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METHODOLOGY

Teachers' and Students' Perceptions of the Active Science Curriculum: Incorporating Physical Activity Into Middle School Science Classrooms

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Abstract

Many children participate in little to no regular physical education during the school day. National recommendations call for schools to offer physical activity as part of planned academic lessons that teach math, language arts, science, and other subjects through movement. The purpose of this study was to analyze students' and teachers' perceptions of the Active Science curriculum to determine the feasibility of incorporating a classroom-based physical activity program into middle school science lessons. Forty-seven fifth and sixth grade female students and two science teachers participated in the study. The instruments used to evaluate students' and teachers' perceptions of the curriculum included (a) individual interviews with two science teachers, (b) written perception questionnaires completed by the students, and (c) a focus group interview with a sample of eight students. Findings revealed that the students enjoyed incorporating physical activity into class, learned science content and skills, and used technology within the curriculum. Teachers felt that it was feasible to incorporate physical activity into the lessons and identified that the curriculum improved students' science knowledge and inquiry skills, exposed them to the use of technology, and integrated fun and interactive physical activities into class.

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The United States faces a childhood obesity epidemic that is on the rise, and no single action alone will reverse the problem (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). One of the major contributing factors to the obesity problem is that children are becoming less physically active (U.S. Department of Health and Human Services, 2008). Lack of physical activity (PA) is an issue seen at home and in schools. Researchers have indicated children spend more than 7 hr per day watching television, using a computer, or using mobile devices (e.g., cell phones, iPods, MP3 players; Kaiser Family Health Foundation, 2010). Results from the Youth Risk Behavior Survey (Centers for Disease Control and Prevention [CDC], 2009) indicate that 25% of middle school students play video or computer games or use a computer for an activity that was not schoolwork for 3 or more hours per day on an average school day. Nationwide, 33% of students watch television 3 or more hours per day on an average school day. The problem with children excessively watching television or spending too much time on computers or gaming systems is that it takes away from engaging in PA such as organized sports or informal playing. The CDC (2009) reported that less than 20% of high school students meet the current recommendations of 60 min of daily PA.

Research suggests that children's negative attitudes toward PA may impact their involvement in exercise later in life (Papacharisis & Goudas, 2003). In schools, children's perceptions of their physical education experiences can contribute to decisions regarding their engagement in activity (Pate, Pfeiffer, Stewart, Ziegler, & Dowda, 2004). Negative perceptions of PA may be one of the many factors contributing to the alarming decline in children's activity levels. Therefore, creating positive PA experiences for students to promote exercise beyond the school environment is important.

The literature has shown that increasing students' confidence in their ability to engage in PA increases the likelihood of enjoyment and therefore the likelihood of regular participation in PA (Subramaniam & Silverman, 2002). Students are more likely to have positive attitudes toward PA if they participate in activities that interest them. In one of the more comprehensive reviews of students' attitudes toward physical education, Subramaniam and Silverman (2007) examined many of the attitudinal studies and provided a summary of the methods used in practice. They concluded that children's views of physical education are influenced by factors including the exact nature of the curriculum to which they have been exposed,

their gender, their history of PA experiences, and their general motor ability.

In schools, physical education opportunities have declined due to budgetary concerns, pressures to improve standardized test scores, and difficulty allocating time for PA. Many children participate in little to no regular physical education during the school day. For example, Lee, Burgeson, Fulton and Spain (2006) estimated that only 3.8% of elementary schools provide daily physical education. To combat the lack of PA in the schools, the White House Task Force on Childhood Obesity (2010) created an in-depth narrative titled "Solving Childhood Obesity Within a Generation," and the report calls for educators to create innovative and engaging teaching techniques that promote PA in school. In particular, one recommendation from the report is to incorporate movement into the curriculum and classroom activities. Schools could offer PA as part of planned academic lessons that teach math, language arts, science, and other subjects through movement (Stewart, Dennison, Kohl, & Doyle, 2004). As a result, these activities contribute to students' accumulated PA during the school day. A second recommendation calls is to integrate technology into the school curriculum. For example, heart rate monitors are excellent tools that can be used to monitor students' fitness levels and to motivate children to achieve higher intensity levels during activity (Loucaides, Jago, & Charalambous, 2009). Additionally, teachers are using "exergaming" technologies (Dance Dance Revolution and Nintendo® Wii), which combine video games and exercise to promote movement. The initial studies on examining the effects of exergaming technologies have yielded positive results on increasing PA in students that would normally not participate in activity (Papastergiou, 2009).

