<td>1) Students choose a multiplication table and footwork pattern and run through ladder calling out multiplication facts. Students may have footwork patterns they use in Sport outside school. Encourage them to use and be creative.</td>
</tr>
<tr>
<td>2) Students alternate multiplication tables</td>
</tr>
<tr>
<td>3) Students run through ladder and then cheat pass ball back and forwards to partner taking turns to work through table. Students then rotate position.</td>
</tr>
<tr>
<td>4) Students get to end of ladder and may have repeated 8x table. Partner then shouts a number e.g. 9 partner answers 86 and swaps places.</td>
</tr>
</tbody>
</table>
### Activity: How many jumps?

<table>
<thead>
<tr>
<th>Mathematics Strand:</th>
<th>Number and Algebra: Fractions and Decimals 2</th>
</tr>
</thead>
</table>
| **Outcome:**        | • MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions  
                      • MA3-2 WM → Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations  
                      • MA3-3 WM → Gives a valid reason for supporting one possible solution over another  
                      • MA3-7 NA → Compares, orders and calculates with decimals, simple fractions and simple percentages |
| **Indicator:**       | Directly applicable to MA3-7 NA:  
                      • Compare and order simple fractions with related denominators using strategies such as... equivalent fractions |
| **Resources:**       | • Class set of PVC Jump Rope Plastic Handles  
                      • worksheet |
| **Instructions:**    | 1. In the defined area, students are to be in pairs with each individual having a jump rope. Ensure that there is enough space between each pair for safety reasons  
                      2. Students in their pair are to work together to calculate the amount of skips they have to complete, here they fill out the worksheet then complete the amount of skips required. Repeat this step for every question  
                      3. The teacher is to be circulating to provide students with guidance if needed  
                      4. When in the classroom, mark the worksheet and enable students to compare results  
                      5. Allow students to create their own questions for other groups. |
<table>
<thead>
<tr>
<th>How many to skip?</th>
<th>Total number to skip?</th>
<th>How many to skip?</th>
<th>Total number to skip?</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/7 of 21</td>
<td></td>
<td>3/7 of 21</td>
<td></td>
</tr>
<tr>
<td>1/2 of 10</td>
<td></td>
<td>1/2 of 10</td>
<td></td>
</tr>
<tr>
<td>3/10 of 20</td>
<td></td>
<td>7/10 of 20</td>
<td></td>
</tr>
<tr>
<td>4/6 of 36</td>
<td></td>
<td>2/6 of 36</td>
<td></td>
</tr>
<tr>
<td>1/9 of 9</td>
<td></td>
<td>8/9 of 9</td>
<td></td>
</tr>
<tr>
<td>6/9 of 18</td>
<td></td>
<td>3/9 of 18</td>
<td></td>
</tr>
<tr>
<td>4/12 of 24</td>
<td></td>
<td>8/12 of 24</td>
<td></td>
</tr>
<tr>
<td>1/2 of 26</td>
<td></td>
<td>1/2 of 26</td>
<td></td>
</tr>
<tr>
<td>10/15 of 21</td>
<td></td>
<td>5/15 of 21</td>
<td></td>
</tr>
<tr>
<td>1/5 of 10</td>
<td></td>
<td>4/5 of 10</td>
<td></td>
</tr>
<tr>
<td><strong>Total Amount:</strong></td>
<td><strong>Total Amount:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity: How close are you?

Mathematics Strand: Number and Algebra: Addition and Subtraction 1

Outcome:
- MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions
- MA3-2 WM → Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations
- MA3-3 WM → Gives a valid reason for supporting one possible solution over another
- MA3-5 NA → Selects and applies appropriate strategies for addition and subtraction with counting numbers of any size

Indicator: Directly applicable to MA3-5 NA
- Use estimation to check the reasonableness of answers to addition and subtraction calculations

Resources:
- Different locations around the school, for example school office, playground, classroom etc.
- Class set of Pedometers (Optional)

Instructions:
1. Before completing the walking to the destinations around the school, students must estimate the amount of steps it takes to arrive at the destination. As a class discuss what destinations will be used. Also write the destinations on the worksheet, for example: the classroom to the school office, then the school office to the adventure playground, then the adventure playground to the library etc.
2. Walk to the destinations, students count each step they complete and record it on the worksheet. When going from one destination to the next, start counting the steps from zero.
3. Whilst at each destination, work out the difference between the estimated amount to the actual amount of steps for each destination. Then complete addition for the total estimated amount of steps as well as the total amount of actual steps. Then subtract the two amounts.
4. With the total amount of steps completed, subtract from: 10,000.
5. Enable students to compare results to other students in the class.
6. Perform mathematical equations based on results.
7. Children can complete bar chart graphs comparing actual and estimate.

