READY TO LEARN: THE IMPACT OF THE MORNING BLAST PHYSICAL ACTIVITY INTERVENTION ON ELEMENTARY SCHOOL STUDENTS

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Abstract

Objective: The purpose of this study was to investigate the effects of a physical activity intervention programme, named "Morning Blast", on elementary school students' math learning and daily physical activity. The Morning Blast intervention programme was a 16-week cardiovascular endurance emphasized physical activity program that students voluntarily participated in before the school day. Participants that volunteered, did so for the duration of the program. **Methods:** This mixed-methods study included seven educators and 83 students (n=90). The students were all children who were enrolled in Grades 3, 4, and 5 in a semi-rural elementary school in the United States. Data were collected through focus-group interviews, surveys, quantitative analysis of step counts, and from quasi-experimental research design. **Results:** Students in the experimental group were found to have: (1) increased scores on math standard score, (2) greater confidence in their academic ability, and (3) had more accumulated steps compared to students in the control group. Students in the experimental group also reported that they were more "ready to learn" after completing the physical activity intervention. This finding was also confirmed by their teachers. **Conclusion:** This study demonstrates how an increase in physical activity during the morning time has positive benefits for students throughout the school day.

Keywords: health promotion, physical activity, quasi-experimental design, wireless pedometers

Introduction

More than three decades ago, the United States' Office of Disease Prevention and Health Promotion established a list of goals and objectives, called *Healthy People,* which promoted a healthy lifestyle. The increase of physical activity levels among young children in order to reduce the risk of childhood obesity was one of those goals (Office of Disease Prevention and Health Promotion, 2000). However, as recent as three years ago the same topics of childhood inactivity and obesity were reemphasized, this time by the First Lady Michelle Obama. The re-emphasis was based on alarming statistics where in the United States, children of the age of 6 to 11 years who were obese increased from 7% in 1980 to nearly 18% in 2012. Likewise, the percentage of adolescents aged 12-19 years who were obese increased from 5% to almost 21% over the same time frame (Ogden, Carroll, Kit, & Flegal, 2014). In her *Let's Move! Active Schools* launch event on February 28, 2013, First Lady Obama (2016) called on schools to actively address the problem of childhood obese: "With each passing year, schools feel like it's just getting harder to find time, the money, and the will to help our kids be active. But just because it's hard doesn't mean we should stop trying" (p.5). In March 2016, the *Let's Move! Active Schools Progress Report* was released and provided details about how schools can be a place for change on this more than thirty-decade year old problem.

Children receive numerous health benefits by participating in physical activity. Benefits include reduced risks of cardiovascular diseases, strengthened bones and muscles, and improved mental health and mood (Centers for Disease Control and Prevention [CDC], 2011). Despite the health benefits, the opportunities for children to participate in physical activity most often occur after the school day is over and on the weekends (McKenzie,

Marshall, Sallis, & Conway, 2000; Mota, Santos, Guerra, Ribeiro, & Duarte, 2003; Trost, Pate, Freedson, Sallis, & Taylor, 2000). Unfortunately, physical activity opportunities during the school day are decreasing in much of the United States due to the greater emphasis on academic achievement and standardized testing (Lee, Burgeson, Fulton, & Spain, 2007). The daily time for physical education and physical activity is reassigned to support other academic areas like math and literacy (Dale, Corbin, & Dale, 2000).

However, research has shown that there was no conflict between physical activity and academic learning (Son & Meisel, 2006; Trost, Fees, & Dzewaltowski, 2008; Williams, Carter, Kibbe, & Dennison, 2009). Most importantly, a positive relationship between physical activity and academic achievement was well documented (Chomitz, Slining, McGowan, Mitchell, Dawson, & Hacker, 2009; Smith & Lounsbery, 2009; Uhrich & Swalm, 2007). Chomitz and her colleagues (2009) suggested that physical activity time does not impact academics in a negative light and "in fact learning may be enhanced by physically active students" (p.36). For example, participation in daily exercise sessions had a positive effect on elementary students' reading comprehension (Uhrich & Swalm, 2007), on spatial awareness and math skills (Frederick, Kokot, & Krog, 2006). Studies have also found that increased physical activity in elementary schools correlated positively with improvements in on-task behaviours and concentration (Lowden, Powney, Davidson, & James, 2001) and resulted in students who were more attentive after the physical activity time (Holmes, Pellegrini, & Schmidt, 2006). Students who are more aerobically fit performed better on standardized achievement tests (Wittberg, Northrup, & Cottrel, 2009). Even though there is body of literature that shows the benefits of increased physical activity in elementary schools, physical education and physical activity continues to get squeezed out of the daily schedule. To remedy that situation, some schools and physical education teachers have offered physical activity times before and after school (American Alliance for Health, Physical Education, Recreation, and Dance [AAHPERD], 2011; National Association for Sport and Physical Education & American Heart Association [NASPE & AHA], 2012). There is a gap in the literature, though, regarding the impact of physical activity before school.