Taking the recommendations from the childhood obesity report, we created a classroom-based PA curriculum that incorporates technologies into middle school science classrooms to increase PA levels and improve academic achievement. The curriculum is called "Active Science." The purpose of this study was to analyze the students' and teachers' perceptions of the Active Science curriculum to determine the feasibility of incorporating a classroom-based PA program into middle school science lessons.

Method

Methodological Design

A mixed-method, qualitative and quantitative research design was implemented to examine students' and teachers' perceptions regarding incorporating classroom-based PA into middle school science curriculum. An exploratory approach, based on grounded theory methodology and principles, was used for the qualitative portion of the study to provide the researcher with the opportunity to gain a deeper understanding of students' and teachers' perceptions (Creswell, 1998; Strauss & Corbin, 1998). We conducted individual semistructured interviews with the teachers, allowing us to gain an in-depth understanding of classroom teachers' perceptions and understanding about integrating PA into the classroom. The semistructured interview format afforded us the opportunity to probe more deeply into participants' responses and to ask follow-up questions leading to richer, more robust data. We conducted a focus group with a subset of students to gain a deeper understanding of their perceptions and thoughts about integrating movement in the classroom. The quantitative methods included a student survey with Likert scale questions that provided a secondary data source to increase the credibility and trustworthiness of the qualitative data.

Participants and Setting

Forty-seven fifth and sixth grade female students and two science teachers were the subjects in this exploratory research study conducted at a tuition-free, independent middle school in Massachusetts. School enrollment included 95% Hispanic, 3% Asian, and 2% African American female students. Ninety-one percent of the student body qualified for free or reduced-price lunch. Written parental consent and student assent forms were completed prior to study participation. We obtained approval for the study from the institutional review board at Merrimack College. We approached the school administration to determine whether they were interested in participating in the study. We selected the science classes based on teachers' and students' willingness to participate in data collection. Participants understood that they would be asked to provide their perceptions about the Active Science curriculum, which the teachers implemented as part of their regular science class.

Instrumentation

In this study we used written surveys, interviews, and a focus group to determine students' and teachers' perceptions of their experiences participating in a classroom-based PA curriculum. We collected qualitative and quantitative data. The curriculum evaluation of students' and teachers' perceptions included three components: (1) individual interviews with two science teachers, (2) written perception questionnaires completed by the students, and (3) a focus group interview with a sample of eight students. We piloted the survey and interview questions with a sample of middle school students and teachers prior to implementing them in this study. We used feedback from the pilot subjects to improve the instruments used in the study.

Students' perceptions questionnaire. We developed a questionnaire designed (a) to determine students' perceptions about incorporating PA into the classroom and (b) to assess their thoughts about what they learned in science. The survey was a series of statements that asked them to rate their feelings about PA and science in the classroom (responses ranging from 1 = *strongly disagree* to 4 = *strongly agree*). We designed this survey to help support the data collected during the focus groups and interviews as a means of data triangulation. We adapted this instrument from the Physical Activity Enjoyment Scale (PACES), which is a reliable and valid tool used to assess perceptions of PA for this age group (Kendzierski & DeCarlo, 1991). We developed the questionnaire with the assistance of the science teachers to ensure that the questions were age appropriate and objective. The students completed the questionnaire at the conclusion of the curriculum.

Student focus group. We conducted a focus group interview with a random sample of students (n = 8) from the four classes. The focus group occurred in the science classroom during a free period for the students. The purpose of the focus group was to solicit feedback from the students on their thoughts and feelings about participating in the curriculum. We asked students open-ended questions regarding their feelings on the science lessons, incorporating PA into the classroom, the use of activity monitors to collect data, and their overall positive and negative opinions of the program. The focus group lasted approximately 70 min, and we used a tape recorder to ensure that no comments were missed during the interview. Table 1 presents selected questions from the focus group interview guide.

Table 1

Sample Student and Teacher Interview Questions

A. Teacher Questions
Did the students enjoy incorporating physical activity into the science lessons? Why?
In your opinion, did you feel the students learned the science content as a result of the curriculum? How?
How did incorporating physical activity into your science class affect your teaching?
B. Student Questions
What were your feelings about incorporating physical activity into your science class? Did you like it or dislike it? Why?
What were your feelings on you collecting data on yourself and then using that data in class to learn science?
Did you feel incorporating physical activity into your science lessons helped you understand the science content (nutrition and fitness) and science skills (reading and interpreting graphs, scientific method)? If so, how? If not, why not?

