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Effects of a 16-Week Online Classroom Physical Activity Integration Course on Student-Level Outcomes

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ABSTRACT
Background: Teachers can help students meet physical activity (PA) recommendations by integrating PA into the classroom. Few studies have evaluated student PA after teacher-received professional development. Purpose: This study measured student PA outcomes from an online, 16-week course for teachers on classroom PA integration. Course-enrolled (“intervention”) teachers were asked to integrate 30 minutes of daily PA into their classrooms and collaborate with teachers in their school, referred to as “PA Partners.” Methods: Eighty-two students from the classrooms of seven teachers (3 intervention, 4 PA Partners) wore accelerometers during school at the beginning and end of the 16-week course. Multilevel mixed effect models were used to examine PA pre to post. Results: At the beginning of the course, students with intervention teachers spent a larger percentage of time in moderate-to-vigorous PA (MVPA) than students of PA Partners. MVPA did not change across the duration of the course for intervention students, but MVPA for students of PA Partners increased significantly (boys: 3.3%; girls: 1.6%; p < .01). Discussion: Findings suggest the course had ancillary impacts on non-enrolled PA Partners. Translation to Health Education Practice: Health educators should encourage interpersonal-level resources from the social ecological model when training teachers to integrate classroom PA. A AJHE Self-Study quiz is online for this article via the SHAPE America Online Institute (SAOI) http://portal.shapeamerica.org/trn-Webinars

Background
Physical activity (PA) in children promotes healthy growth and development including strengthening bones, building cardiorespiratory capacity, and reducing the risk of chronic disease. Psychological health can also benefit from PA, which has been linked with reduced depression and greater engagement and perseverance in children and adolescents. Furthermore, engaging in regular PA is associated with higher student academic achievement. Despite the multitude of known benefits, most children in the United States are not meeting the recommended 60 minutes per day of moderate-to-vigorous physical activity (MVPA). With 95% of American children attending school for up to 13 years of their life, schools are optimally positioned to support efforts to increase childhood PA. The Institute of Medicine recommends schools in the United States (U.S.) provide 30 minutes of MVPA daily for elementary-level children and evidence has begun to highlight the need for more comprehensive interventions that target the reduction of sedentarism in school.

Based on a social ecological framework, Comprehensive School PA Programs (CSPAPs) advocate for providing students with several opportunities for PA throughout the school day to help them reach recommended levels, including before, during, and after school PA in addition to physical education. Given that legislative mandates for physical education vary widely and in some states, are entirely absent, incorporating PA opportunities in settings where students spend a lot of their school time is essential. Reducing sedentary time by providing PA opportunities during the school day can elicit several benefits for students. For instance, integrating PA into the classroom setting has been associated with more MVPA, greater on-task behavior, and improved academic performance. Common classroom PA integration techniques include teacher-directed transitions (e.g., between desks and a common area), PA breaks (e.g., active videos), and PA-infused academic lessons (e.g., active science experiment).

As increased attention is brought to the international epidemic of childhood obesity, teachers have emerged as crucial leaders for increasing youth PA in schools. However, classroom teachers may perceive multilevel barriers and lack support related to integrating daily
PA.²¹ Public health recommendations include the provision of more professional learning opportunities for various school stakeholders as a strategy for reducing the perceived barriers to PA integration.²² The U.S. National Physical Activity Plan²³ recommends preparing educators to deliver PA to students through pre-service and in-service professional development (PD). While some studies have focused on PD for teachers in classroom PA integration, the results for student-level PA are mixed.²⁴,²⁵ Thus, a need remains for evaluating student-level PA outcomes resulting from PD opportunities,²⁶,²⁷ particularly novel approaches that expand beyond single-dose opportunities such as one-day workshops.²⁸