This current study addressed this literature gap by investigating the impact of a physical activity intervention programme—which will be referred to by the moniker *Morning Blast*—on elementary students' academic achievement and daily fitness. The study had three purposes. First, the study measured the daily physical activity of upper elementary school participants in the Morning Blast intervention programme compared to a control group. Second, the study examined how participation in the Morning Blast intervention programme affected the participants' math achievement, which was the subject directly after the Morning Blast. Third, the study reported on participants' perceptions of being involved in the Morning Blast intervention programme.

Methods

The study uses a mixed-methods research design. Creswell (2012) explains that mixed-methods research design "includes the collection and analysis of both qualitative and quantitative data to triangulate findings" (p. 217). The study's qualitative data shed light on the participants' perceptions about Morning Blast. The quantitative data provided descriptive statistics to compare the study's treatment group with the control group. Before any data were collected, human subject research permission was granted from the University Institutional Review Board (IRB). Likewise, consent forms were filled out by the school's principal, educators, and parents.

The study addresses the following research questions:

1) What are the effects of the Morning Blast aerobic exercise intervention on elementary students' math achievement, math self-competency, and their physical activity?

2) What are elementary school participants' perceptions of the Morning Blast intervention programme and increasing their physical activity throughout the school day?

Context for Morning Blast

The Morning Blast was an aerobic intense, student-centered physical activity intervention programme for elementary aged students. The intervention was scheduled during a 15-minute time block before the

participating school day began and was conducted four days a week from Mondays through Thursdays. It lasted for the study's 16-week duration. Morning Blast consisted of movement games, cardiovascular efficiency exercises, and the physical educator's pre-selected activities based on student feedback about exercise games that the students enjoyed. All activity sessions offered ensured movement of all students during the 15-minute physical activity bouts before school. Examples of these exercise games include: 1) Hospital, which is a movement game that is similar to a modified game of dodgeball, but played in a manner that allows for all to stay in and play for continuous movement and 2) Hoopla, which is movement game where students are on teams and move bean bags to different hula-hoop stations without getting any of their original bean bags stolen. This activity included mathematical concept knowledge—like number sense—along with the continuous physical movement required to play.

Participants

The study's participants were drawn from a convenience sample of students and educators in an elementary school located a semi-rural area of East Texas. The study's participants included 83 students, 48 boys and 35 girls, who were enrolled in Grades 3, 4, and 5 in an elementary school in a semi-rural area of East Texas in the United States. The student participants ranged in age from 8 to 11 years old. Also, the study included seven adult participants including the teachers in Grade 3, Grade 4, and Grade 5 at the study's participating school and the school's principal.

Quantitative Data Sources and Analysis

The study's quantitative data corresponded to addressing the first research question about the effect of the Morning Blast intervention programme. The study's quantitative methodology included a quasi-experimental design. All the participants were given a Yamax Digi-Walker™ SW-701 (Yamax Corp., Tokyo, Japan). Then participants were assigned to two groups: A control group (49 students) and experimental group (34 students). The experimental group participated in the Morning Blast intervention programme for 15 minutes before the school day, while the control group elected not to participate. All the participants from both groups, though, wore their pedometers throughout the day. All the participants put on their pedometers at the same time each morning (i.e., when they arrived at the school's morning check-in at 7:40 am) for four days a week (Monday to Thursday). The participants wore their pedometers at the right-hand side of the waist from the time they arrived at school to the time they were released. Each day of the study, individual participant's steps were entered into a spreadsheet, and the pedometers were reset to zero. All the students in grades 3, 4, and 5 were trained by the research team on how to wear and handle the pedometers at the start of the study. Individual students were retrained during the duration of the study as needed. The pedometers were not sealed for the convenience of installing, retrieving, and recording the step data; however, students were encouraged to ignore the pedometer and keep their school days as usual.

