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"Walkabouts" Integrated Physical Activities from Preschool to Second Grade: Feasibility and Effect on Classroom Engagement

Spyridoula Vazou[1] · Katharine Long[1] · Kimberley D. Lakes[2] · Nicolle L. Whalen[3]

Abstract

Background An evolving literature demonstrates that physical activity in the classroom represents a promising avenue not only for increasing the physical activity of youth but also for facilitating academic achievement and classroom engagement. However, structured physical activity programs that make clear connections with the academic standards across different grades are limited.

Objective The purpose of this study was to examine the feasibility and effectiveness of the "Walkabouts", a web-based physically active learning program, on attention and behavioral control of children.

Method Twelve preK to 2nd grade classes ($N = 245$ students) were assigned to the intervention (integrating "Walkabouts" with academics) or control (no added movement) group. Teacher ratings of students' attention and behavioral control in the classroom were collected before and after the 7-week intervention in both groups. Treatment fidelity was monitored through observations and daily teacher logs.

Results Teachers perceived the Walkabouts to be feasible, physically active, of appropriate difficulty, and enjoyable for the students. MANOVAs showed a significant time by group interaction, meaning that the intervention group improved significantly more, compared to the control group, in both attention and behavioral control whereas the control group declined over time. A significant time by group by grade interaction showed that the benefit of Walkabouts was larger for the Kindergarten students.

Conclusions Integrating movement with academic subjects with programs such as the Walkabouts, may facilitate learning and academic achievement by increasing cognitive and behavioral control in the classroom. Schools can focus on academic achievement goals without sacrificing physical activity throughout the school day.

Keywords Active learning · Movement · Cognition · Activity break · Intervention · School

✉ Spyridoula Vazou
svazou@iastate.edu

Extended author information available on the last page of the article

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Introduction

In recent years, the body of evidence, while still developing, is strong enough to support that physical activity is beneficial to cognitive function and academic performance (Donnelly et al. 2016; Owen et al. 2016; Singh et al. 2019) as well as to a variety of health outcomes, including feeling better, sleeping better, and performing daily tasks more easily (King et al. 2018). It is remarkable that, for the first time, the ASCD (former Association for Supervision and Curriculum Development), a leading educational agency, in collaboration with the Centers for Disease Control and Prevention adopted a joint goal to promote learning and health through the whole-school, whole-community, whole-child model (WSCC model; ASCD 2014). According to the WSCC model, which is built on the five tenets of ASCD's Whole Child Initiative (healthy, safe, engaged, supported, and challenged), children need to be healthy and safe in order to attain higher academic performance. Academic performance is defined broadly not only based on academic achievement, such as grades and standardized test scores, but also based on cognitive skills and attitudes, such as memory, attention/concentration, and verbal ability, as well as academic behavior, meaning conduct, attendance, and time-on-task (CDC 2010).

The need to include more physical activity throughout the school day has been emphasized by several national organizations (e.g., the National Academy of Medicine [former Institute of Medicine], SHAPE America). It is recommended that children should accumulate 60 min of physical activity within the school environment through a variety of approaches in addition to physical education, including the academic classroom, recess, as well as through before and after school programs (IOM 2013). Classroom-based physical activity has received increasing attention over the last decade, with a burgeoning empirical literature supporting that physical activity in the classroom is a promising strategy that could promote learning and academic performance (Donnelly and Lambourne 2011; Norris et al. 2015; Watson et al. 2017; Webster et al. 2015), as well as motivation and enjoyment (Howie et al. 2014; Mavilidi et al. 2016; Vazou et al. 2012; Vazou and Skrade 2017). The most commonly recommended and researched strategies of adding movement in the academic classroom is through short activity breaks (unrelated to the learning task), as an energy booster, or through integration with the academic subjects to teach new concepts or review recently learned concepts (Vazou et al. 2020; Webster et al. 2015).

Classroom-based physical activity interventions were evaluated in a recent review and meta-analysis, showing that classroom-based physical activity increased on-task behavior and led to improvements in academic achievement, whereas the effects were not significant for cognitive function outcomes (Watson et al. 2017). However, this meta-analysis did not differentiate the effect of activity breaks and integrated physical activities. Positive effects of classroom-based physical activities on academic-related outcomes were found in another meta-analysis that included four intervention studies (Erwin et al. 2012b). A systematic review conducted only on integrated physical activities showed that academic performance either significantly improved or was no different compared to inactive lessons (Norris et al. 2015). Owen's meta-analysis (2016), on the other hand, found that only the effect of interventions with activity breaks (4 studies included) was significant on school engagement (including time-on-task, emotions, and cognition), compared to integrated physical activity (5 studies) and recess (3 studies) interventions. However, it is important to emphasize that interpretation of the results from these meta-analyses should be conducted with caution due to the very small number of studies included, the lack of differentiation between activity breaks and integrated physical activities in some cases, the differences

in the characteristics of the interventions (e.g., acute vs. long-term interventions, different types of comparison groups), and the absence of the inclusion of interventions conducted in the preschool environment.

