

## University of Groningen

### Physically active learning

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# 1

loop 20:2=10 ik 6x5=30 boom 14:2=7  
10x10=100 raam 5+6=11 school 71-12=59 oom 36:6=6 sam 12+12=24 ee  
vaart 8:2=4 weeg 16-7=9 loop 20:2=10 ik 6x5=30 zit 25+5=30 boom 14  
bel 3-1=2 boek 10x10=100 raam 5+6=11 school 71-12=59 oom 36:6=6 sam 12  
6+1=7 vaart 8:2=4 weeg 16-7=9 loop 20:2=10 ik 6x5=30 zit 25+5=30 boom 14  
4+2:7=6 bel 3-1=2 boek 10x10=100 raam 5+6=11 school 71-12=59 oom 36:6=6 sam 12  
5x5=25 net 6+1=7 vaart 8:2=4 weeg 16-7=9 loop 20:2=10 ik 6x5=30 zit 25+5=30 boom 14  
6x8=48 miep 4+2:7=6 bel 3-1=2 boek 10x10=100 raam 5+6=11 school 71-12=59 oom 36:6=6 sam 12  
5+15=20 tol 5x5=25 net 6+1=7 vaart 8:2=4 weeg 16-7=9 loop 20:2=10 ik 6x5=30 zit 25+5=30 boom 14  
pim 15-6=9 kees 6x8=48 miep 4+2:7=6 bel 3-1=2 boek 10x10=100 raam 5+6=11 school 71-12=59 oom 36:6=6 sam 12  
8-5=3 bus 9x11=99 kat 5+15=20 tol 5x5=25 net 6+1=7 vaart 8:2=4 weeg 16-7=9 loop 20:2=10 ik 6x5=30 zit 25+5=30 boom 14  
16:4=4 mus 2+7+8=31 pim 15-6=9 kees 6x8=48 miep 4+2:7=6 bel 3-1=2 boek 10x10=100 raam 5+6=11 school 71-12=59 oom 36:6=6 sam 12  
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## General introduction

## BACKGROUND

The incorporation of physical activity into academic lessons is a novel approach. In the last decade, the effects of physically active academic lessons were studied in America. In the Physical Activity Across the Curriculum (PAAC) intervention, physical activity was integrated into 30-minute academic lessons for three years. The aim of the study was to promote physical activity and to reduce overweight of children. The most intriguing outcome was that children who participated in the PAAC intervention showed a significant greater change in academic achievement scores compared to controls.<sup>1</sup> This is an encouraging finding, but more studies on physically active academic lessons are necessary to examine the effects of the lessons on learning outcomes of children.<sup>2</sup> In addition, it is unclear how the results from the PAAC study might play out in children from more diverse socioeconomic backgrounds. It is widely known that children from disadvantaged families achieve worse academically than children from other families.<sup>3-4</sup> For over 40 years, the achievement gap between socially disadvantaged children (SDC) and children without this disadvantage (non-SDC) has been an important issue in the Dutch education policy. SDC (based on parental education level) in the Netherlands achieve worse than non-SDC. So far, many efforts to close the gap had little success.<sup>5</sup> New ways of teaching and learning might be necessary to improve the academic performances of SDC. Perhaps the integration of physical activity into academic lessons might contribute to closing the achievement gap. In this thesis, the implementation of a physically active academic intervention and the effects of the intervention on academic engagement and academic achievement of SDC and non-SDC are examined.

## THEORETICAL FRAMEWORK

### Academic achievement

The most important skills that all children in Dutch elementary schools should develop to actively take part in society, are defined in the so-called core objectives. The objectives are divided into Dutch language, mathematics and arithmetic, English language, exploratory social studies, art education, and physical education.<sup>6</sup> The vast majority of the objectives are concentrated around academic subjects. This is of great importance for children's future. For example, the development of literacy and numeracy is important to avoid economic and social problems in later daily life.<sup>7</sup> To attain the above-mentioned objectives, children are spending on average 66% of their time at school sitting behind their school desks.<sup>8</sup>

However, since there is growing evidence for the association between physical activity and cognitive functioning, (some of) the academic objectives might also be attained by being physically active.<sup>9</sup>

