
Designing Physical Activity Opportunities During
Instruction to Increase Cognitive Brain Function and
Prevent Cognitive Overload

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EDITOR'S FOREWARD

Preconditions (when to use the theory)

Content

- *All content.*

Learners

- *All learners.*

Learning Environments

- *Not one-size fits all. Intervention is adaptable and can be used in all environments including learner-centered and teacher-centered.*

Instructional Development Constraints

- *No constraints. Activities can be catered to all learners and environments.*

Values (opinions about what is important)

About Ends (learning goals)

- *All kinds of learning goals are supported.*

About Means (instructional methods)

- *Immersive concept for learners and teachers.*
- *Breaking monotony and freeing learners from routine tasks.*
- *Allows for reflection and processing of new material/information.*

About Priorities (criteria for successful instruction)

- *Effectiveness, efficiency, and appeal are all highly valued.*
- *Collaboration between learner and teacher (to choose the appropriate activity).*

About Power (to make decisions about the previous three):

- *Providing as many reasonable options for activity is key to effectiveness.*

Universal Principles

1. Explicit Explanation

- Teachers should explain the purpose and benefits of the chosen physical activity in a very clear way; this requires the teacher to have knowledge about the effects of the said activity

2. Incorporating time for activity breaks during instruction time

- Activity should be a part of the lesson

3. Freedom of Choice

- Teachers should supply activity options for students to choose from in relation to time allotted. However, students are given the option to create their own activity within the given parameters

4. Provide an example/model for activity choices –

- Can be in the form of a video tutorial, experienced learners/teacher demonstrations

Situational Principles

None. This intervention can be applied in all situations.

Implementation Issues

1. Limited measurement options –

- Measurement of the effectiveness of Physical Activity is limited but can be carried out in various ways over time

The following are factors to be aware of when implementing Physical Activity, particularly with the distinction between adult learners and children.

2. K – 16

- **Physical Limitations** – It is important to be aware of skill level when creating Physical Activity for groups of youth learners.

3. Work Force

- **Physical Limitations** – Some adult learners may not be physically fit/active, so it is important to be aware of the limitations of learners when creating activities for an entire group of adults.

Designing Physical Opportunities During Instruction to Increase Cognitive Brain Function and Prevent Cognitive Overload

I. Introduction

In this section, we will discuss the goals and purpose of incorporating Physical Activity (PA) into instruction, in addition to the various types of Physical Activity.

What is Physical Activity?

When most people think of Physical Activity (PA), they usually reference some sort of aerobic exercise or physical education that is associated with K-12 curriculum. However, PA as an instructional intervention is quite different. The goals, purpose and even the optics differ from the traditional physical education curriculum.

“Broadly defined, physical activity refers to activity that is part of one’s daily life involving bodily movements and the use of skeletal muscles.” (Bherer, 2013) While there are no set definitions for classroom-based physical activity, the following definitions are provided in order to maintain consistency and clarity throughout the remainder of this systematic review.

**Classroom-based physical activity:* physical activity carried out during regular class time, and can occur either inside or outside the classroom (e.g. hallway, playground), and is distinct from school recess/lunch break times. Classroom-based physical activity can take three forms:

1. *Active breaks:* short bouts of physical activity performed as a break from academic instruction (Watson et al. 2017)
2. *Curriculum-focused active breaks:* short bouts of physical activity that include curriculum content (Watson et al. 2017)

3. *Physically active lessons*: the integration of physical activity into lessons in key learning areas other than physical education (e.g. mathematics) (Watson et al. 2017)

*The above listed definitions can be applied to the workforce and non-classroom environments

Why PA (Purpose)

The goal of incorporating PA into instruction is to provide learners with the opportunity to relieve their cognitive efforts on a given task/content for a few moments, allowing them to shift their focus to another activity.

Theoretical Background

Intervention uses aspects from two main interventions: Personal Investment Theory, and The Physical Activity Across Curriculum (PAAC) Project Intervention. Many aspects are derived from the PAAC Below is an overview of the above mentioned theories.

Personal Investment Theory

Personal investment theory is concerned with how persons choose to invest their energy, talent, and time in particular activities. It emphasizes the role played by social and cultural contexts in determining motivational patterns in performing achievement tasks. Personal investment theory is a multifaceted theory of motivation, in which three key components engage students in the process of learning:

1. Achievement Goals (mastery, performance, social, and extrinsic)
2. Sense of Self (sense of purpose, self-reliance, negative self-concept, positive self-concept)

3. Facilitating Conditions (parent support, teacher support, peer support).
(McInerney, 2008).

The Physical Activity Across Curriculum Project

Objective

Physical Activity Across the Curriculum (PAAC) was a three-year cluster randomized controlled trial to promote physical activity and diminish increases in overweight and obesity in elementary school children.

