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Moving Maths — the effects of physically active math lessons

Submission date
08/04/2019

Recruitment status
No longer recruiting

Registration date
10/04/2019

Overall study status
Completed

Last Edited
14/10/2022

Condition category
Other

[X] Prospectively registered
[_] Protocol
[_] Statistical analysis plan
[X] Results
[_] Individual participant data

Plain English summary of protocol

Background and study aims
Physical activity, especially physical activity integrated into the school day, has been suggested to be potentially beneficial for attention, executive functions and school performance. However, the effects of prolonged physical activity interventions on children's learning are largely unknown. In order to support young students' learning and healthy active lifestyles in today's complex and dynamic learning environment, the aim of this study is to examine the effects of physical activity integrated into mathematics lessons on learning outcomes, engagement, motivation and motor skills.

Who can participate?
Third-grade teachers and their students (mean age 9 years)

What does the study involve?
The classes are randomly allocated to one of three groups with different teaching methods for math lessons:
Group 1: Physically active math lessons in which physical activity is integrated into learning goals
Group 2: Physically active math lessons with breaks and including physical activity not related to learning goals
Group 3: Control group (traditional math lessons)
The lessons are taught instead of regular math classes for a period of six months, while the control group receive typical sedentary classroom lessons. The children's math performance, cognitive functions, motivation in mathematics and motor skills are measured before and after the six-month teaching period. Their physical activity level before and in the middle of the teaching period, learning difficulties and motor learning difficulties, body composition and family background are assessed. In addition, the teachers' experiences, own competence and enjoyment about the physically active math lessons and their conceptions about the physically active math lessons are assessed.

What are the possible benefits and risks of participating?
The study will increase the scientific understanding of the effects of physical activity, especially the effects of physical activity integrated into academic lessons, on children's learning, enjoyment, engagement, learning motivation and motor skills. This information is needed to

develop teaching that support learning via physically active methods. In addition, the study will crucially expand our understanding of the mechanisms responsible for the positive effects of physical activity on learning. Furthermore, the study will provide practical methods and materials for teachers to change the learning environments and school cultures to become more physically active. Participation in the study does not include any risks; study practices are part of a regular school day.

When is the study starting, and how long is it expected to run?
March 2017 to May 2020

Who is funding the study?
Finnish Ministry of Education and Culture

Where is the study going to be run from?
LIKES Research Centre for Physical Activity and Health, Jyväskylä, Finland

Who is the main contact?
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Study website
https://www.likes.fi/en/research/effects-of-physical-activity/moving-maths

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Additional identifiers

EudraCT/CTIS number
Nil known

IRAS number

ClinicalTrials.gov number
Nil known

Secondary identifying numbers
OKM/66/626/2016

Study information

Scientific Title
Moving Maths — the effects of physically active math lessons on children's learning outcomes, school engagement, motivation and motor skills

Study objectives
The overarching aim of the proposed study is to gain an understanding of the effects of physically active math lessons on children's learning outcomes, cognitive functions, affective school engagement, learning motivation and motor skills through a randomised controlled trial (RCT). The design involves a comparison of three groups exposed to different teaching methods of math lessons.
Group 1: Physically active math lessons in which physical activity is integrated into learning goals (improving the automatisation of basic arithmetic skills, such as addition, subtraction and multiplication, through active learning games and tasks)
Group 2: Physically active math lessons with breaks and including physical activity not related to learning goals (breaks that include physical activities that increase the heart rate and train motor skills)
Group 3: Control group (typical, traditional math lessons)

The long-term effects after a six-month intervention period (H1–H3) will be investigated. Furthermore, we will examine the mediating effects of affective school engagement, learning motivation and motor skills on the influence of physically active math lessons on cognition and learning outcomes (H2–H3). We make the following hypotheses.

H1: Physically active math lessons with physical activity integrated into learning goals will enhance children's cognitive functions and math performance after a six-month period compared with lessons with physical activity not related to learning goals (Group 1 vs. Group 2) and compared with typical math lessons (Group 1 vs. Group 3).