<table>
<thead>
<tr>
<th>Locations</th>
<th>Estimated amount of steps</th>
<th>Actual steps taken</th>
<th>Difference between estimated and actual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Mathematics

**Strand:** Number and Algebra; Multiplication and Division 1

**Outcome:**
- **MA3-1WM:** Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions
- **MA3-2 WM:** Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations
- **MA3-3 WM:** Gives a valid reason for supporting one possible solution over another
- **MA3-6 NA:** Selects and applies appropriate strategies for multiplication and division and applies the order of operations to calculations involving more than one operation

**Indicator:** Directly applicable to MA3-6 NA:
- Recognise and use different notations to indicate division

**Resources:**
- One floor target per group of students. If you do not have a target, draw a target on the ground using chalk
- Each group is to have a set of beanbags
- Large Dice
- Paper and pen or workbook (this enables students to record their results)

**Instructions:**
1) Each child will throw up to 5 bean bags on to a target. They add up the total. They then divide the total by the number thrown. This will give the mean score.
2) Each child throws two bean bags on to the target. They then roll the 20 sided dice and multiply the number rolled by the total score.
3) Children should be encouraged to estimate their answer and record before actually working out.
Activity: Metronome


ren to create own movements.
### Activity: Who is right?

<table>
<thead>
<tr>
<th>Mathematics Strand:</th>
<th>Measurement and Geometry: Area 2</th>
</tr>
</thead>
</table>
| **Outcome:**        | • MA3-1WM  Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions  
                      • MA4-2 WM  Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations  
                      • MA3-10 MG  Selects and uses the appropriate unit to calculate areas, including the areas of squares, rectangles and triangles |
| **Indicator:**      | Directly applicable to MA3-10 MG:  
                      • Read and interpret one-to-many scales on maps and simple scale drawings to calculate an area, e.g. calculate the area of a shopping centre on a map where 1 cm represents 100m |
| **Resources:**      | • Map or aerial image of the school with a scale  
                      • A trundle wheel per group of students  
                      • A fibreglass tape measure per group of students  
                      • Each student needs to have a cm ruler |
| **Instructions:**   | 1. Students are to be in small groups, no more than 4 per group.  
                      2. Students are to use a ruler and measure different locations around the school that are evident on the map. Then they are to work out the size of the location using the scale evident. When measuring the different locations around the school on the map, the students need to measure the length of the location to the nearest millimetre as well as measure the breadth of the location to the nearest millimetre. Here they will then work out the area of the location. For example, the school playground may measure 10cm on the map, by 5 cm. Here the area is 50cm squared. However, if the scale is 1 cm = 10m, students have to work out the area according to the map, for example, using the above measurements 10cm on the map, equals to 100m in actual length, whilst 5cm equals 50m in actual breadth. Here, the actual area should be 500m squared.  
                      3. Students in their group are to physically measure out the different locations they choose around the school using a trundle wheel and a tape measure. They then record their results on the worksheet. They are also to work out the area of the location as well.  
                      4. When back in the classroom, students are to work out the difference between the scaled measurements (from the map) with the actual recorded distance.  
                      5. Encourage students to estimate distance home. Check using technology. |
<table>
<thead>
<tr>
<th>Location</th>
<th>School Map Measurements (using the ruler)</th>
<th>Scaled measurements from the school map results</th>
<th>Actual measurements (using a transit, wheel, and tape measure)</th>
<th>Difference between the scaled measurements and the actual measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length:</td>
<td>Breath:</td>
<td>Overall Area:</td>
<td>Length:</td>
</tr>
<tr>
<td>Area 1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area 2:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area 3:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area 4:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area 5:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity. Which unit is the best unit?