Because teachers have reported barriers such as lack of motivation, time, space, resources, and administrative support²¹ that reduce their successful implementation of PA integration strategies, some interventions have incorporated communities of practice, where groups of individuals with shared experiences collaborate to overcome barriers and address common goals.²⁹,³⁰ For example, after an intervention utilizing a community of practice for implementation of a six-week PA integration program, preservice and in-service teachers reported the support and idea sharing provided by the community facilitated their program implementation.³¹ Given the empirical support for communities of practice, it is recommended that school PA leaders collaborate with a team of individuals from their shared environment on PA implementation.³²

**Purpose**

Guided by the social ecological framework and specifically the research supporting communities of practice for teachers implementing school PA at the interpersonal level, the purpose of this study was to explore the effects of a 16-week online course designed to enhance teachers' capacity to integrate classroom PA on students' MVPA and sedentary time. The hypothesis was that students of teachers enrolled in the course (hereafter referred to as “intervention teachers”) would experience an increase in classroom MVPA while students with teachers not enrolled in the course (“PA Partners”) would remain constant across the semester.

**Methods**

**Design, participants, and school setting**

This study employed a quasi-experimental, pre-post with comparison-group design. Teacher invitation was based upon enrollment in the online course, teacher interest, employment status (1.0 FTE), school level (elementary), and receptiveness of school administration to research participation as well as geographic proximity to the university (90-mile radius). As a component of the online class, enrolled teachers were asked to enlist two or three fellow full-time teachers from their school to form a team of “PA Partners.” Permission to conduct research was obtained from the University’s Institutional Review Board, participating school districts, principals, and classroom teachers. Consent documents in both English and Spanish were sent home with children once a week for several weeks. Consent documents signed by parents/guardians were returned to school and collected by participating teachers. In order to obtain student assent, trained research assistants explained the study to each classroom using IRB-approved, age-appropriate language. Participating children gave verbal assent. Only students with signed parent consent forms and verbal assent participated in the study.

**Intervention**

Intervention teachers were enrolled in a 16-week online course focused on classroom PA integration during the spring semester of 2018. The course was delivered online through the University’s Canvas Learning Management System (Instructure, Salt Lake City, Utah).

SES 513: Integrating Physical Activity into the Classroom is an online 3-credit graduate course designed to help in-service teachers “evaluate and explore current methods for bringing physical activity into the regular classroom, while developing a team of teacher champions at [the teacher’s] school.” The course consists of two primary charges. First, teachers are asked to commit to integrating 30 minutes of PA every day into their classrooms. Second, the teachers must recruit two or three teachers from their school to form a team of “PA Partners” and with that team, complete a capstone project that increases school-wide PA. Teachers in the course are expected to integrate 30 minutes of PA into their classrooms by the third week of class and complete their capstone project by the end of the 16-week course (see Table 1). In conjunction with course-enrolled teachers, PA Partners were also asked to integrate 30 minutes of PA into their classrooms but were not provided with course materials.

The course covered one module approximately every 3 weeks. The first module focused on understanding research on PA integration and conducting a school needs-assessment. In the second module, teachers learned about best practices in PA integration and selected PA Partners to support them in the design and implementation of their capstone project. Teams then collaboratively developed a vision and detailed plan that
addressed a PA-related school need identified by the enrolled teacher in module one. In module three, teachers began to implement their capstone projects and during module four, enrolled teachers concluded their capstone projects and completed a final paper detailing their projects. The course contained eight discussion boards, three quizzes and an in-person meeting with the teacher in addition to the planning and implementing of the capstone project.

Procedure

Assenting elementary school children with parental consent wore hip-worn accelerometers (Actigraph, GT3X+) for five consecutive school days at pre and post during the spring 2018 semester. For five classrooms (two intervention, three PA partners), pre measures were collected during the second week of the online course, and post measures were collected during the final week of the online course. For two classrooms (one intervention, one PA Partner), premeasures occurred during the third week of the online course, and post measures were collected during the final week of the course. Accelerometers were set to collect data in five-second epochs to account for the transitory PA of children. On the first day of each data collection period, students and teachers were instructed on how to properly wear the accelerometers (i.e., above the right hip). For the remainder of the data collection period, teachers fitted students with accelerometers at the start of the school day, recording when students began and ended wearing the accelerometers. Additionally, teachers were asked to provide the research team with a copy of their daily school schedule and report any discrepancies in routine (e.g., extra recess time, school assembly) so that accelerometer data could be time-mapped to school context (time in the classroom vs. time outside of the classroom).