Other quantitative data included math test scores and a math self-competency scale. Math was selected because it was the subject that took place after the Morning Blast intervention programme. There were two math test scores that served as a pre-test/post-test for math achievement. These scores were: (1) The math benchmark test scores and (2) the State of Texas Assessments of Academic Readiness (STAAR) Math Test. The participants completed the benchmark test at the beginning of the spring semester, which served as the pre-test of math achievement. The STARR test was taken in late April, and these scores were treated as the post-test of math achievement.

The math self-competency instrument was adapted from Marsh's (1992) work on self-concept and Sabatelli and Anderson's (2005) suggestions about self-competencies inventory. The instrument collected data on students' competence in math with a reliability of .88. The instrument was designed to identify the students' perceptions about their aptitude and attitude for math. Sample questions included: a) Mathematics is not one of my best subjects; b) I have always done well in mathematics, and c) I get good grades in mathematics. Students responded to these statements by selecting a range of true and false Likert-scale categories. This instrument was slightly modified by using a four-point Likert scale using faces, ranging from deep frown (false) to broad smile (true) alongside the four choices. Before the intervention, participants completed this survey as a pre-assessment. The classroom teacher read each question, the responses, and provided explanations to students' misconceptions. The same survey was given as a post-assessment upon the conclusion of the

intervention. The total score was treated as math competency score; higher score indicates higher math competency.

School day step counts (SSC) were used to measure students' PA. SSC was collected and accumulated on a daily basis by the Yamax Digi-Walker™ SW-701. Data were initially entered and organized using Microsoft® Excel® 2011(Microsoft Corporation, Redmond, WA) and further analyzed in SPSS® Version 21(SPSS, Inc., Chicago, IL). Based on the students' PA patterns during the baseline data collection and suggestions from Rowe et al. (2004), school daily step counts that are lower than 1000, and over 30,000 were treated as missing data.

These quantitative data were analyzed using descriptive statistical analyses for mean values for each variable. Repeated-measure ANOVAs were conducted to detect if there were any statistical significant differences in the participants' math test scores, math competency, and PA between the control group and experimental groups. The baseline phases and the intervention phases of the study were also analyzed for any statistical differences between the control and experimental groups. Eta-squared (η^2) is a measure of effect size in ANOVA. Based on Cohen's rule of thumb for effect size, .02 is considered small, .02 to .13 is considered medium, and .26 or larger is considered large effect size (Pierce, Block, & Aguinis, 2004).

Qualitative Data Sources and Analysis

The study's qualitative methodology included all of the same procedures in regards to placement and usage of the pedometers and respective participant pool as identified in the quantitative portion of this section. Qualitative data were collected concurrently with the quantitative data. There were two qualitative data sources: focus group interviews and a short survey that the study's participants completed.

The focus group interviews were conducted with the student and educator participants. The interviews provided additional sources of data regarding the students' perceptions and teachers' perceptions of the Morning Blast activity. These data added confidence to the findings (Creswell & Miller, 2000; Hatch, 2002). The student focus groups were divided by grade level for a total of three student focus group. The fifth-grade focus group interview had 6 participants. The fourth-grade focus group had 10 participants. The third grade focus group was comprised of 8 students. There were also three focus group interviews conducted with classroom teachers. The educators were interviewed in pairs, according to their grade level teaching teams. A total of 6 classroom teachers were interviewed. The interviews were conducted because the researchers agreed that perceptions about physical activity, learning, and pedometers were best discovered through dialogue and the interview process was the most productive approach to pursue (Rubin & Rubin, 2005). The interviews were semi-structured and included a similar open-ended question type of script (Holstein & Gubrium, 1995). The student focus group interview script included questions about the students' enjoyment of Morning Blast, their perceptions of any benefits they gained from Morning Blast, and words they associated with Morning Blast. The teachers' script included questions about their perceptions of the students' enjoyment of Morning Blast, whether the Morning Blast activity benefitted students' learning, and questions for the students. All focus group interviews were recorded on a digital recorder and then downloaded into password protected computer files for confidentiality purposes. The sound files were then transcribed into a Microsoft Word document. No participant identifiers were included in the data analysis or write-up of the findings.