Methods

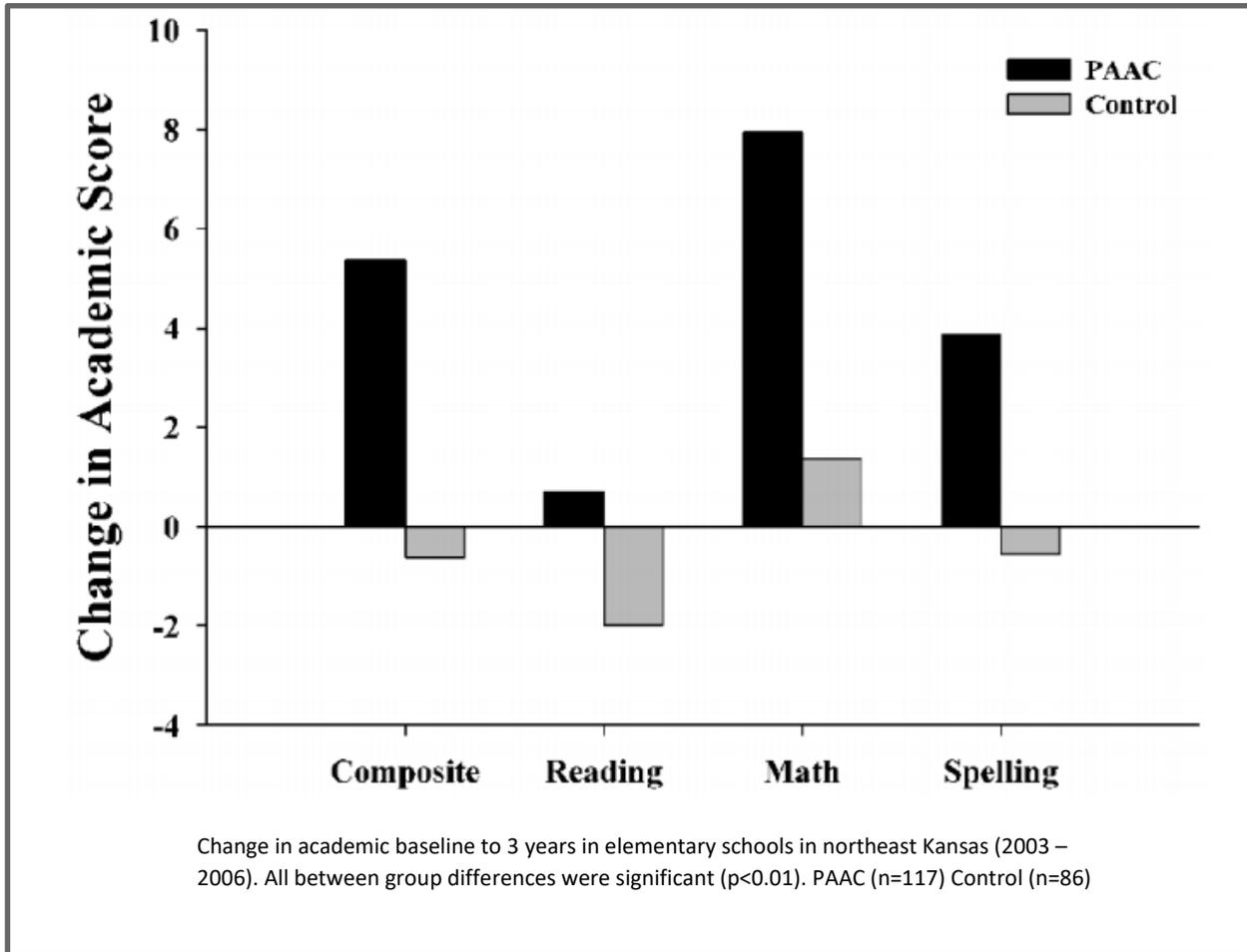
Twenty-four elementary schools were cluster randomized to the PAAC intervention or served as control. All children in grades two and three were followed to grades four and five. PAAC promoted 90 minutes/wk of moderate to vigorous intensity physically active academic lessons delivered by classroom teachers. BMI was the primary outcome, daily PA and academic achievement were secondary outcomes.

Results

The three-year change in BMI for PAAC was 2.0 ± 1.9 and control 1.9 ± 1.9 , respectively (NS). However, change in BMI from baseline to three years was significantly influenced by exposure to PAAC. Schools with ≥ 75 minutes of PAAC/wk showed significantly less increase in BMI at three years compared to schools that had < 75 minutes of PAAC (1.8 ± 1.8 vs. 2.4 ± 2.0 , $p=0.02$). PAAC schools had significantly greater changes in daily PA and academic achievement scores.

