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CURRICULUM & TEACHING STUDIES | RESEARCH ARTICLE

Impact of short duration health & science energizers in the elementary school classroom

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Abstract: *Background:* Acute physical activity breaks lasting 10–60 min have been related to positive effects on student focus and academic performance. The aim of this study was to evaluate the impact of repeated brief physical activity-infused academic lessons (1–5 min) on student retention and on-task behavior. *Methods:* One class from each K-2 grade level ($N = 114$) was randomly assigned to the control or experimental condition. Teachers introduced two health and science lessons lasting no more than 5 min every day for six weeks using the 1-Minute Energizer (experimental) or sedentary equivalent (control) curriculum. Student knowledge and behavior was assessed pre- and post-intervention with curriculum-specific oral quizzes and classroom observations. *Results:* Improvement in quiz performance with the intervention ($+80.5 \pm 12.4\%$; $p < 0.001$) was not different between groups ($F(1, 89) = 0.05$, $p > 0.05$) despite greater lesson time in control classrooms. Experimental students exhibited fewer disruptive behaviors (DB) and spent more time on-task (OT) post-intervention (DB: $F(1,89) = 10.72$, $p < 0.01$; OT: $F(1,89) = 5.56$, $p < 0.05$). *Conclusions:* 1-Minute Energizers are an effective instructional tool for increasing health and science knowledge with the added benefits of improving student focus and providing more opportunities for physical activity participation.

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PUBLIC INTEREST STATEMENT

Despite recent efforts to improve physical activity promotion policies and programs, physical inactivity rates for low-income American youth have remained alarmingly high. The results from the current study demonstrate for the first time that academic content can be effectively combined with short bursts of physical activity in the classroom. The convenience and short duration of the 1-Minute Energizer lessons make it possible to increase physical activity during the school day without detracting from instructional goals. Students retain as much information with brief physical activity-infused lessons as they do with traditional sedentary instructional methods. Regular physical activity breaks also increase on-task behavior, which may improve learning in other subject areas. Ultimately, schools can be more confident in the decision to interrupt sedentary time with physically active lessons. Brief physical activity breaks should be seen as one component of a more comprehensive physical activity promotion approach in schools.

Subjects: Education Studies; Primary/Elementary Education; Early Childhood; Classroom Practice; Curriculum Studies; Early Years

Keywords: physical activity breaks; curriculum; student learning; methods and materials of instruction; teaching techniques; early childhood

1. Introduction

It is well known that obesity is a leading health concern for both children and adults in the United States today. In 2012, 18% of American children aged 6–11 and 21% of children aged 12–18 were obese (Ogden, Carroll, Kit, & Flegal, 2014). In addition to negative consequences on physical health, obesity has been shown to be negatively correlated with executive functioning and spatial reasoning in young children and adolescents (Liang, Matheson, Kaye, & Boutelle, 2014). The obesity epidemic is directly related to a decrease in physical activity (Ogden et al., 2014). Although the US Department of Health and Human Services recommends that children ages 6–17 participate in at least 60 min of physical activity each day (U.S. Department of Health & Human Services, 2008), only 25% of students aged 6–15 in the US and 28.7% of children living in Los Angeles meet this recommendation (Dentro et al., 2014; Los Angeles County Department of Public Health, 2013). In urban environments, high physical inactivity rates may be related to limited space to participate in safe physical activity. Indeed, 14.2% of Los Angeles adults report living in a neighborhood that does not have walking paths, parks, playgrounds, or sport fields (Los Angeles County Department of Public Health, 2013). Consequently, a majority of daily physical activity is accumulated at school.