<table>
<thead>
<tr>
<th>Mathematics Strand</th>
<th>Measurement and Geometry: Area 1</th>
</tr>
</thead>
</table>
| Outcome:           | • MA1-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions  
                    • MA1-10 MG → Selects and uses the appropriate unit to calculate areas, including the areas of squares, rectangles and triangles |
| Indicator:         | Directly applicable to MA1-10 MG:  
                    • Apply measurement skills to solve problems involving area in everyday units |
| Resources:         | • Different locations around the school where the area can be calculated, for example classroom, hall, cola, playground etc  
                    • A fibreglass tape measure per destination  
                    • A meter ruler or trundle wheel can also be used at each destination if needed |

Instructions:  
1. Students are to be in small groups.  
2. Before completing the calculations of area of the destinations around the school, students must estimate the length of the destination using different units. They must also calculate the breadth or the width of the destination as well as the final area of each destination. As a class discuss what destinations will be used. For example: the classroom, the hall, the cola etc.  
3. Record the actual measurements of the area using the following units stated on the worksheet to measure the length, the breadth as well as the area of the destination. Then record the results on the worksheet. When mapping out or completing the area of the destination, even though students are in groups, they are individually to complete the calculation of the results as there may be a discrepancy between results. For example when working out the area of the playground, Student A when skipping may have calculated 49 square skips, whereas Student B may have calculated the same area, using skipping results in 56 square skips.  
4. Whilst at each destination work out the difference between the estimated overall area to the actual amount of overall area.  
5. When back in the classroom, discuss with students the need of appropriate metric units when calculating the area of different destinations. Also discuss the discrepancy between non-standard units and the problems that arise as a result.
<table>
<thead>
<tr>
<th>Location</th>
<th>Units used:</th>
<th>Estimated Measurements:</th>
<th>Actual measurements:</th>
<th>Overall Area difference:</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Side gallop</td>
<td>Hop</td>
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<td>Tape measure</td>
<td>2 feet jumps</td>
<td>Side gallop</td>
<td>Hop</td>
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</table>
Activity: Race against the stopwatch

Mathematics Strand: Number and Algebra: Addition and Subtraction 2

Outcome:
- MA3-1WM → Describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions
- MA3-2 WM → Selects and applies appropriate problem solving strategies, including technological applications, in undertaking investigations
- MA3-3 WM → Gives a valid reason for supporting one possible solution over another
- MA3-5 NA → Selects and applies appropriate strategies for addition and subtraction with counting numbers of any size

Indicator: Directly applicable to MA3-5 NA:
- Use estimation to check solutions to addition and subtraction problems
- Use efficient methods to record solutions to addition and subtraction problems
- A flat surface that is 20 metres long
- Tape measure to measure the length required
- Class set of stopwatches
- 10 Flexidomes
- Worksheet

Resources:

Instructions:
1. Students complete the estimated column of the worksheet. Here they estimate how long they think it will take them to complete the required activity for the required length. For example how long they think it will take to run 20 metres.
2. Students are to be in pairs. The other person in the pair is to record the person’s results whilst the person is completing the activity. Then switch roles. As each person is completing the activity, they need to record their time result they received on the worksheet. Use the flexidomes to indicate where they have to complete the activity to.
3. Enable students to choose which activities they complete in order
4. When completion of all the activities occurs, students are to work out the difference between the estimated amounts of time to the actual amount of time for each activity. Then complete addition for the total estimated amount of time as well as the total amount of actual time. Then subtract the two amounts.
5. Enable students to compare results to other students in the class and work out the speed and time of completing the activity for 100 metres/km etc
6. Construct appropriate graphs

<table>
<thead>
<tr>
<th>Activities to complete</th>
<th>Estimated amount of time</th>
<th>Actual time taken</th>
<th>Difference between estimated and actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running</td>
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</table>
Appendix 13: EASY Minds Assessment Tools

**Name:** ___________________
**School:** ___________________

### MATHEMATICS ATTITUDE SCALE

**Directions:** This scale will help you find out about how you find yourself and mathematics. Please indicate whether you agree or disagree with each statement. This is a survey NOT a test, so there is no right or wrong answer. The only correct responses are only those that are true to you. Do not spend much time with any statement, *but be sure to answer every statement.* Please tick one answer for each statement.