Conclusions

The PAAC approach may promote daily PA and academic achievement in elementary school children. Additionally, 75 minutes of PAAC activities may attenuate increases in BMI. (Donnelly et al, 2009).



II. Values

The idea of incorporating PA into instruction is one that requires efforts on the part of the instructor and the learner. Instructors are held accountable for incorporating time during instruction as well as understanding the benefits of PA on cognitive development. Learners are tasked with actual participation and choosing their own activities, depending on the type of PA needed by the instructor.

One of the main purposes of PA is to initiate a mental break from cognitive activity in an effort to stimulate the brain. “Madigan’s (2004) Action Based Learning Theory has found mental concentration to increase when students are given movement opportunities to reset their vigilance alertness. The movement is not only a natural human undertaking; it is a stimulant (Medina, 2008).” (Patterson, 2011)

It is important when selecting activities to keep in mind that activities need to be appealing, with a possible focus on ease of do-ability, effective in the fact that it actually gives the learner a mental break, and efficient in terms of feasibility. All three of these conditions affect learners and instructors equally. If one condition is not met, the intervention will not be beneficial.

Collaboration between the instructor and learner are paramount! This collaboration will provide the opportunity for learners to take an active role in the intervention, while at the same time, allowing instructors to get to know their learners on a deeper level. This interaction will foster a relationship that will play a key role in future instruction.

III. Universal Principles

Principle 1: Explicit Explanation

Having a working knowledge is vital to incorporating PA into instruction. Learners may question the validity and purpose, and in order to be transparent and clear with them, it is best to have the background knowledge, regardless of the instructor's chosen field of content. In her dissertation, Patterson explained the physiological and chemical connection between the brain and PA:

“Exercise impacts the molecular systems which is important for synaptic plasticity and learning and memory” (Vayman & Gomez-Pinilla, p. 699). This occurs because exercise and movement provide the brain with more oxygen-rich blood, allowing more neurotransmitters to be engaged, more endorphins to be released, and the overall groups of neural networks to develop, becoming stronger (Tremarche et al., 2007). Medina (2008) found that even small amounts of movement every week can improve memory processing tasks.”

(Patterson, 2011)

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“Physical activity is associated with many physical and mental health benefits; however, many children do not meet the national physical activity guidelines. While schools provide an ideal setting to promote children's physical activity, adding physical activity to the school day can be difficult given time constraints often imposed by competing key learning areas.

Classroom-based physical activity may provide an opportunity to increase school-based physical activity while concurrently improving academic-related outcomes.” (Watson, et al., 2017).

Workforce

“Several studies support the notion that physical activity is a significant moderator of age-related cognitive decline. The impact of physical activity on cognition in older adults is more strongly supported by results from intervention studies, which generally show that older adults who have completed a physical activity program often show enhanced cognitive performance” (Bherer, et al, 2013).

Principle 2: Incorporating time for activity breaks during instruction time

While planning, instructors and even designers should make an effort to incorporate PA into instruction time. For obvious reasons, the type of PA will depend on the amount of time allotted by the instructor. The purpose the actual inclusion into plans is to negate the chance of ‘not having enough time.’ If instructors make an effort to demonstrate the importance of PA, then students will mimic the behavior and begin to value it as well.

Principle 3: Freedom of Choice

This component makes this intervention truly learner-centered. In contrast to the PAAC, learner-choice was not an option. However, if learners are able to choose their activity, there would be more participation and enthusiasm.

Fostering learner autonomy is key to creating a learner-centered environment and is the ultimate goal in learner-centered instruction. Ceylan states that “Autonomous learners have the capacity to determine realistic and reachable goals, select appropriate methods and techniques to be used, monitor their own learning process, and evaluate the progress of their own learning (Little, 1991). According to Dam (1990), an autonomous learner is an active participant in the social processes of learning and an active interpreter of new information in terms of what she/he already and uniquely knows. Autonomous people are intrinsically motivated, perceive

themselves to be in control of their decision-making, take responsibility for the outcomes of their actions and have confidence in themselves (Deci & Ryan, 1985; Bandura, 1989; Doyal & Gough, 1991).” (Ceylan, 2015)

Depending on the environment there are several ways to have learner-choice, even it is in a limited fashion of the instructor giving the learners a group of activities to choose from. Other ideas include having the learners research their own activities, and rotating chosen activities

Principle 4: Provide an example/model for activity choices

Modeling can occur in several ways, depending on the environment. The use of all resources is encouraged including technology; however, the most valuable modeling factor may be a leader. “Modeling desired behaviors by a person significant to the targeted individual is frequently associated with greater achievement of that behavior. Modeling by teachers may be an important mediator of PA in children and strategies to remove classroom barriers and increased teacher modeling should be emphasized in future studies.” (Donnelly, et al., 2009).