In addition to preventing obesity, physical activity has several other benefits. It strengthens bones and muscles, helps reduce stress, and reduces the risk for heart disease and diabetes (Haskell et al., 2007; Strong et al., 2005). Regular physical activity participation and higher physical fitness levels have also been related to improvements in school-age student on-task behavior in the classroom and academic achievement (Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001; Lambourne et al., 2013; Pindus et al., 2016). Despite the well-established benefits of physical activity, recess, physical education (PE), and extracurricular sports programs continue to be cut in American elementary schools as a result of budget and staffing limitations (Lafleur et al., 2013; Turner, Johnson, Slater, & Chaloupka, 2014). Sadly, since the passage of No Child Left Behind, the amount of time devoted to PE and recess in US elementary schools has decreased by 40 and 50 min per week, respectively (Kohl & Cook, 2013). In order to counteract the impact of these cuts and to increase physical activity minutes during the school day, many organizations have recommended introducing physical activity into the classroom (Centers for Disease Control & Prevention, 2013; Elliot, Erwin, Hall, & Heidorn, 2013; Kohl & Cook, 2013). Increasing physical activity through breaks in academic content specifically has been shown to improve student focus, decrease off-task behavior, and increase on-task behavior (Drollette et al., 2014; Evenson, Ballard, Lee, & Ammerman, 2009; Jarrett et al., 1998; Ma, Mare, & Gurd, 2014; Mahar et al., 2006). Studies demonstrate that executive function and cognitive control were significantly improved after an acute bout of moderate to vigorous intensity exercise in 4th and 5th grade students (Drollette et al., 2014; Howie, Schatz, & Pate, 2015). However, many teachers are still reluctant to take time away from instructional minutes (Dinkel, Lee, & Schaffer, 2016; McMullen, Kulinna, & Cothran, 2014).

Combining physical activity with academic instruction is one strategy to increase physical activity and student enjoyment throughout the day without significant disruption to instructional time (Vazou & Smiley-Oyen, 2014; Webster, Russ, Vazou, Goh, & Erwin, 2015). Research shows that physical activity-infused lessons lasting between 10 and 60 minutes have the same impact on content retention as other teaching methods for students between the ages of 9 and 12 (Ahamed et al., 2007; Norris, Shelton, Dunsmuir, Duke-Williams, & Stamatakis, 2015). Some studies demonstrate that academic achievement is better for students when the academic lesson includes physical activity (Donnelly & Lambourne, 2011; Kirk, Vizcarra, Looney, & Kirk, 2014; Mullender-Wijnsma et al., 2016). For example, when academic lessons were instructed using physical activity for 90 minutes per week in the Physical Activity Across the Curriculum (PAAC) trial, 2nd and 3rd grade students performed

better on standardized tests than those in a control classroom after a period of three years (Donnelly & Lambourne, 2011). Similarly, researchers recorded a significantly greater improvement in math and spelling scores for 2nd and 3rd graders after a two year intervention consisting of active math and language lessons each lasting 10–15 min per day, three times per week (Mullender-Wijnsma et al., 2016). In another study, physical activity lessons lasting a total of 30 min per day delivered over a period of 6 months improved early literacy in Head Start preschool students (Kirk et al., 2014). Unfortunately, many of the studies that have evaluated physically active lessons differ in study design (e.g. lesson duration, intervention duration, age group, academic performance measures) and teacher compliance and neglect to collect baseline data. As a result, it is difficult to identify the minimal exposure parameters needed to induce cognitive and behavioral changes with physical activity lessons. Although Howie et al. (2015) showed no benefit of acute 5-min exercise breaks on executive function in 4th and 5th graders, the effects of repeated short duration physical activity breaks combined with academic lessons on content retention or classroom behavior are unknown.

2. Research purpose and hypotheses

The current study attempts to fill a gap in the literature by focusing on young children (grades K-2) and the incorporation of brief physical activity lessons in the form of 1-Minute Energizers (1–5 min). The purpose of this study was to explore the impact of 1-Minute Energizer lessons on (1) elementary student knowledge related to the health and science concepts delivered in the Energizers and (2) classroom behavior previously shown to impact academic achievement. It was hypothesized that after a period of 6-weeks, on-task behavior and disruptive behaviors would increase and decrease, respectively in experimental classrooms with no difference in content retention compared to control classrooms.

3. Methods

All study procedures were approved by the Occidental College Human Subjects Institutional Review Board prior to study commencement (RANE-D12197/8). In addition to receiving school district and principal site approval, adult consent forms were collected from all participating teachers and signed minor consent forms were collected from parents of all participating students.

