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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**Disclosure of editing services**

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.


(Paper 4 is currently under review in *Eurasia Journal of Mathematics, Science and Technology Education.*


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.

Conclusions

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).