Child age, gender, and race/ethnicity information were collected via school administrative records. Information regarding intervention teachers’ completion of course assignments was provided via e-mail by the instructor of the online course.

Data analysis

Child accelerometer days were included in the analysis if they were within ± 2.5 standard deviations of daily total wear time and sedentary time. Cut-point thresholds for PA and sedentary behavior were determined using Evenson et al. and Matthews et al. cut-points, respectively. All data were transformed into percent of total classroom time spent active (light, moderate, and vigorous activity combined), in MVPA, and in sedentary behavior. Data were analyzed using multilevel mixed-effects regression controlling for grade, day of the week, and student race (fixed effects) with children nested within teachers, and teachers nested within school (random effects). Primary analyses showed differences by gender, so inferential analyses were performed separately for boys and girls.

Results

Of the 60 teachers enrolled in the course, 11 were eligible to participate in the study because they met the study

<table>
<thead>
<tr>
<th>Week</th>
<th>Module</th>
<th>Relevant Assignments</th>
<th>Module Objectives</th>
</tr>
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</table>
| 1    | Module 0: Course Policies and Procedures | - Identify 2-3 teachers to participate in capstone project (PA Partners)  
- Check in with building administrator about course requirements and capstone project  
- Conduct readiness survey and develop areas of need | - Demonstrate familiarity with course policies, procedures and timeline. |
| 2–4  | Module 1: Understand Research | - Submit weekly lesson plans with pre-scheduled activity breaks  
- Develop a detailed plan for capstone project collaboratively with PA Partners  
- Begin implementing 30 minutes of activity into the classroom | - Explain the correlation between brain research, PA, and academic achievement and how it relates to positive school climate, improved attendance, and reduced behavior incidences.  
- Describe the recommended amount of PA per day and at what intensity level.  
- Describe how various levels of PA can be integrated into academic content throughout the school day. |
| 5–7  | Module 2: Best Practices | - Compile PA resources that can be used in the classroom | - List a variety of resources for supporting PA in the classroom.  
- Determine the appropriateness of an activity for the developmental level of your class. |
| 8–10 | Module 3: Taking Action | - Reflect on efforts to integrate PA into classroom  
- Demonstrate PA activities in the classroom | - Identify the components of quality PA in the classroom.  
- Integrate research prescribed PA into daily practice and school-wide approaches. |
| 11–16| Module 4: Capstone Project | - Complete and evaluate capstone project  
- Evaluate PA activities as to their effectiveness and desired purpose | - Articulate the key points that comprise a persuasive argument to students, teachers, administrators, and parents as to why PA should be included during the school day. |

*Abbreviation: PA = physical activity.
requirements for employment status (1.0 FTE) and school level (elementary). The final sample consisted of three teachers who consented to participate in the study and had school administration receptive to research participation. All teachers in the intervention successfully recruited at least one teacher to participate as their comparator in the study. One enrolled teacher recruited two PA Partners to serve as their comparison. Intervention teachers (n = 3) were all non-Hispanic, White females who taught 5th, 4th, and 1st grade. PA Partners (n = 4) were 54.6% non-Hispanic, White and 75.0% female; three taught 4th grade and one taught 2nd grade.

All three participating schools were located in one state in the Western U.S. Two schools were classified by their State Department of Education as rural districts and free and reduced lunch (FRL) participation ranged from 53 to 66%, slightly higher than the state average. The average daily temperature during data collection ranged from 18° to 55° Fahrenheit at pre and 65–70° Fahrenheit at post.