3.1. Participants

A total of sixteen classrooms representing grades K-5 and two elementary schools in the San Gabriel Unified School District in Southern California were recruited to participate in the current study. All sixteen teachers completed pre- and post-training surveys that determined which teaching techniques were most commonly incorporated into academic lessons. A convenience sample ($N = 114$) including two kindergarten, 1st, and 2nd grade classrooms from the same school completed the 1-Minute Energizer intervention. One classroom from each intervention grade level was randomly assigned to either the control or the experimental condition (Table 1). This sample size was adequate (> 96) for this study at an alpha level of 0.05 and power of 0.90 as determined through a power analysis conducted in G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) for a 2 (condition) \times 2 (time points) design using the effect size of 0.265 obtained from previous studies (Mullender-Wijnsma et al., 2016; Vazou & Smiley-Oyen, 2014).

Table 1. Subject number by category

	Male	Female	Kindergarten	1st grade	2nd grade
Control	30	21	13	20	18
Experimental	30	25	19	17	19

Notes: Values represent subject number included in statistical analysis after incomplete data sets and extreme outliers were removed from an original intervention pool of 57 control and 57 experimental subjects.

3.2. Materials

3.2.1. 1-Minute Energizers resource

As a result of a request made by teachers in Los Angeles County Title 1 schools (more than 50% of students eligible for free or reduced lunch) in 2013, the Kinesiology Department at Occidental College developed the 1-Minute Energizers resource. This resource includes detailed written and pictorial instructions for leading ten curricular-based physical activity energizers in the classroom that require little to no equipment or setup. All energizers are designed to last no more than a couple minutes after the teacher and students become familiar with the procedure. In addition to instructions for a basic procedure, the resource includes grade-level specific challenges, supplemental content and images, and modifications for space limitations. Nine energizers introduce elementary school students to the human body while delivering specific material related to the content standards in the areas of health, physical education, nutrition competencies, and science as established by the California State Department of Education. For example, students learn the anatomy and function of the digestive system in ‘Swallow This’ by pretending to be a morsel of food traveling through the gastrointestinal tract reciting names of the different sections while participating in movement patterns that represent the function of that section. In another energizer called ‘Rising with the Sun,’ students perform sun salutations with controlled breathing as the teacher explains how the respiratory system functions. The tenth energizer is an active review of the material in the other energizers.

The resource facilitates a cross-curricular approach including subjects previously mentioned as well as math (e.g. students add and subtract, practice counting tasks, and complete problems on flashcards) and music (e.g. move bones of the body at the joint while singing a song set to the tune of “Wheels on the Bus”). Experiential learn-by-doing (designing a meal that follows MyPlate guidelines; using specific movements to contract or stretch a specific muscle) and game-based (e.g. modified game of tag as teams work together as the immune system to fight off pathogens) approaches are included.

1-Minute Energizers were reviewed and edited by the California Department of Public Health, the California Department of Education, and piloted in two school districts prior to publication and implementation for the current study. Requests for electronic copies of the resource should be made to the corresponding author.

3.2.2. Control curriculum

An equivalent sedentary lesson incorporating traditional instructional techniques (lecture, discussion, Q and A, demonstration, memory matching games, drawing and coloring, etc.) was designed for each 1-Minute Energizer and each 1-Minute Energizer challenge. The control curriculum lessons deliver the same content while students remain seated.

3.3. Design

The current study was conducted over a period of nine weeks during the spring semester. Two weeks were devoted to teacher training and baseline testing followed by a six-week intervention and another week for post-intervention testing. Prior to the intervention, all teachers, independent of condition assignment, attended a two-hour train-the-trainer workshop led by research assistants during district compensated teacher prep time. In the workshop, researchers presented a review of literature related to the benefits of physical activity for elementary school students. The workshop gave teachers the opportunity to practice leading energizers and challenges, clarify content, learn how to perform specific movements, and to brainstorm about how the resource could be effectively incorporated into the school day. At the training, all teachers were provided with the materials needed to implement lessons in the classroom.

In the six intervention classrooms, experimental and control teachers were instructed to spend no more than a total of ten minutes each day introducing two of the 1-Minute Energizers or control

lessons throughout the duration of the intervention period. Additionally, teachers were asked to record the time spent on each topic each day. Teachers were asked to follow the basic procedure until they perceived that the students had sufficient mastery to transition to the challenges. Optimally, all students were exposed to the content in each energizer twice per week (once for the energizer and once during the review). Non-intervention classroom teachers were instructed to incorporate 1-Minute Energizers into their curriculum as they saw fit based on previous teaching experience and knowledge and skills gained at the training workshop.