Surveys were also given to the experimental group's student participants and the study's educators. The surveys provided further documentation about the students' and teachers' perceptions of Morning Blast. The surveys were 5 point Likert Scale surveys that mirrored each other in terms of content. The student survey included statements about students' level of (a) enjoyment of Morning Blast, (b) motivation and engagement in academic work after Morning Blast, (c) collaboration with others, and (d) overall health and fitness. The teacher survey included similar categories of questions, but the teachers responded with their perceptions of the effects of the Morning Blast activity on their students.

The interview data were analyzed using a three-step interpretive approach (Miles & Huberman, 1994). Data were first transcribed and read in their entirety. Then the data were organized according to categories and compared using the constant-comparative method (Glaser & Strauss, 1967). Frequencies in the data were further analyzed to establish patterns in the data. While reading the data and using the initial broad categories, patterns and themes were made into codes. Charts and meta-matrices were created to compare, contrast, and

probe for additional themes across the data (Miles & Huberman, 1994). This process of inductive analyses facilitated this process by dissecting the collected data in a highly detailed manner to extract rich understandings (Hatch, 2002). The inductive analysis process developed themes and these themes were coded for greater comprehension. For the purpose of this article, the themes are related to students' and teachers' perceptions regarding pedometers, physical activity levels, learning, and students' self-competency about math. Furthermore, by applying an inductive approach to the data analysis, the researchers were able to explore discrepant cases and legitimate the perceptions of individual participants whose views about physical activity or pedometers were different from those of other participants. Such discrepant case occurrences were noted and could be the foundation for future studies.

Results

The article organizes the study's results in relationship to the research questions. Each research question is addressed in a separate subsection.

Question 1: Effects of Morning Blast

The first research question examined the effects of the Morning Blast aerobic exercise intervention on elementary students' math achievement, math self-competency, and their overall physical activity. Addressing math achievement, the study found that the Morning Blast had a positive impact on math achievement; students in the experimental groups increased more points on math test scores compared to students in the control group. Results are shown in Table 1. Students in the control group had mean math scores of 1457.96 ± 415.98 and 1641.20±375.78 before and after the experiment respectively, which showed an increase in math score for 183.24 points. Students in the experimental group had mean math scores of 1362.53±307.12 and 1609.72± 133.22 before and after the experiment respectively; an increase in math score for 247.19 was found. Although there was no significant difference found in math score between these two groups before and after the experiment ($F(1,82)=.308$, $p=.580$, $F(1,82)=.240$, $p= .626$, respectively), students in the experimental group average started with lower math scores, but increased about 64 more points on their math test scores when compared to students in the control group; the achievement gap between these two groups was narrowed. Meanwhile, there was a significant experimental effect on students' math self-competency [$F(1,77)=4.558$, $p=.036$], with $\eta^2=.056$. Table 2 represents students' math self-competency. As Table 2 shows, students in the experimental group were more confident in their math self-competency compared to the students in the control group. The experimental group was significantly more positive about their math ability compared to the control group before this experiment with $F(1, 80)= 5.837$, $p=.018$. Although this difference was not significant after the experiment ($F(1,78)=1.317$, $p=.255$), students in the experimental group had a greater affinity for math learning compared to the students in the control group.

Table 1: Math scores from baseline to intervention

	Baseline	Intervention
Control	1457.96 ± 415.98	1641.2 ± 375.78
Experimental	1362.53 ± 307.12	1609.72± 133.22

Note: Values are means ± standard deviation.

Table 2: Math self-competency for pre and post survey

	Math self-competency Pre	Math self-competency Post
Control	10.94±2.10	12.82±2.01
Experimental	12.36±2.41	13.42±2.49

Note: Values are means ± standard deviation.

Third, there was a significant difference in step counts before and after the intervention [$F(1,81)=37.283$, $p<.001$] with a large effect size [$\eta^2=.315$]. Students in the experimental groups accumulated more steps compared to students in the control group. However, no statistical significant difference were found between control and experimental group [$F(1,81)=.326$, $p=.570$]. These step data are shown in Table 3. The study did find, however, that school step counts (SSC) vary across gender and age. Table 4 presents the means ± standard deviation of baseline SSC.

Table 3: School step counts (SSC) of students in control and experimental groups

	Baseline	Intervention
Control	4856.57±1228.10	5574.34±1345.82
Experimental	5019.85±1388.94	5711.83±1198.75

Note: Values are means ± standard deviation.