H2: Physically active math lessons with physical activity integrated into learning goals will enhance children's affective engagement and learning motivation after a six-month period compared with lessons with physical activity not related to learning goals (Group 1 vs. Group 2) and compared with typical math lessons (Group 1 vs. Group 3), and will positively affect children' s learning outcomes through these effects on engagement and learning motivation (mediation effect).

H3: A six-month intervention period of physically active math lessons will enhance children's motor skills compared with typical math lessons (Groups 1 and 2 vs. Group 3) and will positively affect children's cognitive functions through these effects on motor skills (mediation effect).

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 29/03/2019, Ethics Committee of the University of Jyväskylä (PO Box 35, FI-40014 University of Jyväskylä, Finland; Tel: +358 (0)408054233; Email: secretary-ethicomm@jyu.fi), no reference number available

Study design
Interventional cluster randomised controlled trial

Primary study design
Interventional

Secondary study design
Randomised cross over trial

Study setting(s)
School

Study type(s)
Quality of life

Participant information sheet
This material is not available in web format. Please use contact details to request a participant information sheet.

Health condition(s) or problem(s) studied
School-based physical activity

Interventions
In order to determine the effectiveness of physically active math intervention in enhancing learning through physical activity, the researchers will conduct a cluster RCT with random allocation at the school level. They will invite third-grade teachers from 9 to 10 schools in the Jyväskylä school district in Finland to participate in the study. Afterward, children in the

volunteer teachers' classes will be invited to participate in the study. The volunteer teachers will be randomly assigned to follow different teaching methods by using lottery at school level. The design involves a comparison of three groups exposed to different teaching methods of math lessons.

Group 1 (n=120): Physically active math lessons in which 20 minutes of physical activity is integrated into learning goals (improving automatisation of basic arithmetic skills, such as addition, subtraction and multiplication, and improving general curriculum-based age-level math skills through active learning games and tasks, which also train motor skills)

Group 2 (n=120): Physically active math lessons with two 5-minute breaks and including physical activity not related to learning goals (breaks that include physical activities that train motor skills)

Group 3 (n= 120): Control group (usual math lessons)

The intervention lessons will be taught instead of regular math lessons (four lessons per week) for a period of six months, while the control group will receive typical sedentary classroom lessons. The teaching of all groups will follow the national curriculum for basic education, and the groups will use the same textbook as will other classes.

A follow-up study is under consideration, and the subjects and their caregivers will also be asked for their consent to be contacted for this study.

Intervention Type
Behavioural

Primary outcome measure
Math performance:
1. General math performance assessed at baseline and after the intervention with a test battery including comparison of one-digit numbers, comparison of multi-digit numbers, reasoning of number series, single-digit addition, single-digit subtraction and multi-digit addition and subtraction
2. Curriculum-based math performance assessed at baseline and after the intervention with a math test including multiplication and division, calculation strategies, problem solving, geometry and units of measurements

Secondary outcome measures
1. Cognitive functions:
1.1. Executive functions assessed with a modified flanker task and a colour-shape switch task at baseline and after the intervention
1.2. Fluid reasoning assessed with a Wechsler Intelligence Scale for Children (WISC) matrix reasoning at baseline and after the intervention
1.3. Spatial visualisation assessed with a spatial relations test from the Woodcock–Johnson test battery (1977) at baseline and after the intervention
2. Reading fluency assessed with a LUKSU test at baseline and after the intervention
3. Physical fitness:
3.1. Motor skill performance assessed with Körperkoordinationstest für Kinder (KTK) test battery and with aiming-and-catching subtests from the Movement Assessment Battery for children (MABC-2) test battery at baseline and after the intervention
3.2. Manual dexterity with manual dexterity subtests from the MABC-2 test battery at baseline