3.4. Measures

3.4.1. Teaching practice questionnaire

In order to assess the practices most commonly utilized in the classroom (e.g. games, seated desk work, demonstration, discussion, etc.) as well as the willingness of teachers to incorporate classroom-based physical activity into the school day, school teachers completed a brief questionnaire prior to the 1-Minute Energizer training and again after 8-weeks. Teachers participating in the intervention were instructed not to talk about their specific participation with other teachers until after the intervention had completed and post-questionnaires collected. Analysis of these questionnaires was used to determine whether participation in the intervention influenced teaching style preferences.

3.4.2. Student knowledge content quizzes

Prior to and after the intervention, student knowledge was assessed with a 40 question, 12–15-min oral content quiz facilitated by research assistants in a private room. An oral quiz was selected in order to account for reading level differences in K-2 classrooms. The quiz was placed in front of the student as the researcher read the question aloud and waited for a response. Students were given a maximum of 10 seconds to respond before the researcher recorded either a correct or incorrect answer. If students did not provide a response, incorrect was recorded. None of the student participants had registered learning disabilities. As a result, researchers were confident that 10 seconds was an appropriate time limit. Questions consisted of identification and multiple choice questions. For the identification questions, a researcher pointed to a picture and asked the student to identify the selected body part or food group item (e.g. stomach in an anatomical drawing of the gastrointestinal tract). Multiple choice questions complete with labeled picture options required higher level understanding of system function (e.g. location where air travels first after breathing in). Researchers were not blind to the condition and all attempts were made to match the same researcher and student during post-testing to minimize potential impact of researcher delivery style. The quiz was found to be highly reliable for assessing student knowledge with a Cronbach alpha value of 0.99.

3.4.3. Classroom behavior observations

At the end of a two-week training period, researchers rated behavior for students in a 13-min classroom training video. The intraclass correlation coefficient demonstrated significant absolute agreement in ratings for each of the observation variables: noncompliance (ICC = 0.894, $p < 0.05$), inattentiveness (ICC = 0.939, $p < 0.05$), and disruptive behavior (0.906, $p < 0.05$).

In order to minimize the impact of researcher presence on student behavior, researchers arrived 20–30 min prior to the initiation of data collection. At this time, the teacher introduced the researcher to the class and gave students an opportunity to ask the researcher questions. During data collection, the researcher assumed his/her seat in the back of the classroom. In a single systematic scan, each student was observed for a total of five seconds and off-task behavior recorded in one second, a procedure previously described by Jarrett et al. (1998). A pre-timed alarm was set in researcher iPod devices so that observation time could be kept standard. Although efforts were made to observe one student immediately after data had been recorded for the previous student using teacher-provided seating assignments, there were instances in which researchers were required to stop the iPod recording in order to find the next student. Researchers placed a check in the appropriate off-task behavior box if a student was Noncompliant (student does not follow instruction of the teacher within 5 s), Inattentive (student is not looking at teacher or source of instruction), and/or Disruptive

(student participates in disruptive behaviors such as making noise, getting out of seat, throwing items, talking to neighbor out of turn). In addition to student behavior, researchers recorded the type of instruction being used by the teacher: lecture and/or demonstration, individual deskwork (silent reading or assignments), group deskwork (seated assignments or activities), teacher-facilitated classroom discussion, role-play or skits, arts and crafts, interactive games or energizers requiring physical activity. Each student was observed for a minimum of twenty times during each observation period. After all data had been collected, the percent of time that students spent on-task (no off-task behaviors) was calculated. It has been previously shown that this observation procedure is effective for assessing classroom behavior (Jarrett et al., 1998; Mahar et al., 2006; Pellegrini, Huberty, & Jones, 1995).

A total of four 40-min classroom observations were completed in control and experimental classrooms before and again after the intervention. Pre- and post-intervention observations were averaged for each participant. Observation data were collected at the same times of day on the same days of the week pre-and post-intervention. These data collection times were the same across all groups. Teacher-provided seating assignments were used to match the same students during data collection periods. Observation and quiz data were collected on different days.

