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“Intervention development is where creativity, science and art meet and the balance is delicate”

~ Hoddinott, 2015

Summary

Background

Physical activity (PA) can be an important element in children's lives since it can promote good physical and mental health. In the last fifteen years, an emerging body of research has focused on the notion that PA can affect learning and academic performance. Two different research areas have shown promising results: 1) Exercise and cognition, which has found that PA with moderate to high intensity affects brain plasticity and thereby its ability to perform academically and 2) embodied learning, where the body is integrated into the learning process, which have shown promising tendencies to affect learning. Much of this research has been conducted in laboratory set-ups, carried out by researchers with children as test subjects. Implementing these types of PA in schools is complex and calls for customized interventions taking into account the unique circumstances and prerequisites of school staff.

This PhD project aims to design and test the feasibility of two PA interventions for schools, based on research in exercise and cognition and embodied learning.

Methodology

The first study was a design study using theories of Educational Design Research as framework. Teachers from four schools, external experts, and the interdisciplinary research group behind Active School took part in the design-based study. It comprised development processes in a design workshop, in-school testing of design skeletons with observation, and refinements in an iterative pattern.

The second study integrated the results of the development study into its methodology. A feasibility study was conducted in seven new schools. The schools implemented one of the two interventions designed in the first study in third grade classes for eight weeks. The feasibility was explored using mixed methods to capture the degree of understanding, acceptability and appropriateness of the two interventions. Furthermore, adoption and implementation were evaluated. Data were collected through a validated survey, weekly text message surveys, and group interviews with teachers.

Educators from the intervention courses and the research group held scientific meetings that formed a basis for the refinement and expansion of the interventions and implementation strategies concerning the future RCT study. The adjustment of the interventions fed into a protocol, which is the final part of this PhD project.

Results

The outcome was two different PA interventions: “Move & Learn” and “Run, Jump & Fun”. These had a prescribed frequency, dose, and a set of accompanying strategies intended to aid implementation.

Move & Learn intervention: 4 × 30 minutes of Move & Learn activities each week, delivered by the Danish teacher (2 × 30 minutes) and the Maths teacher (2 × 30 minutes) on different days of the week.
Run, Jump & Fun intervention: 4 × 30 minutes of Run, Jump & Fun activities each week, delivered by school staff (teachers, pedagogues) with moderate to vigorous intensity.
The feasibility study found that the interventions were context-specific and appropriate for teachers. The target frequency and dose were achieved to a degree that met the objectives. The evaluation of the strategies to promote the feasibility of the interventions showed that the most important strategies to promote feasibility were the content of the courses and the inspirational material guiding each of the interventions. Furthermore, several recommendations were synthesized and incorporated into the finalization of the interventions, primarily based on the results of the qualitative exploration in the feasibility study.
The final interventions for the future RCT study had additionally a guided establishment process at each participating school. Additionally fifteen hours of training in the specific intervention were included and spread over 3-4 courses. It had intervention-specific principles to guide implementation in each intervention, teaching materials, models, and equipment. Teacher team meetings at each school throughout the whole school year were further arranged to facilitate and sustain the interventions.

Conclusion

In summary, the design process with collaboration between researchers and school staff was an innovative way to design the two interventions for Active School.
The conclusions from the feasibility study reflected that the interventions was experienced feasible to use in an RCT study, albeit in an adjusted version based on the synthesized recommendations. These results were integrated in the expansion of the interventions into the Active School RCT study protocol, which makes up the last part of this PhD project.

Dansk resumé (Danish Summary)

Baggrund

Fysisk aktivitet kan være et vigtigt element i børns liv, da det kan fremme fysisk og mental sundhed. I de seneste 15 år er der kommet en voksende mængde forskning, der fokuserer på, hvordan fysisk aktivitet kan påvirke læring og akademisk præstation. To forskningsområder har vist lovende resultater: To forskellige forsknings tilgange har vist lovende resultater: 1) Fysisk aktivitet som påvirker kognition, hvor forskningen har påvist, at fysisk aktivitet med moderat til høj intensitet kan påvirke hjernens plasticitet og dermed dens evne til at præstere fx i dansk- eller matematik-test og 2) Kropsforankret læring, hvor kroppen integreres i læreprocessen, hvilket også har vist lovende tendenser til at kunne påvirke læring positivt. Denne forskning er primært gennemført i laboratorieopsætninger, hvor forskere har brugt børn som testpersoner. At implementere disse former for fysisk aktivitet i skolen er imidlertid komplekst og kræver skræddersyede interventioner, der tager højde for skolens specifikke vilkår og personalets forudsætninger.
Dette ph.d.-projekt har til formål at designe og teste gennemførbarheden af to fysiske aktivitetsinterventioner til skoler, baseret på forskning i "Fysisk aktivitet som påvirker kognition" og "Kropsforankret læring".

Metode

Det første studie var et design-baseret studie, der brugte teorier fra uddannelses-design som ramme. Lærere fra fire skoler, eksterne eksperter og den tværfaglige forskningsgruppe bag Active School deltog i design studiet. Det omfattede udviklingsprocesser i en designworkshop, test af design-skeletter i skolen med observation af undervisningen og finjustering i et iterativt mønster.
Det andet studie integrerede resultaterne fra design-studiet i sin metode. En undersøgelse af gennemførbarhed blev udført på syv nye skoler. Skolerne implementerede en af de to interventioner i 8 uger i 3. klasse. Evalueringen af gennemførbarheden blev undersøgt med et mixed methods for at måle graden af forståelse, accept og relevans af de to interventioner hos lærerne. Ydermere blev det evalueret i hvilken grad det var muligt at udføre interventionerne præcist og hvordan de blev modtaget og af lærerne. Data blev indsamlet gennem et valideret spørgeskema, ugentlige SMS-undersøgelser og gruppeinterviews med lærere.