Across the seven participating classrooms, 82 students provided both signed parental/guardian consent and verbal assent. Seven-hundred and twenty-four student-days of accelerometer data were collected and 24 student-days (3.2%) were excluded from the analysis (greater than ± 2.5 standard deviations from the mean). Statistical outliers were likely due to insufficient wear time (e.g., student leaving early for a doctor’s appointment) and/or device malfunction. All children had at least four valid days of classroom accelerometer data at both pre and post with the maximum possible being 10 days per student.

All intervention teachers received credit for the course and completed necessary coursework. Although capstone projects were open-ended, all three intervention teachers created a PA integration resource with ideas for classroom teachers and distributed the resource throughout their school. Based upon teacher activity logs, intervention teachers reported successfully meeting the daily 30-min PA goal 86%-100% of the time.

At pre, 16% of intervention student-days and 2% of PA Partner student-days met the school-day IOM benchmark of 30 minutes of MVPA during class time alone. At post, 14% of student-days and 11% of student-days met this benchmark in intervention and PA Partner classrooms, respectively. Overall, students were acquiring approximately 83.4 min of activity (light PA and MVPA) and 18.5 minutes of MVPA during class time (see Table 2).

Including all intensities of PA, pre measures indicated that students of PA Partners spent less class time engaged in movement (boys: 23.4% of class time, approx. 71.4 min; girls: 24.6% of class time, approx. 75.2 min) than intervention students (boys: 31.1% of class time, approx. 96.6 min; girls: 27.5% of class time, approx. 85.0 min). Across the

Table 2. Model-derived classroom intervention effects.

<table>
<thead>
<tr>
<th>Classroom Time (%)</th>
<th>Pre Mean (95% CI)</th>
<th>Post Mean (95% CI)</th>
<th>Adj. Differences in Δ (95% CI)</th>
<th>Group x Time p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls’ Sedentary</td>
<td>27.2 (16.4, 38.0)</td>
<td>25.8 (15.5, 36.1)</td>
<td>1.4 (-2.8, 5.6)</td>
<td>0.252</td>
</tr>
<tr>
<td>Girls’ Light Activity</td>
<td>10.4 (8.0, 12.8)</td>
<td>7.3 (6.0, 8.6)</td>
<td>-3.1 (-4.7, -1.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>Boys’ Sedentary</td>
<td>12.7 (9.9, 15.5)</td>
<td>11.9 (9.3, 14.5)</td>
<td>-0.8 (-2.0, 0.4)</td>
<td>0.001</td>
</tr>
<tr>
<td>Boys’ Light Activity</td>
<td>6.9 (4.4, 9.4)</td>
<td>5.7 (3.8, 7.5)</td>
<td>-1.2 (-3.3, 1.0)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

The table shows the model-derived classroom intervention effects for various time percentages categorized as Sedentary and Light Activity. The data indicates significant differences between pre and post measures, with Girls’ Sedentary activity showing a decrease of 3.1% while Boys’ Light Activity shows an increase of 1.2%. The Adj. Differences in Δ (95% CI) values and group x time p-values highlight the statistical significance of these changes.
duration of the course, PA Partners’ boys increased their class time PA by 7.4% (approx. 22.6 min; p < .01) while intervention boys did not change their activity time significantly. Similarly, PA Partners’ girls increased their class time activity by 2.3% (approx. 7.0 min; p < .01) while intervention girls’ activity did not change significantly across the semester (Table 2). Student gender, age, and race did not significantly differ (p > .05) between enrolled teacher and PA Partner groups (Table 3).