There is a growing number of interventions focused on the effectiveness of integrated physical activities on academic outcomes in elementary schools, with promising results. The integration of physical activities with mathematical concepts has received more attention in the literature, especially in the upper elementary (2^{nd} -5^{th}) grades, with most studies showing significant improvements in math learning, math fluency, and classroom engagement (DeGreeff et al. 2016; Donnelly and Lambourne 2011; Erwin et al. 2012a; Fedewa et al. 2015; Goh et al. 2016; Mullender et al. 2015; Szabo-Reed et al. 2019; Vazou and Skrade 2017), and fewer studies showing no significant differences compared to the traditional learning methods (Reed et al. 2010; Riley et al. 2016). Importantly, no studies have shown an effect favoring traditional instructional methods over the integrated physical activities. Of the existing studies, two interventions were conducted with children of lower elementary grades (Egger et al. 2019; Have et al. 2018), both showing significant improvements in math performance.

The programs that have examined the integration of physical activities with language arts and literacy are fewer in number and have yielded mixed results across different age groups. While there are studies that have found the integration of physical activity with language arts to be beneficial for memory and literacy in preschool classes (Mavilidi et al. 2015; Kirk et al. 2014), with upper elementary grades there were mixed results. Specifically, in some studies with upper elementary grades the integrated lessons were found to result in significant improvements in reading fluency and spelling (Erwin et al. 2012a; DeGreeff et al. 2016), whereas in other studies spelling or reading performance did not differ from the control group (Egger et al. 2019; Fedewa et al. 2015; Mavilidi et al. 2018; Reed et al. 2010; Szabo-Reed et al. 2019). In the studies conducted with preschool children, integrated learning included a close connection of the cognitive and the sensorimotor practice, by, for example, using the whole body to act out words during the foreign language learning (Mavilidi et al. 2015) or the rhyming practice (Kirk et al. 2014). According to the embodied cognition theory, enhanced memory and learning occur when large motor actions and sensorimotor experiences contribute to higher-quality mental representations during learning (Madan and Singhal 2012). Therefore, those qualitative characteristics of the integrated physical activities may had been responsible for the enhanced learning in the intervention groups, compared to the control groups.

Even though studies are limited in number, the effect of integrated physical activities, compared to activity breaks and traditional learning, on academic outcomes has been explored in both acute and chronic interventions, with findings showing that the largest learning and academic benefits are accrued when physical activity is integrated with academic subjects, compared to activity breaks (Egger et al. 2019; Mavilidi et al. 2015; Schmidt et al. 2016). Integrating physical activities with academic subjects is a strategy that is preferred by teachers, as shown in a number of recent qualitative studies (Dinkel et al. 2017; Mullins et al. 2019; Stylianou et al. 2016; Van der Berg et al. 2017). Based on a nationally representative survey (Turner and Chaloupka 2017), in 71.7% of schools at least one teacher had used integrated physical activities, although the degree of adoption within each school varied widely. In order for integrated physical activities to be established as an appealing strategy in the academic classroom, it is important to consider teacher's perspectives and contextual factors that could facilitate or undermine their successful implementation (Carlson et al. 2017; Dinkel et al. 2017; Michael et al. 2019; Calvert et al. 2018). Lack of time, space, support, and teacher's perceived

competence as well as students' difficulty to refocus on the academic task have been identified by teachers as substantial barriers to the implementation of classroom-based physical activities (Carlson et al. 2017; Dinkel et al. 2017; Michael et al. 2019; Goh et al. 2017; Quarmby et al. 2019; Routen et al. 2018; Stylianou et al. 2016). On the other hand, classroom-based physical activities that are easy (simple, ready-to-use material, require no equipment) and short (5–10 min) seem to be favored by teachers across different grades (McMullen et al. 2014; Michael et al. 2019; Stylianou et al. 2016; Van den Berg et al. 2017), with integrated physical activities being even more favorable as time is not taken away from academics and the curricular content is reinforced (Martin and Murtagh 2017; McMullen et al. 2014; Van den Berg et al. 2017).