Undervisere fra interventionskurserne og forskningsgruppen holdt videnskabelige møder som dannede grundlag for tilpasning og udvidelse af interventionerne og implementeringsstrategierne med henblik på at lave et randomiseret kontrolleret studie med de to interventioner. Justeringerne af interventionerne blev samlet i en protokol, som udgør den sidste del af dette ph.d.-projekt.

Resultater

Resultatet var to forskellige interventioner for fysisk aktivitet – "Move & Learn" og "Run, Jump & Fun" med en fastsat frekvens, dosis og tilhørende strategier til at understøtte lærernes implementering.

Move & Learn intervention: 4 × 30 minutter Move & Learn aktiviteter hver uge, der skulle leveres af dansklæreren (2 × 30 minutter) og matematiklæreren (2 × 30 minutter) på forskellige dage af ugen.

Run, Jump & Fun intervention: 4 × 30 minutter Run, Jump & Fun aktiviteter hver uge leveret af skolepersonalet (lærere, pædagoger) med moderat til høj intensitet.

Undersøgelsen af gennemførlighed fandt, at interventionerne var kontekstspecifikke og passende for lærerne. Opfyldelse i forhold til frekvens og dosis blev opnået i en grad der stemte med det målsatte. Evalueringen af strategierne for at fremme interventionernes gennemførlighed viste, at de vigtigste strategier var kurserne og inspirations materialet, der ledte hver af interventionerne. En række anbefalinger til finjustering af interventionerne blev opstillet og indarbejdet i færdiggørelsen af interventionerne, på baggrund af resultater fra den kvalitative del af feasibility-studiet.

Begge de færdige interventioner til det planlagte randomiserede kontrollerede studie understøttes af en guidet etableringsproces på hver deltagende skole. Ydermere består de af 15 timers undervisning i den specifikke intervention fordelt på 3-4 kurser, interventionsspecifikke principper der guider implementeringen af hver intervention, undervisningsmaterialer, modeller og udstyr. Lærer team-møder på hver skole gennem året skal yderligere facilitere og opretholde interventionerne.

Konklusion

Sammenfattende var udviklings-processen med samarbejde mellem forskere og skolepersonale, en innovativ tilgang til at designe de to interventioner til Active School. Undersøgelsen af gennemførbarhed viste, at interventionerne blev oplevet som

anvendelige i et randomiseret kontrolleret studie, dog i en justeret version, der byggede på anbefalinger fra undersøgelsen af gennemførlighed.
Disse resultater blev integreret i den videre udvikling af interventionerne i Active Schools RCT-studie protokol, som udgør den sidste del af dette ph.d.-projekt.

List of papers

Paper 1: Jeppesen, L.S., Bugge, A., Smedegaard, S., Wienecke, J., & Sandfeld Melcher, J. Developing ACTIVE SCHOOL–The Design Process of Two School-Based Physical Activity. *Translational Journal of American College of Sports Medicine* (2024). DOI: 10.1249/TJX.0000000000000251 (Status: Published)

Paper 2: Jeppesen, L.S., Sandfeld, J., Smedegaard, S., Nielsen, G., Brekke Mandelid, M., Norup, M., Wienecke, J. & Bugge, A. Implementation Outcomes and Recommendations of two Physical Activity Interventions: Results from the Danish ACTIVE SCHOOL Feasibility Study. *International Journal of Environmental Research and Public Health, Special Issue: Physical Activity Interventions for Sedentary Behaviour Change* 22 (1):67 (2025). DOI: 10.3390/ijerph22010067 (Status: Published)

Paper 3: Jeppesen, L.S., Damsgaard, L., Stolpe, M.N., Sandfeld Melcher, J.N., Wienecke, J., Nielsen, G., Smedegaard, S., Henriksen, A.H., Hansen, R.A., Hillman, C.H., Tammelin, T.H., Resaland, G.K., Daly-Smith, A. & Bugge, A. Study protocol for the ACTIVE SCHOOL study investigating two different strategies of physical activity to improve academic performance in Schoolchildren. *BMC Pediatrics* 24, 174 (2024).
DOI: 10.1186/s12887-024-04647-9 (Status: Published)

Thesis outline

The thesis begins with 1. *Introduction*, presenting the general benefits of (PA), and why PA in schools has become an area of interest in Denmark, focusing on the benefits of PA across sectors.

In 2. *Background*, the latest knowledge of PA in schools is presented. Special attention is given to research on two different types of PA: "Embodied learning" and "exercise and cognition". Furthermore, this chapter presents research on the feasibility of interventions as an important phase preceding the study of the implementation.

The next chapter, *3. Aim and research questions*, describes the purpose and research questions of the PhD project, followed by 4. *Conceptual framework*, outlining the project's worldview, methodology, and theoretical framework. The following chapter, *5. Methods*, covers methods used in all phases of the project. The three papers of the studies are presented in 6. *Results* and **s**upplemented with additional findings not presented in the papers. 7. *Discussion* contains a discussion of three research questions across the studies, in relation to other studies in the field and through the lens of the frameworks adopted in the methodology of this thesis. The final chapter is 8. *Conclusion*, including implications for future practice and research.