

Moving Maths — the effects of physically active math lessons

Submission date 08/04/2019	Recruitment status No longer recruiting	<input checked="" type="checkbox"/> Prospectively registered <input type="checkbox"/> Protocol
Registration date 10/04/2019	Overall study status Completed	<input type="checkbox"/> Statistical analysis plan <input checked="" type="checkbox"/> Results
Last Edited 14/10/2022	Condition category Other	<input type="checkbox"/> 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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Additional identifiers

Clinical Trials Information System (CTIS)

Nil known

Protocol serial number

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 automatisisation 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

Study type(s)

Quality of life

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 automatised 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(s)

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

Key secondary outcome(s)

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

Completion date

31/05/2020

Eligibility

Key inclusion criteria

Third-grade students (mean age of 9 years)

Participant type(s)

Healthy volunteer

Healthy volunteers allowed

No

Age group

Child

Sex

All

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 information

Organisation

LIKES Research Centre for Physical Activity and Health

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

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
Study website	Study website	11/11/2025	11/11/2025	No	Yes