3.5. Data analysis

All quantitative analyses were performed using IBM SPSS Statistics, version 23 (IBM Corp., Armonk, NY). An alpha of 0.05 was adopted as the standard for significance. An ANCOVA was used to analyze the impact of experimental condition, sex, and grade level on post-intervention student knowledge and behavior controlling for pre-intervention quiz and observation behavior scores, respectively. Cohen's *d* was used to determine effect size when appropriate (Cohen, 1988; Field, 2013). Incomplete data sets for individual participants and extreme outliers identified through boxplot analysis were not included in ANCOVA analysis.

4. Results

4.1. Teaching practices

Prior to study commencement, three of the sixteen participating teachers indicated that they had never used interactive games and/or energizers requiring physical activity as an instructional technique. For those teachers who did incorporate interactive games, the frequency was a maximum of one to two times per week. The most common techniques used to teach health and science concepts specifically were lecture/demonstration and teacher-led discussion, techniques practiced multiple times per day by more than 50% of teachers. Only one of the teachers surveyed agreed that their personal curriculum adequately covers health and fitness topics. All teachers admitted that if they had not participated in the study, they would likely introduce less than one quarter of the topics covered in the 1-Minute Energizers resource despite the direct connection to California State Standards. In the follow-up survey, fourteen out of sixteen teachers indicated that they plan on introducing the 1-Minute Energizers or continuing to incorporate 1-Minute Energizers into their curriculum with a median frequency of 1–2 times per week. Additionally, ten out of sixteen teachers would recommend the resource to other teachers even if a teacher training was not available.

4.2. Student knowledge

Baseline quiz scores did not differ between control and experimental groups or between males and females ($p > 0.05$), but did differ by grade level ($p < 0.05$) (Table 2). ANCOVA analysis demonstrated that the significant improvement in quiz performance after the six-week intervention ($+80.5 \pm 12.4\%$; $d = 1.42$ (large effect), $p < 0.001$) was not different between sexes ($F(1,89) = 0.01$, $p > 0.05$) or between control and experimental groups ($F(1, 89) = 0.05$, $p > 0.05$) despite more total time devoted to lessons in the control classrooms as a result of greater teacher compliance to the intervention protocol (Con = 279.2 ± 8.2 min vs. Exp = 237.8 ± 1.2 min, $p < 0.05$) (Table 2). Grade level, on the other hand, significantly impacted post-intervention quiz scores when controlling for baseline scores ($F(2, 89) = 28.05$, $p < 0.001$, $d = 1.59$, large effect) (Table 2).

Table 2. Quiz scores pre- and post-intervention

	Pre-intervention (points)	Post-intervention (points)	Δ pre to post (%)
Control	10.7 ± 0.6	17.8 ± 0.6 ^a	74.3 ± 1.6
Experimental	11.0 ± 0.6	17.6 ± 0.5 ^a	78.1 ± 0.1
Male	10.8 ± 0.7	17.8 ± 0.6 ^a	81.9 ± 1.5
Female	11.2 ± 0.6	18.2 ± 0.5 ^a	75.5 ± 1.8
Kindergarten	7.9 ± 0.8 ^b	11.3 ± 0.7 ^{a,b}	60.2 ± 2.5 ^b
1st Grade	11.0 ± 0.7	20.1 ± 0.7 ^a	91.2 ± 1.9
2nd Grade	13.6 ± 0.7	21.4 ± 0.9 ^a	75.9 ± 1.9

Notes: Values are means ± standard error. Both pre-and post-intervention quizzes were scored out of a possible 40 points representing 1 point per question.

^aSignificantly different relative to pre-intervention values, $p < 0.05$.

^bSignificantly different than 1st and 2nd grade students, $p < 0.001$.

4.3. Student classroom behavior

Instructional style had a significant effect on off-task classroom behaviors. The delivery of material through arts and crafts resulted in fewer instances of noncompliance in comparison to lecture and individual deskwork (0.1 ± 0.03 vs. 0.4 ± 0.12 and $0.4 \pm 0.08 \text{ min}^{-1}$, respectively, $d = 0.50$ (medium effect), $p < 0.05$). Discussion resulted in fewer instances of inattentiveness in comparison to lecture, individual deskwork, and arts and crafts (0.6 ± 0.26 vs. 3.6 ± 0.46 , 2.8 ± 0.24 , and $2.5 \pm 0.28 \text{ min}^{-1}$, respectively, $d = 0.63$ (medium effect), $p < 0.05$). Disruptive behaviors were more prevalent during lecture-style instruction than arts and crafts and discussion (1.3 ± 0.23 vs. 0.5 ± 0.12 and $0.2 \pm 0.14 \text{ min}^{-1}$, respectively, $d = 0.58$ (medium effect), $p < 0.05$).