Table 4: SSC for boys and girls in Grades 3 to 5

Grade	Boys	Girls
3rd	5078±1765(n=16)	5121±1039(n=12)
4th	5326±1186(n=17)	5251±1062(n=13)
5th	4603±1089(n=15)	4038± 1370(n=10)

Note: Values are means ± standard deviation.

As Table 4 shows, the Grades 4 and 5 boys accumulated more SSC than girls. Analysis yielded significant main effects of grade [F (2, 77) =4.051, p= .021]. Third and fourth grade students had significantly more SSC than fifth [p= .046, p= .011, respectively].

Question 2: Perceptions of Morning Blast

The study's second research question asked, "What are elementary school participants' perceptions of Morning Blast and increasing their physical activity throughout the school day?" The students in the experimental group shared a great deal of enthusiasm for the Morning Blast intervention programme (see results in Table 5).

Table 5: Experimental group's responses to the survey questions

	Strongly Agree and Agree	Undecided	Disagree and Strongly Disagree
I enjoyed participating in Morning Blast.	100%	0%	0%
Morning Blast helped me to stay focus throughout the school day.	77%	18%	5%
I am a better student because of Morning Blast.	68%	32%	0%
Morning Blast has helped me to work better with my classmates.	82%	18%	0%
I feel healthier because of Morning Blast.	95%	5%	0%
Morning Blast has increased my interest in school.	90%	5%	5%

As Table 5 shows all the experimental group's participants either agreed or strongly agreed that they enjoyed participating in Morning Blast. Additionally, almost 95% agreed or strongly agreed with the statement, "I feel healthier because of the Morning Blast." The attitudes that the experimental group reported on their surveys were consistent with the student focus group interview responses. These small groups were made up of students in the experimental group; there were three focus groups with students - one from each grade level of the study (i.e., Grades 3, 4, and 5). When asked the question, "Tell me about the Morning Blast intervention, do you like it? Do you enjoy it?" Each of the small groups reported that they did enjoy Morning Blast and were "ready to learn" because of their involvement in the intervention programme. By "ready to learn," participants meant that they "were awake and focused," "got their wiggles out," and "got their brain moving to think" about math problems. The students in the focus groups also explained that they felt more engaged and focused for academic learning after they completed the Morning Blast activities. Here is how one fourth grade participant described the Morning Blast experience, "I am like super hyper, but if you go to Morning Blast you get your hyper out, so you don't do the hyper things in class."

The experimental group not only displayed the progress on their math scores but also reported in their interviews that they felt like they were "better math students" because of their participation in Morning Blast. The experimental group members also shared that Morning Blast provided a "healthy habit" of exercise that

was just "like having PE every day." A fifth-grade participant in the experimental group explained it by stating, "I know that some kids' favorite time is PE and they have to wait all day to get there or they can only go there once or twice a week. So it [Morning Blast] is a good way to go to PE every morning."

The article's researchers also interviewed and surveyed the study's educators. The educators had mixed reviews about the Morning Blast intervention programme. While the educators agreed that their students enjoyed Morning Blast, they were hesitant to attribute the intervention to improvements in math. One of the educator's quotes sums up the general attitude among the educators, "I had students who when they missed Morning Blast would announce, 'Oh, I am so sad that I missed Morning Blast!' They enjoyed it a lot. However, as far as attributing any changes because of Morning Blast, I just can't say." Table 6 shows the educators' perceptions about the Morning Blast activity from the survey.

Table 6: Educators' responses to the survey questions

	Strongly Agree and Agree	Undecided	Disagree and Strongly Disagree
Morning Blast has helped my students to stay focused throughout the school day.	0%	100%	0%
Morning Blast helped to increase the motivation of my students.	17%	66%	17%
Morning Blast increased the level of student engagement throughout the school day.	0%	66%	34%
Morning Blast has positively impacted my students' learning and achievement in math.	0%	83%	17%
Morning Blast has improved the collaboration among the students in the class.	0%	83%	17%
Since participating in Morning Blast, my students seem healthier.	0%	100%	0%

The educators in contrast to the students were ambivalent about the impact of Morning Blast on their students. As Table 6 shows, most of their answers to the statements were in the Undecided category. Educators were 100% undecided about the survey statements regarding whether Morning Blast helped their students to stay focused and whether their students seemed healthier because of Morning Blast. Only one educator agreed a single survey statement (i.e., Morning Blast has helped to increase the motivation of my students). For the rest of the survey statements the educators either disagreed or were undecided.