Ready-to-use material, through DVDs, interactive boards, or websites have been utilized by teachers as a solution to keeping material "easy," but in most cases those materials focus on providing activity breaks (e.g., fitness tasks, dances) and less frequently integrate academic content aligned with the curricular content (Erwin et al. 2012a; Dinkel et al. 2017; Norris et al.2016; Van den Berg et al. 2016; Vazou et al. 2020; Whitt-Glover et al. 2011). For example, a website with dance videos was used by half of the teachers in the study by Dinkel et al. (2017), and teachers reported that the videos were well received by younger students but were perceived as somewhat silly by older students. Therefore, the potential for successful implementation of integrated physical activity programs could be maximized when programs are easy to implement and teachers won't have to spend additional time to develop material and build specific skills to demonstrate and teach the integrated physical activities.

Furthermore, it should be emphasized that in order for a novel integrated physical activity program to be adopted and implemented in school, teachers need to receive information about the efficacy and effectiveness of the program. This information is obtained through program evaluation, and more specifically, process and outcome evaluations. Program evaluation is important because it provides the opportunity to understand how the program operates and its effectiveness on outcomes that are valued by the targeted audience (Saunders et al. 2005).

Therefore, the purpose of this study was to examine the feasibility and effectiveness of an interactive video-based program called "Walkabouts" that integrates physical activities with math and language arts concepts from the preschool to the second-grade level. Specifically, the study focused on the following two objectives: 1) to assess the feasibility and level of implementation of the program, and 2) to measure the effectiveness of the integrated Walkabouts with math and language arts on students' classroom behavioral control and attention, compared to traditional teaching, from preschool to second grade.

Method

Participants

The participants were 245 children (Intervention $n = 158$, $M_{age} = 6.01 \pm 1.45$; Control $n = 87$, $M_{age} = 5.33 \pm 1.44$) from twelve preschool-to-second grade classes in three rural elementary schools from the same school district. The demographics for gender, grade, ethnicity of students, and the number of teachers and classes from the intervention and the control group are presented in Table 1.

Table 1 Participant characteristics of walkabouts (intervention) and traditional (control) group

Participants	Intervention ($n=158$)	Control ($n=87$)	Total ($n=245$)
Gender			
Male	92 (58.2%)	49 (55.7%)	140
Female	66 (41.8%)	39 (44.3%)	105
Grade			
Preschool	37 (23.4%)	40 (45.5%)	77
Kindergarten	26 (16.5%)	25 (28.4%)	50
1st Grade[#]	45 (28.5%)	–	45
2nd Grade	50 (31.6%)	23 (26.1%)	73
Ethnicity			
Caucasian	145 (91.8%)	77 (87.5%)	222
Asian	4 (2.5%)	1 (1.1%)	5
Hispanic	5 (3.2%)	–	5
Other	3 (1.9%)	2 (2.3%)	5
missing values	1 (0.6%)	7 (8.0%)	8
Number of teachers	7	4	11
Number of classes	8	4	12
Class size	$M=21.8$ ($SD=5.13$)	$M=22$ ($SD=2.16$)	

[#]The 1st Grade students were not included in the analysis due to lack of comparison group

Design and Treatment

This study used a two-group quasi-experimental design with teachers selecting their involvement in the intervention or control group based on their willingness to integrate physical activities with academics. Teachers in the intervention group were asked to use "Walkabouts" in the classroom three times per week for 7 weeks, for an overall 20 school days. Teachers in the control group were asked to continue with their regular teaching strategies and activities. Teacher consent forms were collected before the intervention. All student data were de-identified to protect student anonymity. The study satisfied the criteria for being exempt from the requirement of signed informed consent from students and parents, as approved by the University Institutional Review Board (IRB).

"Walkabouts" Walkabouts is a commercially available web-based program that integrates fundamental movements, such as hopping, jumping, marching, stretching, with math and language arts in the academic classroom from preschool to second grade. Teachers log into an online platform (www.activedinc.com) and select a Walkabout video based on the grade, subject, common core standards, and their learning objectives. Walkabouts correlate with each state's specific standards in mathematics and English language arts per grade. For example, students are asked to lunge to the left, jump in the middle or lunge to the right to provide an answer based on the question asked [e.g., "Choose the shapes that were joined to make a rectangle". Standards: Compose simple shapes to form larger shapes. (K.G.6.) (DOK 2,3)]. The program includes a large number of sessions that teachers can select from that best suit the content being taught at that time. Walkabouts are projected

on classroom whiteboards, last about 7–10 min, and include active learning through interactive, kid-friendly characters and stories/adventures. The content in each Walkabout changes each time they are played to provide teachers and students a novel experience and to prevent students anticipating each question. Walkabouts do not require a large space area as students can stand and move by their desks. No equipment is needed for the Walkabouts. Teachers can participate with the students or stand and lead the Walkabouts played on the whiteboard. Follow-up questions and worksheets for each Walkabout are available for use by the teacher.