Noncompliant (NC) and inattentive (IA) behaviors were significantly less frequent after the six-week intervention (NC: 0.20 ± 0.04 vs. $0.10 \pm 0.03 \text{ min}^{-1}$, $d = 0.21$, small effect, $p < 0.05$; IA: 1.91 ± 0.16 vs. $1.30 \pm 0.11 \text{ min}^{-1}$, $d = 0.34$, small effect, $p < 0.001$). Similarly, the percent time on-task (OT) was significantly greater after the intervention (78.1 ± 1.6 vs. $83.5 \pm 1.3\%$, $d = 0.27$, small effect, $p < 0.01$). Post-intervention noncompliant and inattentive behavior frequency were not affected by sex (NC: $F(1,89) = 2.26$, $p > 0.05$; IA: $F(1,89) = 0.007$, $p > 0.05$) or condition (NC: $F(1,89) = 1.90$, $p > 0.05$; IA: $F(1,89) = 0.75$, $p > 0.05$), but were influenced by grade level (NC: $F(2,89) = 5.42$, $d = 0.70$ (medium effect), $p < 0.01$; IA: $F(2,89) = 25.88$, $d = 1.53$ (large effect), $p < 0.001$) when controlling for baseline behaviors (Table 3). Post-intervention disruptive behavior frequency as well as the percent of time on-task was affected by both condition (DB: $F(1,89) = 10.72$, $d = 0.69$ (medium effect), $p < 0.01$;

Table 3. Change in classroom behaviors pre- to post-intervention

	NC (min^{-1})	IA (min^{-1})	DB (min^{-1})	OT (%)
Control	-0.09 ± 0.04	-0.73 ± 0.15 ^a	0.10 ± 0.09	-1.4 ± 4.8
Experimental	-0.16 ± 0.04 ^a	-0.54 ± 0.14 ^a	-0.29 ± 0.10 ^{a,b}	28.0 ± 4.4 ^{a,b}
Male	-0.12 ± 0.04 ^a	-0.63 ± 0.15 ^a	-0.07 ± 0.10	13.1 ± 4.9 ^a
Female	-0.17 ± 0.04	-0.65 ± 0.12 ^a	-0.15 ± 0.09	13.1 ± 4.2 ^a
Kindergarten	-0.21 ± 0.05 ^{a,c}	-1.00 ± 0.20 ^{a,c}	-0.37 ± 0.11 ^{a,c}	19.6 ± 5.9 ^{a,c}
1st Grade	-0.17 ± 0.05 ^c	-1.61 ± 0.17 ^{a,c}	-0.18 ± 0.10 ^c	21.2 ± 5.6 ^{a,c}
2nd Grade	-0.004 ± 0.04	-0.13 ± 0.15	0.27 ± 0.10 ^a	1.2 ± 5.3

Notes: Values are mean changes ± standard error. Noncompliance (NC), Inattentive (IA), and Disruptive Behaviors (DB) were recorded in frequency units per minute. Time on-task (OT) was standardized for total time each individual student was observed.

^aSignificant difference between pre- and post-intervention values, $p < 0.05$.

^bSignificantly different than control students, $p < 0.05$.

^cSignificantly different than 2nd grade students, $p < 0.05$.

OT: $F(1,89) = 5.56$, $d = 0.50$ (medium effect), $p < 0.05$) and grade (DB: $F(2,89) = 11.04$, $d = 1.00$ (large effect), $p < 0.001$; OT: ($F(2,89) = 26.86$, $d = 1.55$ (large effect), $p < 0.001$) when controlling for pre-intervention behavior (Table 3). Neither disruptive behavior nor percent time on-task was influenced by sex (DB: $F(1,89) = 3.33$, $p > 0.05$; OT: $F(1,89) = 2.16$, $p > 0.05$).