3.3. Aerobic fitness assessed with a 20-meter shuttle run test (Eurofit test protocol) at baseline and after the intervention
3.4. Muscular fitness assessed with a curl-up test (Eurofit test protocol), a push-up test and standing broad jump (Eurofit test protocol) test
4. Children's own competence and motivation in mathematics and enjoyment of math classes, assessed using self-reported questionnaires at baseline and after the intervention
5. Physical activity assessed with the following:
5.1. Objective use of accelerometers at baseline and during the intervention
5.2. Subjective use of questionnaires at baseline and after the intervention
5.3. Children's main caregivers' completion of a questionnaire concerning the children's physical activity at baseline
6. Weight and body composition assessed via body composition analyser InBody 720 at baseline
7. Teachers' own competence and enjoyment in teaching each physically active math lesson, assessed using a diary filled in by the teachers after every math class
8. Children's motivation, concentration and peaceful learning environment assessed using a diary filled in by the teachers after every math class
9. Teachers' experiences about the physically active math lessons, assessed using an interview after the intervention
10. Family background assessed using a questionnaire filled in by the children's main caregivers at baseline
11. Children's learning difficulties and need for educational support assessed using a questionnaire filled in by the teachers at baseline
12. Children's motor learning difficulties assessed with the Finnish version of the Dutch Motor Observation Questionnaire for Teachers (MOQ-T-FI) filled in by the teachers at baseline
13. Teachers' experiences about the physically active teaching methods in different school subjects, assessed with a questionnaire at baseline and during and after intervention

Overall study start date
24/03/2017

Completion date
31/05/2020

Eligibility

Key inclusion criteria
Third-grade students (mean age of 9 years)

Participant type(s)
Healthy volunteer

Age group
Child

Sex
Both

Target number of participants
N 400 children, 9–10 clusters , 40 participants per cluster

Total final enrolment

394

Key exclusion criteria
Children who are not able to participate in physical activities due to disability or health reasons will not be included in the analyses

Date of first enrolment
15/04/2019

Date of final enrolment
23/09/2019

Locations

Countries of recruitment
Finland

Study participating centre
LIKES, JAMK University of Applied Sciences
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Sponsor type
Research organisation

Website
https://www.likes.fi/en

ROR
https://ror.org/03mahcv92

Funder(s)

Funder type
Government

Funder Name
Opetus- ja Kulttuuriministeriö

Alternative Name(s)
Ministry of Education and Culture, Finland

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
Finland

Results and Publications

Publication and dissemination plan
The protocol has not been published yet, but it will be published in 2020. The preliminary results will be reported at international and national congresses in 2020–2021. The research team will prepare and submit five to seven manuscripts to high-level international, peer-reviewed journals during 2021–2023, with a preference for leading open-access journals (e.g. Plos Medicine). Furthermore, during the study project, one doctoral thesis will be prepared (PhD estimated to be finished 2022). The project will produce materials for math lessons used in Grade 3 (adaptable for Grades 1–4) for use by teaching staff, particularly classroom teachers in primary schools. Materials will be spread by our key partners, the Niilo Mäki Institute (NMI) and network and the Finnish Schools on the Move network. Moreover, the project will communicate the results via several national and international seminars and webinars, thereby ensuring effective and rapid dissemination of the study results.

Intention to publish date
31/05/2023

Individual participant data (IPD) sharing plan
Current IPD sharing statement as of 09/06/2021:
The datasets generated during and/or analysed during the current study are not expected to be made publicly available due to ethical restrictions, as the data contains information that could compromise the research participants' privacy/content. The data of this study are available on reasonable request from the corresponding author. The authors will consider all requests to access the data within the constraints of privacy and consent.

The research material collected during the project is owned by LIKES and administered by the PI. Data will be stored on local servers protected by firewalls and monitored-access control in LIKES Research Centre.

Previous IPD sharing statement:
The datasets generated during and/or analysed during the current study are not expected to be made available due to ethical restrictions, as the data contains information that could compromise the research participants' privacy/content. The research material collected during the project is owned by LIKES and administered by the PI. Data will be stored on local servers protected by firewalls and monitored-access control in LIKES Research Centre.

IPD sharing plan summary

Not expected to be made available

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Results article		17/04/2022	14/10/2022	Yes	No