During the teacher focus group interview, the study's researchers asked questions to probe the teachers' ambivalence toward Morning Blast. The educators were undecided and were careful not to attribute in causal effect to Morning Blast. For example, when asked about any differences they noticed in the students who participated in Morning Blast, one teacher replied, "I don't know how effective Morning Blast is; I just don't know. There are some students who need that exercise time. They are not getting consistent exercise 5 times a week. So Morning Blast provides consistent exercise, which is good." Other teachers shared that they found Morning Blast to be effective, but only for a certain type of student. For example, one teacher shared, "I don't want to say that this programme can't be effective, because for some kids I am sure it is very effective. A lot of the Morning Blast kids were athletic, they loved moving around already." The responses above show how the educators identified the health and exercise benefits of Morning Blast, but hedged in recognizing any academic effects related to Morning Blast.

One thing that both the students and teachers, agreed on in their interviews was that students who participated in Morning Blast had a higher degree of learning readiness. In the student focus group interviews, the phrase "ready to learn" was often repeated. Throughout the teacher focus group interviews, each teacher either said "ready to learn" directly or alluded to learning readiness in their responses. For example, one teacher explained the benefit of Morning Blast by stating, "For the kids who get to school early Morning Blast is great because it gets them moving around and ready for the school day rather than just sitting around." Another teacher also shared about learning readiness by explaining, "I liked Morning Blast activity because the kids are being social yet they are physically active. They can take care of that [being social and active] first thing and they don't have to necessarily do that when they are supposed to be learning." Being ready to learn was a benefit of Morning Blast that was held in common by both the students and teachers.

Discussion

Over a decade ago, Currie and her colleagues (2004) warned that this current generation of children were less active than previous generations and generally did not exhibit healthy lifestyle habits. The CDC (2011) has recently found that many children do not meet the recommended guideline of at least one hour of physical activity a day for five days a week. In light of these realities, the article returns to questions that were raised at the beginning of the article: "How does a physical education teacher respond to these realities? What are ways to support physical activity with children while they are at school?" As a way to support children in physical activity, this study piloted a school-based intervention that provided a Morning Blast physical activity program, which elementary students could participate in before their school academic day started.

The idea for the Morning Blast intervention programme originated from a conversation that one of the article's researchers had, who was an elementary school physical education (PE) teacher at the time of the study, had with the school administrator. The administrator expressed the need for an improved use of school time at the start of the school day and wanted to hear the PE teacher's thoughts. The administrator inquired about whether there was something that the school students could do early in the morning before school started instead of just sitting in the morning care room. Out of that inquiry, the PE teacher went on to design the Morning Blast intervention programme with the focus being on vigorously intense cardiovascular endurance exercises and games. Because these types of exercises and games are linked to reducing body composition and increasing brain activity (Martin & Chalmers, 2007). It is important to note that PE teachers are a vital component to resolve the problem of childhood obesity. As this study showed, turning a sedentary part of the school day into a physically active student-centered time had many fruitful outcomes. It is essential for PE teachers to be part of conversations that involve the use of school time because it is with physical educators' insight that more physical activity could be added within the school day without interfering with any other academic subjects. Moreover, they should also be part of testing the effectiveness of whatever physical activity intervention is designed.

Another question raised at the article's beginning was: "What are the effects of increased physical activity on other subject matter areas?" The study showed that the Morning Blast had a positive impact on math achievement; students in the experimental groups increased more points in math standardized test score compared to students in the control group. This finding is aligned with the literature that physical activity has a positive relationship with academic achievement (Castelli, Hillman, Buck, & Erwin, 2007; Frederick, Kokot, & Krog, 2006; Raudsepp & Viira, 2000; Sibley & Etnier, 2003; Tomporowski, 2003; Uhrich & Swalm, 2007). Given the results, this study adds additional evidence that physical activity has no conflict with academic learning; on the contrary, physical activity facilitates the academic learning. Therefore, cutting physical activity time in an effort to increase the students' academic learning will not achieve its purpose. Data from this study suggested that the Morning Blast intervention programme could be used to narrow the gap in testing scores. The students in the experimental group started with lower math scores but ended with higher scores on their math tests. Now, there could be many reasons for their increase in math test scores. Many interventions have been documented to address gaps in test scores at schools such as reducing class size, modifying the curriculum content, and providing tutoring for struggling students (Chubb & Loveless, 2002). Our finding indicates that besides these interventions, implementing physical activities before academic learning could also help students become ready to learn.