5. Discussion

1-Minute Energizers combine health and science curriculum with physical activity enabling children to gain knowledge that may influence health-related lifestyle decisions as well as an opportunity to decrease classroom sedentary behavior. The results from this study demonstrate for the first time that repeated short bursts of physical activity combined with academic content benefit student focus and content retention in young elementary school students. Indeed, the implementation of a 6-week 1-Minute Energizer curriculum was just as effective as traditional non-activity-based lessons in lesson-specific academic performance measures despite less time devoted to the active lessons by experimental teachers. Additionally, as previously established, there is a direct relationship between physical activity competence and physical activity participation in school children (Babic et al., 2014). In this study, two of the three experimental teachers noted that students were frequently observed practicing the energizers during recess without teacher prompting. Therefore, the implementation of 1-Minute Energizers in the classroom may also increase physical activity participation outside of the classroom.

Previous studies which incorporate short duration physical activity breaks without academic content present conflicting results related to student behavior. For example, in a study conducted by Wilson, Olds, Lushington, Petkov, and Dollman (2016), 10-min physical activity breaks had no effect on attention levels or on-task behavior for 5th and 6th grade students whereas Ma et al. (2014) showed that a four-minute-high intensity interval activity decreased off-task behavior in 2nd and 4th grade students. Both studies compared behavior between students participating in acute active and sedentary breaks, but did not compare behavior of individual students over time. The current study is the first to demonstrate persistent changes in classroom behavior with the addition of short duration physical activity breaks, changes that developed after students were given the chance to adapt to a daily routine that included energizer lessons. Additionally, results in the current study suggest that as children age, the impact of physical activity breaks may decrease which may explain why some studies have not been able to measure behavior changes. It is also possible that the addition of academic content helps students maintain engagement thereby improving the quality of short physical activity breaks. Interestingly, results showed no difference in noncompliant or inattentive behaviors between control and experimental groups. One possible explanation for this result is that the significant changes in these off-task behaviors are primarily a result of students learning teacher expectations, changes that plateaued after 6-weeks. Disruptive behaviors, on the other hand, which are by definition more physical, may have been influenced by time as well as the opportunity to move around more during the school day in experimental classrooms.

As an extension of results from other studies, the increase in percent time spent on-task and the decrease in the frequency of disruptive behaviors with the implementation of 1-Minute Energizers may improve academic performance in topic areas not specific to the energizer curriculum, benefits that are likely to continue into subsequent academic years (Alexander, Entwisle, & Dauber, 1993; Malecki & Elliot, 2002; Turney & McLanahan, 2015). Notably, although kindergarten students exhibited the smallest improvement in quiz performance relative to 1st and 2nd grade students, there was a trend for a greater decline in noncompliant and disruptive behavior after the six weeks. Therefore, a longer duration study may have resulted in more significant learning improvements for this age group.

According to the feedback received from teachers who participated in the study, the 1-Minute Energizer curriculum is a practical and convenient supplement to the lessons they traditionally deliver in their classroom with the advantage of covering health concepts that are not frequently introduced. Interestingly, results from this study confirm that interactive instruction methods whether it

be in the form of arts and crafts, discussion, or physical activity help to enhance the learning environment by decreasing negative classroom behaviors.

6. Study strengths and limitations

This study is strengthened by its mixed model design, the use of a content standard-based curriculum, and its control for teacher compliance. The study also suffers from duration limitations and the lack of intermediate and follow-up data collection periods. Consequently, the minimum intervention duration needed to induce benefits, the degree to which teachers will voluntarily continue to incorporate 1-Minute Energizers into their instruction, or the long-term effects of the intervention are unknown.

Future studies should examine the influence of physical activity lessons on voluntary physical activity participation both at school and at home. Studies should also be performed to determine the impact of short physical activity-infused lessons on engagement and performance in other content areas.

7. Conclusions

In conclusion, 1-Minute Energizers, which include brief academic lessons delivered with physical activity, are an effective instructional tool for increasing health and science knowledge with the added benefits of improving student focus and opportunities for daily physical activity participation. Previous research demonstrates that physical activity participation achieved through active breaks like those delivered through 1-Minute Energizers may also decrease the risk for obesity, provide protective effects on cardiometabolic health, and improve executive functioning, attention, and other cognitive skills (Drollette et al., 2014; Dwyer et al., 2001; Howie et al., 2015; Lambourne et al., 2013; McManus et al., 2015; Pindus et al., 2016; Saunders et al., 2013). As a result of the complimentary results presented here and in other studies, more widespread support for physical activity lesson resources and teacher trainings are recommended.

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