IV. Situational Principles

This intervention has the flexibility to be incorporated into any environment. Instructors and designers alike can create a Physical Activity instructional plan that is catered to the unique learning situation.

V. Implementation Issues

Limited Measurement Options

Measuring the effectiveness of PA can be completed in various ways. Improvement in work performance is a key indicator of effectiveness, but can be the result of multiple factors and not solely PA. Ultimately, most results will be subjective in nature, based on learner and instructor feedback, but can be utilized to improve efforts.

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Physical Limitations

“Over the past 20 years, obesity rates in US children and youth have skyrocketed.” (Pate, et al. 2006) It is vital for an instructor to assess/identify the current levels of activity for their students. Since there is an increase in obesity, instructors need to choose activities that balance aerobic effort with mental effort. It may be necessary to choose activities that allow for only mental effort for some students.

Workforce

Physical Limitations

Trends in obesity rates for adults mirror those for adolescents and youth. Therefore, the same implementation concerns are present for adults.

VI. Closing Remarks

“The understanding of the mechanisms by which exercise affects cognitive abilities has been nourished from several fronts. In particular, exercise has demonstrated an extraordinary aptitude to influence molecular pathways involved with synaptic function underlying learning and memory. . . . and according to these studies, exercise has the extraordinary capacity to enhance mental health.” (Gomez-Pinella and Hillman, 2013).

It is important to recognize the mind-body connection when using this intervention. Physical Activity has the ability to create health mental and physical habits. Macpherson says “Cognitive benefits of PA have been observed from childhood through to old age and may have long lasting effects on brain health.” However, “the link between PA and brain health may be different at each stage of life from childhood, mid-life and late life.” (Macpherson, et al. 2017).

One must be aware of the unique challenges that can arise when utilizing this intervention in a classroom with children. “The potential benefits of PA on cognitive performance, learning, brain structure, and brain function for children are important to understand because the effects may be the foundation upon which more global improvements in academic achievements are attained.” (Donnelly, et al. 2016). If the incorporation of Physical Activity were to be adopted nation-wide, the implications could last for generations and have a global impact leading into adulthood.

Currently the intervention is not used nationwide, so designers must take into account the use of the intervention in the workplace with adults, and the impact that it will have. “In recent decades, an increasing number of studies have suggested that people should adopt physical activity and exercise as part of their lifestyle to alleviate the negative impact of aging on the body and the mind.” (Bherer, 2013). According to the American Council on Exercise, “physical

activity is a natural mood elevator — studies show it relieves mild anxiety and depression, improves energy, and increases a general sense of well-being. It's not a big stretch to suggest that the extent to which workers are physically active on and off the job affects company morale. And supporting worker exercise efforts sends a strong message of support to employees — which in turn can positively affect job satisfaction, retention, and recruitment.”

12 Ways to Promote Physical Activity at Work

Even if your corporate culture isn't quite ready for a workplace physical activity policy, you can get things moving in the right direction with these ideas:

1. Conduct a workplace walkability assessment to ensure a safe and pleasant environment for walking.
2. Offer secure bicycle storage and showers for employees who actively commute.
3. Implement flexible scheduling where feasible —making it easier for employees to carve out time for exercise while juggling work and home responsibilities.
4. Make stairwells more appealing with paint, artwork, and motivational signage.
5. Negotiate a corporate discount with local gyms; low-cost gym membership benefits are sometimes available through medical benefit vendors.
6. Encourage workers to take brief, 2-3 minute fitness breaks throughout the day for brisk walking, stretching, or stair climbing.
7. Offer free or reduced-cost pedometers to employees. Run a simple steps-per-week team competition to drum up peer support for increasing daily steps. No money? Invite your health benefit vendors or local businesses to sponsor this purchase in exchange for co-branding.

8. Sponsor or promote employee participation in community events like 5K or 10K runs, basketball leagues, or charity walk-a-thons.
9. Organize lunchtime walking, running, bicycling, or yoga groups.
10. Encourage walking 1:1 meetings.
11. Make standing or pacing vs. sitting at long meetings an acceptable option.
12. Encourage workers to be active at their workstations as much as possible — by stretching, standing while on the phone or pumping out a few desk push ups while viewing a web conference.

(American Council on Exercise, 2010).

Since the intervention of Physical Activity can be utilized for all content and learners (regardless of fitness level), and in every environment, here are a few examples of possible activities:

Meditation	Brain Teasers
Progressive Breathing	Jogging
Progressive Stretching	Walking
Dynamic Stretching	Tag
Head-Shoulders-Knees-Toes	5-Minute Outdoor Scavenger Hunt

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