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>neutral</th>
<th>disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I am sure that I can learn mathematics.</td>
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<tr>
<td>2.</td>
<td>Knowing mathematics will help me earn a living.</td>
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<td>3.</td>
<td>I don’t think I could do advanced mathematics.</td>
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<td>4.</td>
<td>Mathematics will not be important to me in my life’s work.</td>
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<td>5.</td>
<td>Mathematics is hard for me.</td>
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<td>6.</td>
<td>I’ll need mathematics for my future work.</td>
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<td>7.</td>
<td>I am sure of myself when I do mathematics.</td>
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<td>8.</td>
<td>I don’t expect to use much mathematics when I get out of school.</td>
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<td>9.</td>
<td>Mathematics is a worthwhile, necessary subject.</td>
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<tr>
<td>10.</td>
<td>I’m not the type to do well in mathematics.</td>
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<td>11.</td>
<td>Taking mathematics is a waste of time.</td>
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<td>12.</td>
<td>Mathematics has been my worst subject.</td>
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<td>13.</td>
<td>I think I could handle more difficult mathematics.</td>
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<td>14.</td>
<td>I will use mathematics in many ways as an adult.</td>
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<td>15.</td>
<td>I see mathematics as something I won’t use very often when I get out of high school.</td>
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<td>16.</td>
<td>Most subjects I can handle OK, but I just can’t do a good job with mathematics.</td>
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<td>17.</td>
<td>I can get good grades in mathematics.</td>
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<td>18</td>
<td>I’ll need a good understanding of mathematics for my future work.</td>
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<td>19.</td>
<td>I know I can do well in mathematics.</td>
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<td>20.</td>
<td>Doing well in mathematics is not important for my future.</td>
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<td>21.</td>
<td>I am sure I could do advanced work in mathematics.</td>
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<td>22.</td>
<td>Mathematics is not important for my life.</td>
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<td>23.</td>
<td>I’m no good in mathematics.</td>
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<td>24.</td>
<td>I study mathematics because I know how useful it is.</td>
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E.A.S.Y. Minds Momentary Time Sampling Observation Form

Observer: 

Date: 
Time Start: 
Time End: 
Class: 

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</table>

**Observer Code**

AE Actively engaged  
PE Passively engaged  
OM Off task motor  
OV Off Task Verbal  
OP Off task passive
Teacher Evaluation of the EASY Minds Program

Thank you for taking part in the Easy Minds program. We would like to know what you thought of the program and would be grateful if you could complete the following questionnaire. Your response will help us improve the program for the future.

Please say how much you agree with the following statements and questions by CIRCLING the most appropriate response below. Please be honest in your reply. All responses will be treated in confidence. You do not have to put your name.

<table>
<thead>
<tr>
<th>1) My school was excited when we first heard about Easy Minds</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
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<tbody>
<tr>
<td>a) The timing of the programme (Term 1) was convenient</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td></td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>b)</td>
<td>If there is a time you would have preferred please state:</td>
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<tr>
<td>c)</td>
<td>The program length (6 weeks) was appropriate</td>
<td>SD</td>
<td>D</td>
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<td>d)</td>
<td>The number of sessions (3/week) was appropriate.</td>
<td>SD</td>
<td>D</td>
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### 3) Instructors

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<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>a)</td>
<td>The instructor had a high level of knowledge</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
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<tr>
<td>b)</td>
<td>The instructor communicated well</td>
<td>SD</td>
<td>D</td>
<td>N</td>
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<tr>
<td>c)</td>
<td>The instructor was approachable</td>
<td>SD</td>
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<td>d)</td>
<td>The future success of this programme will depend on the quality of the instructors</td>
<td>SD</td>
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<td>4) The Program</td>
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<tr>
<td>a) The content of the program was relevant for my class</td>
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<td>D</td>
<td>N</td>
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<td>SA</td>
</tr>
<tr>
<td>b) The content of the program was engaging for my class</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>c) The program has changed my attitude to PA integration and will make a difference to my teaching.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>d) The children enjoyed the program.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>e) Did the children enjoy the delivery by an outside instructor?</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>f) Would you feel comfortable teaching the program?</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8) Other</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I was satisfied with the Easy Minds program</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>c) I enjoyed participating in the Easy Minds program</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>
12) What were the benefits of the project to your children? (Describe)


13) How can the Easy minds program be improved? (Please explain)


14) Do you have any additional comments about the Easy Minds that you think might be useful for the researchers?


THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE.

YOUR FEEDBACK IS GREATLY APPRECIATED.
**Student Evaluation of the E.A.S.Y. Minds Program**

Thank you for taking part in the E.A.S.Y. Minds program. We would like to know what you thought of the program and would be grateful if you could complete the following questionnaire. Your response will help us improve the program for the future.

Please say how much you agree with the following statements and questions by CIRCLING the most appropriate response below. Please be honest in your reply. All responses will be treated in confidence. You do not have to put your name on the sheet.

<table>
<thead>
<tr>
<th>Statement</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) I was excited when I first heard about E.A.S.Y. Minds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Timing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) The program length (6 weeks) was good.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) The number of sessions (3/week) was right.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5) The instructors had a high level of knowledge
   a) The Teacher made the activities fun.
   b) The Teacher was enthusiastic.
   c) The Teacher appeared to enjoy the lessons.
   d) The Teacher made the activities easy to understand.