Relative to class time MVPA and sedentary behavior, PA Partners’ students were again spending less class time engaged in MVPA than intervention students (Figures 1 & 2) and spending more time sedentary than intervention students at pre (Figures 3 & 4). Regression analyses indicated significant (p < .01) group-by-time interactions, such that PA Partners’ boys’ and girls’ classroom MVPA increased and boys’ sedentary time decreased while intervention students’

**Table 3. Pre characteristics of students in the intervention and PA partner groups.**

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Intervention (n = 41)</th>
<th>PA Partners (n = 42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean 9.38 SD 1.74</td>
<td>Mean 9.57 SD 0.99</td>
</tr>
<tr>
<td>Grade level</td>
<td>Mean 3.44 SD 1.73</td>
<td>Mean 3.62 SD 0.79</td>
</tr>
<tr>
<td>Nonwhite, n (%)</td>
<td>21 (51.2)</td>
<td>23 (54.8)</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>19 (46.3)</td>
<td>20 (47.6)</td>
</tr>
<tr>
<td>School free or reduced lunch program (mean %, all schools)</td>
<td>59.8</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.** Boys’ change in moderate to vigorous physical activity (MVPA) as a percentage of total classroom time. * indicates a significant interaction of group x time.

**Figure 2.** Girls’ change in moderate to vigorous physical activity (MVPA) as a percentage of total classroom time. * indicates a significant interaction of group x time.

**Discussion**

The primary aim of this study was to measure the student-level PA outcomes of a 16-week online course for teachers in classroom PA integration. Results indicate that all participating teachers were adhering to their commitments of integrating at least 30 minutes of PA daily into the classroom. However, contrary to the study hypothesis, intervention effects from the PD course were found to more positively impact children within PA Partner classrooms than children with course-enrolled (intervention) teachers. Students of intervention teachers maintained class time PA levels while students of PA Partner teachers increased PA and MVPA across the semester-long duration of the
Boys' Sedentary Behavior

![Boys' Sedentary Behavior Graph](image)

Figure 3. Boys' change in sedentary time as a percentage of total classroom time. * indicates a significant interaction of group x time.

course. Boys in the classes of PA Partners also decreased their sedentary time during class.

Findings from this study suggest that the PD course may have had supplemental benefits on elementary students' PA that extended beyond a single intervention teacher.9 Research has indicated that classroom teachers who receive PD on PA integration may successfully increase students' school-day PA,42 but often report wanting more resources, support within their school, and strategies for incorporating movement into their daily routines.43,44 The PD course provided intervention teachers with a wide variety of resources and strategies for classroom movement integration over the course of the semester and allowed sufficient time for processing information, implementing strategies, and critical reflection. This is in contrast to more traditional one-day workshop PD opportunities that often do not facilitate ongoing engagement and reflection. Furthermore, operating like a community of practice, the PA Partners may have helped alleviate some of the personal and social barriers surrounding PA promotion by providing relevant social support and knowledge sharing.30,45,46

Although no significant change in classroom MVPA was observed in students with a course-enrolled teacher, the scheduling flexibility and accessibility of the online PD format may be appealing for a wider variety of teachers compared to traditional in-person PD.37 The online nature of the course could also make it a more scalable model that could be implemented across the country and even around the world. Future PD opportunities may consider using a similar format for reaching teachers with varied knowledge levels of classroom PA integration who otherwise might avoid PD courses that are less flexible and accessible than an online format.

Based on different levels of classroom movement integration, Moon and Webster48 categorize strategies in a "wheel" that allows teachers to distinguish ways they can integrate PA into their classroom and focus on strategies that align with their capacity. The first level, "beginning strategies," describes more basic methods teachers can employ to get students up and active, including technology-driven opportunities (e.g., watching an active video), transitions (e.g., moving from one location in the classroom to another), and physical environmental opportunities (e.g., providing standing desks). The second level, "intermediate strategies," includes movement opportunities via reward/incentive, opening activity at the beginning of the day, and non-academic movement breaks. Finally, the third and likely most advanced level of movement integration strategy is "academic integration," wherein movement is connected with curriculum as a way to help students learn while being active and/or simultaneously learn physical
education and classroom subjects. Although employing academic integration strategies may necessitate greater collaboration with teachers who have successfully used similar techniques (e.g., physical education, health teachers), providing active academic lessons in the classroom is a cost-effective way to increase student PA without sacrificing instruction time and can normalize PA outside of the school gym.