Another positive outcome of the study was the students' self-competency in math, which was frequently reported by students themselves during the focus-group conversations. The experimental group believed that they were more focused on math learning and felt they were "better math students." These statements allude to the experimental group's perceptions of increased levels of self-confidence. This increased awareness of self-confidence provided by the student participants ignites the question for future research: Does participating in physical activity build one's self-perception and confidence? As the results revealed on the math self-competency instrument, this question leaves room for future studies about physical activity. Another area for future studies as mentioned in this study was timing. The Morning Blast intervention was scheduled prior to the experimental group's math workshop time. Research indicates this may also be a factor that needs more studies conducted to fully understand the impact of physical activity scheduling and learning (Carter, 2002; Graham, 2008; Sheehy, 2006; Trost & Van Der Mars, 2009). The timing of the physical activity has displayed importance; having physical activity before the academic learning might be the key to success.

More research is needed into the modes of physical activity. The types of movement and physical activity of students seems to impact how students are ready to learn. Therefore, additional studies must be conducted in order to understand activity types and intensity levels and how these factors may or may not impact learning. Related to the different modes of exercise is the notion that exercise should have an element of being enjoyable. The physical activities provided should be enjoyed by all students so as to achieve the maximum effects. What modes are considered enjoyable? At what intensity levels produce the optimal effects? These are some examples of questions that should be investigated in future studies.

There was a number of interesting physical activity related findings that are important for discussion and future research, as well. Although it was not significant, a much higher student step count was observed in the experimental group compared with the control group. The experimental group increased their physical activity by 15 minutes in the morning, but that seemed to have a greater impact on their overall daily activity at school. The experimental group was not only "ready to learn" but they were also "ready to move" through the rest of the day including at recess time. It should be noted, though, that as the students in the study were older in age, there was a decrease in accumulated student step counts and physical activity, which aligns with research on activity levels and age (Trost et al., 2002). Indeed, the study's fifth-grade students had the lowest overall steps compared with the other grade levels. There are many variables that could influence this decrease in activity as students' age like: (1) the older students become the more their academic workload increases, which in turn causes less time for physical activity and (2) older students are more conscious of their appearance, and thus sweating during a school day seems less appealing. The phenomenon of why there is less movement as students age is another topic worthy of further research. Future research is also needed to identify effective interventions for increasing physical activity among adolescent learners.

Another area of future study is the use of wearable technology to support children's and adolescents' physical activity. The student step count increased significantly in this study with students in the experimental group having a much greater amount of SSC compared to students in the control group. This phenomenon might be due to the behavioural reactivity of wearing pedometers (Beighle, Pangrazi, & Vincent, 2001). For example, Vincent and Pangrazi (2002) found that participants may react to the pedometers and change their normal activity patterns. The study's experimental group reported in their student focus groups that wearing pedometers motivated them to have greater physical activity. This is significant because it explores how pedometers can be used as a tool for motivation in physical education classes and beyond. Currently, there are a lot of wearable devices like analog pedometers, wireless pedometers, and even apps on smartphones that are designed to monitor physical activities. How can educators utilize these devices throughout the school day to motivate and support the physical activity of students? How can schools implement the use of technology to boost physical activity throughout the school day? Which fitness and wellness technology is best rated and cost effective for schools and school districts for use in physical education classes? These questions should be asked in future studies about physical activity and wearable technology.

Conclusion

In conclusion, this study has a number of implications for educators, parents, and students alike. The current study demonstrates how physical activity has positive benefits for students throughout the school day. The study uncovers fruitful and relevant findings related to: (a) developing greater understanding of when and how to incorporate additional physical activity time with elementary students; (b) addressing the lack of movement and onset of childhood obesity through an empirical based intervention based on amount of steps taken per day; (c) providing elementary students with an additional opportunity to participate in physical activity for health benefits; (d) promoting the opportunities for students to ready their brains to learn by being physically active; (e) providing further evidence for the relationship between physical activity motivation and wearing a pedometer; and, (f) exploring the connection between increased physical activity levels and academic subject areas like mathematics. In sum, the study validates how an increase in physical activity in the morning time has positive academic outcomes and healthy benefits for students throughout the school day.

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