Teacher interviews. We conducted a 1-hr semistructured interview with each teacher to enhance the integrity of the data without losing the opportunity to follow up with questions or to delve more deeply into responses. The interviews occurred in the each teacher's classroom at the end of the school day. We developed the interview guide specifically for this study based on existing research. We asked the teachers open-ended questions regarding their use of movement, their understanding of connections between movement and learning, the feasibility of implementing the curriculum, and their positive and negative views of the program. Table 1 presents selected questions from the interview guide.

Procedures

The four science classes were combined with fifth and sixth grade students due to limited classroom space and the low number of total students in the school. Science class sizes ranged from 11 to 13 students and met for approximately 90 min, twice per week. The science classes received the Active Science curriculum for 7 weeks (2 days per week). The next section explains the Active Science curriculum in detail.

Active Science curriculum. We developed seven lessons of integrated exercise activities and seven lessons of science content (14 lessons in total) with the assistance of fifth and sixth grade science teachers. We adapted some of the ideas for the lessons and content from frameworks of the existing Science of Energy Balance and We Can! curricula developed by the National Institutes of Health and National Institute of Diabetes and Digestive and Kidney Diseases. Our lessons introduced concepts of healthy lifestyles through regular PA and nutrition and simultaneously taught important principles in science. Collaborating with the science teachers ensured that each lesson supported the particular learning objectives and goals the teachers and schools specified. In general, the Active Science lessons reinforced topics included as part of national and state science standards such as structure and function in living systems, personal health, nutrition, and scientific investigation.

We created the exercise lessons for the students to complete one type of PA per week (35 min). During the 7 weeks of the framework, students completed seven physical activities: fitness walk, agility exercises, cardiovascular exercise, muscular strength training, hike, Zumba dance, and tennis. The goals of the activity lessons were to get the students exercising as a method of active learning and then to use the PA data in the science curriculum. During the exercise lessons, technology devices (pedometers and heart rate monitors) were used to collect PA data (steps, heart rate, calories burned, etc.) on the students.

Curriculum implementation. During each week, the students had science class on Mondays and Wednesdays. Day 1 (Monday) focused on the introduction of exercise lessons where the students read the background information, created hypotheses, and learned new science vocabulary for the first half of class. During the second half of class, the students participated in the PA of the week (e.g., hike, tennis) where they generated data that were captured on the activity monitoring devices they wore. The students transferred the data from the devices into data journals.

Day 2 (Wednesday) focused on the analysis of the PA data and delivery of the science content. During the first half of class, the students logged on to the Active Science website and entered their personal PA data. Once the entire class had entered the data, the students viewed a series of figures and graphs that displayed the class and individual information (e.g., steps, average heart rate, calories).

The students then completed the data analysis questions that focused on graphical interpretation and scientific inquiry. During the second half of class, the science teacher would teach the science content of the day and integrate the student PA data into the lesson. The science content focused on human body systems, nutrition, fitness, and scientific investigation. The teachers implemented their own handouts, readings, and information to help the students learn the science content. The key to the science content was that the teachers always integrated the students' PA data into the lesson.

Website and online learning. Students and teachers accessed each of the lesson plans and schedule of activities by logging on to an interactive website created by experts in instructional media and web design. The website was used to provide students with an introduction to each weekly topic, describe the goals of each lesson, give clear instructions, provide a system for entering activity data, track student and class progress, provide an interactive class forum for discussions, and describe tasks or homework assignments. Moreover, the website was designed to provide the teacher with a convenient mechanism to organize and deliver each lesson plan in a time-efficient manner.

Data Analysis

We used a grounded theory for data analysis, which included open coding, axial coding, and selective coding. Initially, we identified single thoughts, words, or phrases with common meanings and grouped them into categories. We then analyzed these for relationships and higher level themes. We used NVivo software to analyze the qualitative data. We analyzed descriptive statistics (mean and standard deviation) using SPSS software for the Likert scale questions from the students' perceptions questionnaire. The quantitative data were used to support the themes that were found in the qualitative analysis.

Results

We divided the results of the study into three categories based on the modes of assessment from the students and teachers.

Students' Perceptions Questionnaires

Table 2 displays the means and standard deviations that were calculated for each item on the student questionnaire. The questions were divided into two parts. The first section assessed the students'

perceptions about incorporating PA into the classroom and the second part assessed their feelings about what they learned in science. For the 11 statements on PA, nine of them were written in the positive manner and the mean scores were 3.4 and above on a 4-point scale, indicating that the students *agreed* or *strongly agreed* with these statements. For the two negatively constructed statements, the mean scores were 1.6 and 1.2, which showed that the students *disagreed* or *strongly disagreed* with these statements. Therefore, the students enjoyed the integration of PA into their science classes.