4) The Program
   a) The program was enjoyable.
   b) I looked forward to the lessons.
   c) I liked being physically active in Maths outside the classroom.
   d) I liked being physically active in Maths in the classroom.
   e) Being active helped me learn in Maths.

5) Program Impact
a) After participating in E.A.S.Y. Minds I have more positive feelings about physical activity.  
   SD  D  N  A  SA  

c) After participating in E.A.S.Y. Minds I find it easier to concentrate in class.  
   SD  D  N  A  SA  

d) After participating in E.A.S.Y. Minds I am more active.  
   SD  D  N  A  SA  

e) I enjoyed participating in the E.A.S.Y. Minds program.  
   SD  D  N  A  SA  

f) Being active in Maths made Maths more enjoyable.  
   SD  D  N  A  SA  

g) The program has encouraged me to be more physically active.  
   SD  D  N  A  SA  

h) My involvement in the program has increased my knowledge of the importance of regular physical activity.  
   SD  D  N  A  SA  

6) Which parts of the Easy minds program were most enjoyable? (Describe) List the activities that were your favourite?  

7) Were there any parts of Easy Minds that you did not enjoy? (Please explain)
8) Do you have any additional comments about the Easy Minds that you think might be useful for the researchers?


THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE.

YOUR FEEDBACK IS GREATLY APPRECIATED.
Appendix 15: EASY Minds Evaluation Tools (Phase 2)

TEACHER PROFESSIONAL LEARNING WORKSHOP

EVALUATION SURVEY

Thank you for taking part in the EASY Minds study and Teacher Professional Learning Workshop.

We would like to know what you thought of the day and would be grateful if you could complete the following survey. Please be honest in your reply. All responses will be treated in confidence.

<table>
<thead>
<tr>
<th>1. Overall:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The EASY Minds workshop was enjoyable</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>b. The EASY Minds workshop improved my knowledge about PA integration</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>c. The Easy Minds workshop provided me with useful information and skills that may improve my</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Session 1 – Introduction, current climate and academic performance:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Provided a strong rationale for the Easy Minds program</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>b. The theoretical background helped outline the importance of the program</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Session 2 – Practical session promoting mathematical concepts</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Improved my confidence to teach PA maths lessons</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>b. Provided me with new ideas for teaching PA maths lessons</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Session 3 – Planning and delivering EASY Minds</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. a. Planning an activity with colleagues was valuable</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>b. Brainstorming topics has given me ideas for the program</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
</tbody>
</table>

Please turn over and complete second page
5) Do you have any suggestions for improvements to the EASY minds Professional Learning Workshop or to help you teach PA integrated lessons?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

6) Do you have any other comments?
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Thank you for completing this survey 😊
E.A.S.Y. Minds: Self Evaluation Checklist

<table>
<thead>
<tr>
<th>Date:</th>
<th>Start Time:</th>
<th>Finish Time:</th>
</tr>
</thead>
</table>

**Mathematical content Taught:**

**Movement-based activities completed:**

**Overview of lesson**

### Mathematical concepts

| i) Key mathematical concepts were reinforced throughout the movement-based activity | 1 | 2 | 3 | 4 | 5 |
| ii) Movement aided and promoted learning | 1 | 2 | 3 | 4 | 5 |
| iii) Students were given feedback to support their mathematical knowledge and understanding | 1 | 2 | 3 | 4 | 5 |

### Activity Levels

| i) Transitions were managed smoothly | 1 | 2 | 3 | 4 | 5 |
| ii) Students assisted in the set-up and collection of equipment | 1 | 2 | 3 | 4 | 5 |
| iii) Equipment used promoted physical activity | 1 | 2 | 3 | 4 | 5 |

### Engagement

| i) Students were engaged by the activities taught | 1 | 2 | 3 | 4 | 5 |
| ii) Students remained on-task throughout the lesson | 1 | 2 | 3 | 4 | 5 |
| iii) Students enjoyed the movement-based mathematics lesson | 1 | 2 | 3 | 4 | 5 |

**Comments:**

(Please circle and provide comments) (1 = Not at all true to 5 = Very true)
References

27. Attard C. “If I had to pick an subject, it wouldn’t be maths”: foundations for engagement with mathematics in the middle years. MERJ. 2013;25:569-587.


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