Measures

Teacher Logs

To assess intervention fidelity, teachers in the intervention group used a daily log to record the name and frequency of the Walkabouts used in the classroom, whether or not worksheets were utilized, whether the teacher participated with the students, the perception of the teachers about their overall experience in using each Walkabout, and their perceptions of student experiences. Teachers rated on a scale from 1 to 5 (with 1 representing low levels and 5 high) how satisfied they were with the activity and how focused they believed the students were during the activity. Further, teachers rated how physically engaged the students were and if the students enjoyed the activity on a scale from 1 to 3 (1 = not at all, 3 = very), as well as how the appropriate the activity was for students (1 = very easy, 2 = appropriate level, 3 = very hard). On days when the teachers did not conduct a Walkabout, the log for that day was not completed.

System for Observing Student Movement in Academic Routines and Transitions (SOSMART)

SOSMART was also used as a fidelity measure to record the level and quality of movement during the Walkabouts. SOSMART has been shown to be a valid and reliable method of measuring movement in the classroom (Russ et al. 2017). Students' levels of activity based on the parts of the body that were active (upper body, lower body, full body) as well as the observed level of intensity (sedentary, light, moderate to vigorous physical activity) were measured.

Observations were conducted by two trained observers for the entire class and not for specific students. Once a Walkabout started, the coding began and continued on a 20-s interval until the activity was complete. Observers were synced in time via a tone that sounded every 20 s through split head phones. The observers sat at the back or the side of the classrooms, in a place where they had a good view of the majority of the class without causing a distraction.

Attention and Behavioral Control in the Classroom

The 18-item Strengths and Weaknesses of ADHD-symptoms and Normal behavior (SWAN) rating scale (Swanson et al. 2012) was used to measure two factors, Attention (9 items) and Hyperactivity or Behavioral Control (9 items) in the classroom. The scale

was developed to measure Attention Deficit Hyperactivity Disorder (ADHD) symptoms (inattention, hyperactivity) using a distributional approach that would produce a normal curve in the population (Swanson et al. 2012), positing that attention and behavioral control occur in a continuum in the population, and ADHD represents a clinical group with impairment in these domains. The SWAN has been used in a number of population-based studies and has produced normal distributions in school-based studies (Swanson et al. 2012). The scale is appropriate for use from preschool age and beyond (Lakes et al. 2012), and in this study, it was completed by the teacher for each student. Example questions include "Gives close attention to detail and avoids careless mistakes" (Attention) and "settle down and rest (control constant activity)" (Behavioral Control). Each item is rated using a seven-point response scale, ranging from "far below average" (rated as a 1 in this study) to "far above average" (rated as a 7 in this study); thus, in this study, a rating of 4 was considered "average".

Procedure

Before and after the 7-week intervention period, all teachers completed the SWAN questionnaire for each student in their classroom. Upon completion of the pretest, teachers in the intervention group received access to the Walkabouts website. A short 30-min training on the features of the website was provided by the research team. The teachers in the control group were informed that they would receive access to the Walkabouts upon completion of the intervention period.

During the implementation period, the daily teacher log was completed by teachers in the intervention group. Two researchers observed each intervention classroom once and rated movement using the SOSMART system, to further assess intervention fidelity. The observations were conducted around week four after the teachers and students were normalized to the Walkabouts. The time of day for the observation was selected based on when the teacher usually implemented the Walkabouts.

Data Analysis

Descriptive statistics for intervention fidelity (SOSMART) and feasibility (teacher logs) data were analyzed with Excel. Quantitative outcomes data were analyzed using the Statistical Package for Social Sciences (IBM SPSS Statistics 23). In order to examine changes in attention and behavioral control resulting from two interventions, namely Walkabouts and traditional classroom instruction, a mixed-plot analyses of variance (MANOVA) was conducted with two groups (intervention, control) for the between-subject factor and two time points (pre, post) for the within-subject factor. The MANOVA was conducted with two dependent variables, namely attention and behavioral control. Differences based on grade level and gender were also explored in the same analysis. Follow-up repeated-measure ANOVAs were conducted when MANOVA proved significant, as well as for significant group by grade interaction. Due to lack of data from the first grade in the control group, first grade was excluded from the analysis. Effect sizes for differences between means were calculated using Cohen's *d*.

Results

Feasibility of the Walkabouts

Teacher Log Data

Six out of the seven intervention teachers returned the daily teacher log. Five of the six teachers implemented the activities on average 96% (19 out of 20 times) of the recommended days per week (3 days per week). One teacher in first grade implemented the activities 45% (9 out of 20) of the recommended days. Three teachers participated in the Walkabouts with the students all of the time and three teachers participated around three quarters of the time (75–80%). Almost all of the teachers did not use the worksheets (99%). The descriptive statistics for the teacher log questions are presented in Table 2. The mean scores show that the teachers were satisfied with the activities, and reported that the content and the movements included in the Walkabouts were at appropriate level for the students. Teachers also reported that the students were focused, were physically engaged, and enjoyed the Walkabouts.