Table 2

Students' Responses to Active Science Perception Questionnaire

Response choices were 1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Agree*, 4 = *Strongly Agree*		
PHYSICAL ACTIVITY	***M***	***SD***
1. When I am physically active in science class, I enjoy it.	3.6	0.5
2. When I am physically active in science class, I feel bored.	1.6	0.9
3. When I am physically active in science class, I feel the time goes by quickly.	3.6	0.5
4. When I am physically active in science class, I find it fun.	3.7	0.5
5. When I am physically active in science class, I am able to pay attention to the teacher.	3.4	0.8
6. When I am physically active in science class, I feel tired.	1.6	0.7
7. When I am physically active in science class, I think it's very exciting.	3.5	0.8
8. When I am physically active in science class, I feel that I am healthier.	3.7	0.5
9. When I am physically active in science class, I dislike it.	1.2	0.4
10. When I am physically active in science class, I feel alert.	3.4	0.7
11. When I am physically active in science class, I feel focused in class.	3.5	0.7
Response choices were 1 = *Not at All*, 2 = *Very Little*, 3 = *Somewhat*, 4 = *A Lot*		
SCIENCE	***M***	***SD***
1. Do you think physical activity helped you to understand graphs?	3.4	0.6
2. Do you think physical activity helped you to understand the scientific method?	3.1	0.9
3. Do you think physical activity helped you to understand health and fitness?	3.9	0.4
4. Do you think physical activity helped you to understand nutrition?	3.6	0.7
5. Do you think physical activity helped you to understand your overall body health?	3.8	0.5

In second section of the questionnaire, the students described what science content they felt they learned during the curriculum. The mean responses to the five statements were 3.5 and above on a 4-point scale, indicating that the students felt that incorporating PA into class time allowed them to learn the science content and scientific inquiry skills.

Student Focus Group

Eight students were part of the focus group interview, and the researchers identified four major themes.

Science learning and physical activity. The students felt that incorporating PA into the classroom environment allowed them to learn the science content. One student said, "Combining activity and science made the class fun, and it was great to learn and burn calories at the same time." Another student felt the curriculum "helped us with interpreting graphs and using the scientific method because you had to find out what the purpose was, create a hypothesis, and carry out the experiment." Overall, the students thought the Active Science curriculum was effective at combining PA and science learning.

Experiential learning. The students identified the ability to actively participate during the lessons as a positive aspect of the curriculum. The physical activities allowed them to engage in the data collection process, and one student indicated, "I liked collecting data on myself because I could compare my data with my classmates' data." The class was structured as an active learning environment where the students participated in the lesson by being physically active. Another students explained, "I really liked that I could see my physical activity data change from each lesson depending on how active I was."

Use of technology. The curriculum involved the use of activity monitors (heart rate monitor and pedometers), which collected the PA data that the students used in their science lessons. In addition, the majority of the curriculum was delivered through the online Active Science website. Participants felt that these technologies were important in making the curriculum effective. One student said, "It was cool how we could see our heart rate on the watch [and] then compare it to others on the website." Another student felt that she "would use the pedometer outside of class because I would want to see if I am getting 12,000 steps per day." The use of the activity

monitors and online learning were components of the curriculum that the subjects felt were engaging and useful to learn the material.

Students' enjoyment of physical activity. The integration of PA into traditional science classrooms was the major component of this curriculum. Many of the students indicated that they enjoyed PA being incorporated into the classroom. Specifically, one student described that she "liked the physical activities because we got to move around and have fun while we are doing work." Some students expressed that exercising in class was fun because it was their only form of PA during the day. Another student felt that her favorite part of the curriculum was "the activity portion because I love to move around and I don't really get to do much playing outside."

Teacher Interviews

Table 3 displayed the themes and representative quotes from the teacher interviews that provided information on the teachers' perceptions and attitudes of incorporating the Active Science curriculum into the lessons. Four main themes emerged from the teacher interviews, and a brief description of each theme follows.

Academic skills. During the interviews, the teachers identified that the Active Science curriculum helped the students improve their science inquiry skills and content knowledge. According to the teachers, the Active Science lessons reinforced the science inquiry and investigations skills that the state education framework described all middle school science content areas should include. From the teachers' perspective, the Active Science lessons were successful at facilitating students' learning of new science vocabulary and content.

Exposure to physical activity. The teachers felt that the curriculum promoted positive student attitudes toward incorporating PA into the classroom and an overall enjoyment of PA. As a result of the curriculum, the teachers felt that the students may continue to exercise to meet the PA recommendations and lead healthier lives.