**Limitations**

The present study had limitations that should be considered. First, teachers self-selected into the intervention course, so it is likely these teachers had a higher initial interest in PA than their PA Partners. The higher MVPA among intervention than PA Partner students at pre supports this notion, and could have created a ceiling effect that impeded a dramatic increase in intervention students’ PA. Although intervention teachers were aware of the 30-min classroom PA commitment at the beginning of the course and may have already begun trying to increase PA at pre, the course was set up to initially provide enrolled teachers with foundational knowledge on the importance and types of PA and did not require PA integration until the third week of the course (see Table 1). Furthermore, based on course scheduling, teachers were not provided with additional strategies and resources for integrating PA in their classroom prior to the first round of data collection, so full implementation of 30 min of PA daily was unlikely at pre. Second, only elementary students’ PA was measured, so results may not be generalizable to other populations such as secondary students. Future research should evaluate effects of this and similar PD courses on older students’ school PA and include a control group of students with teachers not affiliated with the course.

Despite some limitations, the present study highlights the efficacy of a more in-depth PD opportunity that extended beyond a one-day workshop and measured student-level outcomes instead of teacher-only changes resulting from a PD experience. Because increasing classroom PA is an effective method for helping to improve student motivation and engagement, on-task behavior, concentration, and academic performance, future research should also examine potential connections between increased student PA and academic performance as a result of teacher PD.

**Translation to Health Education Practice**

Certified Health Education Specialists (CHES) can use the results of this study to plan, support, and evaluate more effective forms of PD opportunities that seek to increase youth PA. Results from this study highlight the importance of PD that incorporates a support system component, indicating it may be a factor that influences the implementation of PA programming. Incorporating social support, such as PA Partners within the same school, in health education programming may help PA leaders effectively integrate daily movement and subsequently improve child health.

Guided by the social ecological model, health educators working with school staff can adapt and advocate for evidence-based, collaborative PD opportunities (National Commission for Health Education Credentialing (NCHEC) Competencies 2.1.2, 2.3.4, & 8.1.5) on implementing Comprehensive School PA Programs (CSPAPs). Currently, several external PD options exist that can be selected based on schools’ interest and capacity, including workshops, online courses like the one described in the present study, and a two-year master’s program focused on PA leadership. Within the CSPAP framework, student-level PA can be considered the core outcome of focus for integrating PA, aligning with the intrapersonal level of the social ecological model. The interpersonal level of the social-ecological model informs the specific facilitation of classroom PA by teachers within the same school. Aligning with the organizational level of the model, health educators and other school leaders (e.g., physical education teachers, principals) can support their classroom teachers with integrating PA by sharing knowledge and resources that take into account the unique culture and context of their school so that classroom PA becomes a norm (NCHEC Competency 8.2.2).

To evaluate professional learning opportunities that are provided specifically to teachers on classroom PA integration, health educators can utilize simple technology or observation. Although accelerometers were used in the present study, evaluators can employ less expensive pedometers to monitor students’ step counts and/or observation of classroom PA opportunities along with students’ behavioral responses (e.g., level of engagement, signs of exertion such as heavier breathing and sweating). Health educators can encourage use of free or low-cost systematic observation tools such as SOSMART or SOPLAY to evaluate PA engagement (NCHEC Competency 4.3.3) though these provide data only when evaluators have access to locations where participants are active.

As part of a CSPAP, classroom PA is important in helping students meet recommendations that link to both higher academic achievement and lower lifetime risk of chronic diseases such as obesity, heart disease, and cancer. Because teachers may lack resources for integrating regular movement into their classrooms, health educators and other PA leaders in the school.
play vital roles in supporting teachers through collaboration and evaluation of PD opportunities to ensure their efforts are being substantiated at the student level (NCHEC Competencies 7.2.4 & 7.2.6).52 In sum, incorporating interpersonal-level support systems into teacher PD opportunities can have ancillary benefits that improve student health as a result of increased daily PA.

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Conflicts of interest

All authors declare that they have no conflicts of interest.

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