Observations of the Implementation of Walkabouts

When a Walkabout was introduced by the teacher, the students were engaged in light physical activity the majority of the time (88%), mainly by using their full body (34%) or their lower body (34%). Only 1% of the time, students were sitting. Occasionally, just the upper body (23%) was actively moving. The students were engaged in moderate to vigorous physical activity 6% of the time. It should be noted that the percentages do not add up to 100% because within the same observation period multiple behaviors could be observed and coded for the same 20 s time period (e.g., half of the students standing and half using the full body). The inter-rater reliability was acceptable (88%) between the two observers.

Table 2 Descriptive statistics for Walkabout implementation (teacher logs)

Questions	*Mean*	*SD*	Rating scale
How satisfied are you with the Walkabout activity?	3.62	1.03	1–5
How focused do you think the students were in the lesson content during the Walkabout?	3.43	0.80	1–5
How physically engaged were the students during the Walkabout?	2.60	0.54	1–3
Related to content, how was the Walkabout for the students?	2.03	0.30	1—very easy ($n=3$) 2—appropriate level ($n=88$) 3—very hard ($n=6$)
Related to motor skills, how was the Walkabout for the students?	1.82	0.39	1—very easy ($n=17$) 2—appropriate level ($n=78$) 3—very hard ($n=0$)
Did the students enjoy the Walkabout?	2.66	0.52	1–3

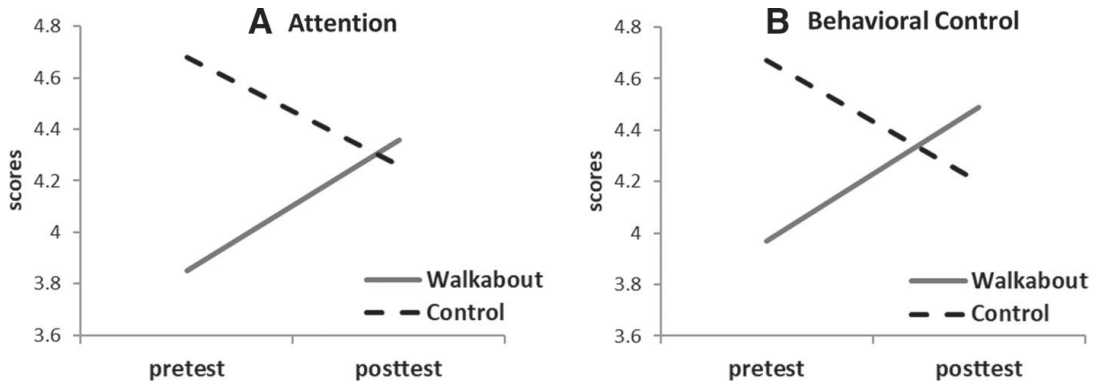

Fig. 1 Time × group interaction on attention and behavioral control

Table 3 Descriptive statistics for attention and behavioral control based on time, group, and grade

Variable	Walkabouts				Control			
	N	Pre M ± SD	Post M ± SD	Pre–post ES	N	Pre M ± SD	Post M ± SD	Pre–post ES
*Attention*Attention								
preK	37	3.99 ± 1.81	4.17 ± 1.80	0.10	40	4.05 ± 1.23	3.99 ± 0.68	− 0.06
K	26	3.46 ± 0.41	4.39 ± 0.63	**1.75**	24	5.84 ± 1.65	4.67 ± 1.58	**− 0.72**
2nd	50	3.95 ± 1.25	4.49 ± 1.15	**0.45**	23	4.57 ± 1.08	4.33 ± 0.98	− 0.23
Behavioral control								
preK	37	4.13 ± 1.92	4.36 ± 1.82	0.14	40	3.95 ± 1.21	3.89 ± 0.70	− 0.06
K	26	3.52 ± 0.47	4.33 ± 0.72	**1.33**	24	6.02 ± 1.65	4.80 ± 1.61	**− 0.75**
2nd	50	4.09 ± 1.23	4.67 ± 1.14	**0.49**	23	4.53 ± 1.18	4.12 ± 1.02	**− 0.37**

PreK Preschool, *K* Kindergarten, *2nd* second grade, *M* mean, *SD* standard deviation, *ES* effect size, effect sizes on bold show significant follow-up pre-to-post test comparisons based on the ANOVA analysis