## Physical activity and academic achievement

Several review studies have suggested that limiting physical activity during a school day will not result in higher academic achievement scores.<sup>10,11</sup> In addition, in the last decades studies have indicated that physical activity is positively related to children's academic achievement and cognitive functioning. Children who are more physically active may achieve better than children who are less physically active.<sup>9,12</sup> A growing number of studies on brain functioning and brain structure found explanations of the association between physical activity and academic achievement in the brain. The evidence that physical activity can influence the brain is promising.<sup>13</sup> First, it was found that aerobic physical activity has immediate beneficial effects on brain functioning accompanied with cognitive improvements. Aerobic exercise immediately increases activity in the brain that may enhance attention.<sup>14</sup> Second, brain functioning can also be affected by prolonged physical activity interventions. For example, 7–8 year old children participating in a nine-month afterschool aerobic exercise program showed improved brain functioning, and the intervention also enhanced cognitive performance.<sup>15</sup> Last, brain structure also seems to change as a result of regular physical activity. Regular aerobic exercise could lead to morphological changes (angiogenesis, neurogenesis and synaptogenesis) in brain regions that are important for learning.<sup>14,16</sup> The association between (aerobic) physical activity and academic achievement (see Figure 1.1) provides an opportunity to develop intervention programs that improve academic achievement by physical activity.

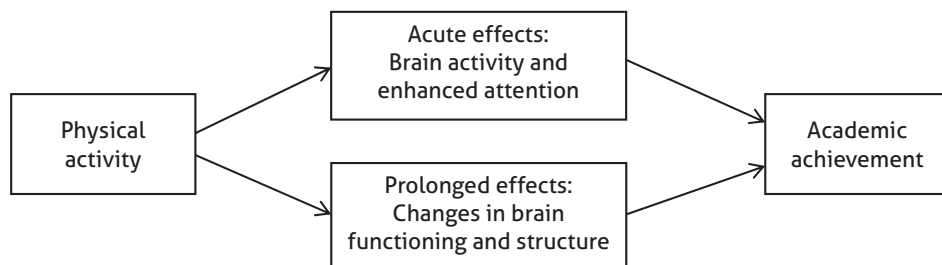


Figure 1.1 Hypothetical model of factors associated with improved academic achievement.

## Physically active academic lessons

The model in Figure 1.1 supports the idea to improve academic achievement by the integration of physical activity into academic classroom lessons. Working within the classroom provides opportunities because children spend the majority of their time at school in the classroom. A few studies already showed that physically active academic lessons improve children's attention. It was found that the lessons improved the on-task behavior during a sedentary lesson that immediately followed a physically active academic lesson.<sup>17,18</sup> As mentioned before, the PAAC study found positive effects of a three-year intervention on math, reading and spelling outcomes.<sup>1</sup> Because further research on physically active academic lessons is required to assess the potential of the lessons and to assess the effects of the lessons for children from diverse socioeconomic backgrounds,<sup>2</sup> we developed 'Fit & Vaardig op school' (Fit and Academically Proficient at School; F&V). F&V is an intervention with a new series of physically active academic lessons. In the F&V program aerobic exercise is integrated into math and language lessons. In each lesson 10–15 minutes are spent on math activities and 10–15 minutes on language activities. During the lessons two types of exercises are performed. The children perform a specific exercise when they answer a question. For example, the children jump on the spot six times to answer the multiplication "2x3". Basic exercises are performed during the remaining part of the lesson, for example marching, jogging or hopping in place. Every lesson is supported by a presentation on the interactive whiteboard whereupon the tasks become visible.

## Objectives and outline of this thesis

The main aim of this study is to examine the effect of the F&V intervention on the academic achievement of SDC and non-SDC. Chapter 2 describes the F&V program evaluation after one pilot year. More specifically, the aim of this chapter is to evaluate the implementation and the effects of the F&V intervention. It is important to investigate this to prevent the absence of positive intervention effects on the long term due to bad implementation. The study is performed at 6 elementary schools and the knowledge that is gained from the study is used to improve the F&V intervention.

The first aim of chapter 3 is to examine the effect of F&V lessons on the academic engagement of SDC and non-SDC. The second aim is to examine the relationship between lesson time spent in moderate to vigorous physical activity and academic engagement. Academic engagement is measured by observing children's time-on-task in the classroom. The time-

on-task of SDC is compared to the time-on-task of non-SDC and it is investigated whether the effect of the intervention on children's time-on-task differs between SDC and non-SDC. Heart rate monitors are used to measure the lesson time spent in moderate to vigorous physical activity.

Chapter 4 and 5 describe the effects of the F&V intervention on children's academic achievement. Second- and third-grade classes of 12 elementary schools are participating in a two-year randomized controlled trial. Chapter 4 aims at demonstrating effects of the two-year F&V intervention on the academic achievement of all children. After one and after two intervention years academic achievement scores of children that participated in the F&V intervention are compared to the scores of children in a control group. The aim of chapter 5 is to examine whether the F&V intervention has a different effect on the academic achievement of SDC in comparison with non-SDC and to examine the follow-up effects of the intervention when the lessons are no longer taught.

To conclude, chapter 6 provides a summary and general discussion. In this chapter, working mechanisms are discussed, suggestions for further research are provided, and practical implications are given.

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