Effectiveness of the Walkabouts on Classroom Behavior

Multivariate ANOVAs showed a significant time by group interaction for attention ($F(1,194) = 64.95$, $p < .001$, $\eta^2 = .25$) and for behavioral control ($F(1,194) = 59.22$, $p < .001$, $\eta^2 = .24$), a significant time by group by grade interaction for attention ($F(2,194) = 17.23$, $p < .001$, $\eta^2 = .15$) and for behavioral control ($F(2,194) = 11.92$, $p < .001$, $\eta^2 = .11$), and a significant group by grade interaction for attention ($F(2,194) = 5.33$, $p = .006$, $\eta^2 = .05$) and for behavioral control ($F(2,194) = 9.09$, $p < .001$, $\eta^2 = .09$). All of the mean scores, the standard deviations and the pre-post difference effect sizes are presented in Table 3. Gender differences were also examined, but no main or interaction effects were identified for either attention or behavioral control.

Based on the time by group interaction, the group that implemented the Walkabouts showed an improvement that outperformed the control group from the beginning to the end of the implementation period on both attention and behavioral control, whereas the control group declined in both attention and behavioral control from the beginning to the end of the 7-week implementation period (Fig. 1).

In order to interpret the three-way interaction of time (pre, post), group (intervention, control), and grade (preK, K, 2nd), follow-up repeated-measure ANOVAs were conducted

for each grade separately. Results showed that for the preschool children there was no significant difference between groups on both attention and behavioral control (see Table 3).

For the kindergarten classes, there was a significant main effect and time x group interaction for both attention ($F(1,48) = 17.28$, $p < .001$, $\eta^2 = .26$; $F(1,48) = 116.18$, $p < .001$, $\eta^2 = .71$, respectively) and behavioral control ($F(1,48) = 21.84$, $p < .001$, $\eta^2 = .31$; $F(1,48) = 61.23$, $p < .001$, $\eta^2 = .56$, respectively). For both attention and behavioral control, the intervention group significantly improved over the implementation period of the Walkabouts ($t = 105.69$, $p = .000$, $d = 1.75$; $t = 50.19$, $p = .000$, $d = 1.33$, respectively), whereas the control group significantly decreased over time ($t = 43.16$, $p = .000$, $d = -.72$; $t = 25.83$, $p = .000$, $d = -.75$, respectively). For second grade classes, the time x group interaction was significant for both attention ($F(1,71) = 10.21$, $p = .002$, $\eta^2 = .13$) and behavioral control ($F(1,71) = 12.84$, $p = .001$, $\eta^2 = .15$). The intervention group significantly improved on both attention and behavioral control ($t = 12.18$, $p = .001$, $d = 0.45$; $t = 10.78$, $p = .002$, $d = 0.49$, respectively). The control group, though, had a significant decrease ($t = 9.36$, $p = .006$, $d = -.37$) from pre to post intervention period only on behavioral control (Table 3).

Discussion

This manuscript describes results from a 7-week intervention study examining (a) the perceived feasibility of Walkabouts, which is a video-based program that integrates physical activity with math and language arts, and (b) the effectiveness of Walkabouts on classroom attention and behavioral control in students from preschool to second grade. For research to become more pragmatic it is essential for novel programs to be evaluated on effectiveness as well as on feasibility through detailed process evaluation methods, covering not only the extent of implementation and fidelity but also the level of perceived feasibility, appropriateness, and satisfaction of teachers and students.

Intervention fidelity results showed that the implementation of the short (7–10 min), video-based Walkabouts three times per week seemed to be a realistic and feasible goal for preschool to second grade teachers. A duration of 5–10 min has been identified as the most preferred duration of classroom-based physical activities by teachers (Howie et al. 2014; McMullen et al. 2014; Van den Berg et al. 2017). Including integrated physical activities on a daily basis has been shown to be challenging in many intervention studies as teachers often identify lack of time as one of the biggest barriers (Carlson et al. 2017; Goh et al. 2017; Michael et al. 2019; Routen et al. 2018; Stylianou et al. 2016). Further, it has been reported that teachers need autonomy and flexibility on how frequently they should implement classroom-based physical activities based on the daily academic demands as well as the needs of their students (e.g., be able to spontaneously implement physical activity when students seem off-task or have hard time understanding the content) (Routen et al. 2018; Watson et al. 2019).

The results also showed that Walkabouts were well-received by both teachers and students. Specifically, the teachers were satisfied with the Walkabouts, and they reported that the students were highly focused, very physically engaged, and it was evident to the teachers that the students enjoyed the Walkabouts. Further, the teachers perceived that the Walkabouts were at an appropriate level regarding motor skills and academic content difficulty. Providing activities that are not at an appropriate level for the students (e.g., being too silly, or too easy) has been identified as a barrier for the implementation of classroom-based physical activities and should be considered when evaluating the quality of such programs

(Dinkel et al. 2017; Michael et al. 2019). The high levels of student enjoyment found in this study, as observed by the teachers, is a notable finding, as enjoyment has been linked to student academic motivation (Vazou et al. 2012). Student enjoyment of classroom-based physical activities has also been acknowledged as critical for the motivation of teachers to implement such programs (Calvert et al. 2018; McMullen et al. 2014, 2016; Michael et al. 2019). It should be highlighted that the Walkabouts are ready-to-use on demand video lessons that do not require any preparation time or specific demonstration skills by the teachers while at the same time their content is focused on curricular-based academic concepts. Those characteristics have been identified as important for the feasibility of classroom-based physical activity programs (Michael et al. 2019; Quarmby et al. 2019; Routen et al. 2018; Stylianou et al. 2016; Van den Berg et al. 2017) and possibly have contributed to the overall satisfaction with the program by the teachers.

Based on the teacher log results, half of the teachers participated in the Walkabouts, along with the students, regardless the fact that teacher participation was not required due to the nature of the activities (ready-to-use videos). Teacher participation should be encouraged as it shows receptivity to the integrated physical activities that in turn may change other teacher's attitudes and promote a positive implementation climate among teachers (Carlson et al. 2017). An active teaching style and teacher's positive attitudes or experiences from physical activity have been identified as facilitators of (or lack of them as barriers to) classroom-based physical activity (Calvert et al. 2018; Michael et al. 2019; Quarmby et al. 2019; Routen et al. 2018; Vazou and Vlachopoulos 2014).

The Walkabouts were accompanied by worksheets for teachers to use in the classroom after the completion of the videos. Based on the results, the worksheets were not used by the teachers in this study. It is possible that the videos alone were adequate for the needs of the students and the worksheets were not perceived as necessary by the teachers. However, the exact reasons the worksheets were not used needs further examination in future studies.

The results from the observations showed that students were engaged in light physical activity the majority of the time (88%) with large body movements and 6% of the time were observed to be in moderate-to-vigorous physical activity, meaning about 1 min on moderate-to-vigorous physical activity and 6–8 min on light physical activity. Previous interventions have reported an accumulation of 2–4 min of moderate-to-vigorous physical activity in the lessons that were integrated with academic subjects (Norris et al. 2018; Riley et al. 2016; Vazou et al. 2018). Even though the actual duration in moderate-to-vigorous intensity was low it was not negligible as the effect size was moderate and the differences in on-task behavior in favor of the intervention group, compared to the control, were significant (Norris et al. 2018; Riley et al. 2016). It is noteworthy that the majority of the time students were not sedentary. The number of intervention studies that included light physical activity in the academic classroom has increased in the literature, with 14 studies been identified in a recent systematic review on classroom integration (Vazou et al. 2020). Light physical activity was achieved either with environmental changes, such as standing and dynamic sitting in stability balls, or with stretching, yoga, and coordination or manipulative exercises. However, studies that have looked at the effect of classroom-based physical activity interventions on sedentary behavior are limited and with inconclusive results (McMichan et al. 2018).

Another finding is that the Walkabouts were perceived by the teachers as developmentally appropriate regarding their motor task difficulty. There is a burgeoning literature arguing that the intensity of exercise is one of the qualitative characteristics that affect cognition, with the level of cognitive engagement and the motor coordination or complexity of the motor tasks are additional qualitative characteristics that affect cognitive outcomes

(Myer et al. 2015; Pesce 2012; Pesce and Ben-Soussan 2016; Vazou et al. 2019). For example, Schmidt et al. (2016) found that the condition of an intervention that focused exclusively on aerobic exercise did not accrue the same cognitive benefits compared to the cognitively engaging physical activity condition.

The results from the 7-week intervention demonstrated that Walkabouts elicited significant improvements on student's attention and behavioral control in the classroom, compared to the control classes that showed significant declines across time. The accrued benefits from the Walkabouts are in line with previous research showing positive effects on on-task behavior (Goh et al. 2016; Mavilidi et al. 2018; Mullender et al. 2015; Norris et al. 2016; Riley et al. 2016) and on cognitive control (Egger et al. 2019) after longitudinal integrated physical activity interventions. On the other hand, the significant decline on attention and behavioral control across time for the traditional lessons in the control group may be attributed to the lack of variability in instruction. Children have short attention span and underdeveloped self-regulation skills that reach to maturation with age (Rebok et al. 1997; Romine and Reynolds 2005) and therefore the classroom environment needs to have variety and be stimulating to keep students' attention high. As research shows, playful physical activities as well as variability during instruction can increase cognitive engagement (Pesce et al. 2019; Tomporowski et al. 2015) and motivation for learning (Vazou and Skrade 2017).

The classroom environment should be stimulating to keep students' attention high, as there is evidence showing that inattentive first graders with normal reading scores after kindergarten were at risk for poor reading outcomes later (Rabiner and Coie 2000). Further, students with high inattentiveness are those who show the greatest improvements in on-task behavior after classroom-based physical activities (Mahar et al. 2006). In the current study, the control classes had higher baseline scores on both attention and behavioral control, compared to the intervention group. Considering that the decision to join the intervention or control group was made by the teachers, it is possible that the control teachers started with very well-behaved students and possibly felt that they didn't need the Walkabout intervention to help their students stay focused in the classroom. However, as the results show, programs like the Walkabouts could help increase or maintain the levels of attention and behavioral control across time.

Furthermore, a significant time by group by grade interaction was found in the current study, showing that the changes were not similar across grades on both attention and behavioral control. Follow-up analysis showed that on both attention and behavioral control the kindergarten and second-grade students benefited significantly from the Walkabouts intervention, compared to the traditional lessons, whereas the improvement was small and not significant across groups for the preschoolers. The non-significant change on both the Walkabouts and the control group in the preschool setting may be attributed to the fact that preschoolers are in general more physically active in the classroom and have more freedom to transition from large to small group play conditions. It is also possible that the dose of the intervention may not have been long enough to be effective for that age group. Preschoolers may need more time to learn new routines and benefit from innovations in the classroom. However, those hypotheses need further investigation in the future. The difference on the findings between the preschool and the kindergarten classrooms may also be explained by the changes in the school setting and its limitations. As children enter kindergarten, they transition from a more active or liberal environment found in the preschool setting or at home to a more structured and sedentary one. Therefore, the need to keep student active while learning may be even higher for that grade, as shown from the results of this study.

Among the limitations of the current study is the lack of randomization between the intervention and control classes. Teachers were given the choice to select whether they wanted to implement the Walkabouts in their classroom or continue with their regular instructional practices. This approach was adopted in order for the implementation of the Walkabouts to be more pragmatic based on the willingness of the teachers to evaluate this innovative teaching method. Additional evaluation of the Walkabouts with a larger sample and a randomized controlled trial is needed. Further, the duration of the Walkabouts intervention was 7-weeks, which is consistent with other long-term classroom based physical activity interventions (Vazou et al. 2020), however, intervention of longer duration and with follow-up testing can provide more information regarding adoption, feasibility, and effectiveness and should be further examined with the Walkabouts program. Another limitation of this study is that even though teachers in the traditional classroom instruction were asked not to make any changes on their program, no measures were taken to determine what occurred in the control classrooms. Further, the levels of physical activity during the Walkabouts were measured with direct observations. Future studies should objectively assess the energy expenditure with the use of heart rate monitors or accelerometers during the integrated Walkabouts lessons, as well as during the traditional lessons.

To conclude, the findings of the present study provide evidence that the Walkabouts were perceived as feasible to implement, with high levels of satisfaction from teachers regarding their appropriateness and easiness, and can help students engage in more physical activity in the classroom while increasing attention and behavioral control. Schools can focus on academic achievement goals without sacrificing physical activity throughout the school day. Implementing programs that integrate physical activity with academic subjects, such as the Walkabouts, may facilitate learning and academic achievement by increasing attention and behavioral control in the classroom. Discovering effective strategies for improving attention span and behavioral control in the classroom should be of interest to stakeholders across the educational spectrum, including teachers, school leaders, and parents.

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Compliance with Ethical Standards

Conflict of interest The first author (SV) received a research Grant from ActivEd. All other authors (KL, KDL, NLW) declare that they have no conflict of interest.

Ethical Approval The study satisfied the criteria for being exempt from the requirement of signed informed consent from students and parents, as approved by the University Institutional Review Board (IRB).

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Affiliations

Spyridoula Vazou[1] · Katharine Long[1] · Kimberley D. Lakes[2] · Nicolle L. Whalen[3]

Katharine Long
knlong21@gmail.com

Kimberley D. Lakes
kimberley.lakes@medsch.ucr.edu

Nicolle L. Whalen
nicolle.whalen@simpson.edu

[1] Department of Kinesiology, Iowa State University, 534 Wallace Road, Ames, IA 50011, USA

[2] Department of Psychiatry and Neuroscience, University of California, Riverside, CA, USA

[3] Department of Sport Science and Health Education, Simpson College, Indianola, IA, USA