Use of technology. The science teachers felt that the Active Science curriculum provided the students with the use of technology in two ways: computer/website interaction and activity monitor use. They highlighted that the lessons provided the students an opportunity to interact with computers and become familiar with the use of a website. With the activity monitors, the teachers felt the devices could provide the appropriate information about PA levels,

which the students could use to determine whether they have met daily PA recommendations.

Incorporating physical activity into academics. The teachers described that an opportunity existed to integrate PA into other academic disciplines. For classroom-based PA to become more widespread and accepted as a new method of teaching, more teachers in other academic areas (language arts, math, social studies) would have to see the benefits of this approach. The science teachers suggested that it could cross over into many disciplines as long as the teachers could be creative in how they designed their lessons to incorporate PA into them.

Discussion

The purpose of this study was to analyze students' and teachers' perceptions of the Active Science curriculum to determine the feasibility of incorporating a classroom-based PA program into middle school science lessons.

Students' Perceptions

General enjoyment of physical activity. Today, PA among children and adolescents has declined, and increasing numbers of children are spending more time in sedentary activities (U.S. Department of Health and Human Services, 2008). A need exists to positively influence the way children view PA to get them excited to exercise and become more active (Dishman et al., 2005). Previous research has shown that PA behaviors adopted in childhood tend to continue into adulthood and that more active children tend to be more active as adults than their sedentary peers (Sallis et al., 2009). The literature has also suggested that if a student develops a positive attitude toward PA, motivation to participate in PA outside of school is more likely to occur. Data from this study revealed that the Active Science lessons exposed the students to new ways of being physically active, which they viewed as fun and exciting (Sallis et al., 2009). The positive response to the Active Science curriculum suggests that this might be one method that teachers can use to expose students to enjoyable physical activities that they may continue to perform outside of school while helping students learn science content.

A significant amount of literature has examined students' attitudes toward physical education classes in schools. Students' attitudes toward physical education are important because the literature has

suggested that students equate their physical education experience with PA engagement outside of school (Hagger et al., 2009). Since students have related physical education experiences to personal PA, they possibly can equate their classroom-based PA to engagement of activity outside of school. For many students, PA in school is often the only time that they can be active, and making these experiences positive and enjoyable is important. The results of this study show that the Active Science students enjoyed incorporating PA into science class. Classroom teachers can incorporate PA into their academic lessons to get students excited and interested in a variety of activities. Similar to physical education experiences, students can develop attitudes toward classroom-based PA that might get them interested in incorporating PA into their daily lives.

Classroom behaviors. In addition to enjoying the Active Science lessons, the students' perceptions questionnaire addressed the students' feelings about the effects of the curriculum on their classroom behaviors. Children often are more attentive and behave better after participation in PA through recess and physical education (Sallis et al., 1999). In addition, classroom-based PA has been shown to improve students' on-task behavior (Mahar et al., 2006). Previous research has indicated that children who are immobile for prolonged periods often become more fidgety and restless and experience reduced concentration (Pellegrini & Davis, 1993). The students in the Active Science curriculum reported that the PA portion of the lessons helped them to feel more alert, focused, and better able to concentrate on what the teacher was discussing in class. During the Active Science lessons, we did not measure on-task behaviors, but the students felt that PA helped them to feel less tired and more alert. In a classroom setting, students who are least on task may cause the most disruption in learning (Stewart et al., 2004). Teachers can implement PA into classes as a method to engage students so they feel more focused on the class material, which would involve more students in the learning process.

"Active Learning" was a concept that many of the students in the Active Science curriculum identified as a positive. During the focus groups, the students felt that the PA portion of the lessons was the enjoyable part because they "got to move around and have fun while doing work." Summeford (2000) discussed that movement is an indispensable part of learning and thinking. Furthermore, movement can reinforce the academic skills of all students (Blaydes, 2001; Sallis et al., 1999). In a traditional classroom, students are

expected to sit for long periods of time and be passive. During the Active Science lessons, the goal was to have the students be active and moving while learning science. The students were engaged in an active and inquiry-based science experiment during each lesson, where they were the subjects collecting data on themselves. Many students addressed that they enjoyed the PA component because they like "being physically active" during class. If teachers and educators feel that students are more engaged and learn better when they are invested in the class or subject, then incorporating PA into a classroom may get students excited about the material.

Science content. Students reported that they learned about the concept of caloric intake and expenditure (energy balance). The nutrition lessons helped the students to understand the importance of what they put in their body (intake) and how they burn off (expenditure) calories to maintain body weight. They felt that the Active Science lessons taught them about the need for a balanced diet in the context of growth and maintaining a healthy body. Because adolescence is a period of intense physiological, psychological, and psychosocial development, young people's bodies may change more rapidly than their attitudes toward them (Lytle, Gerlach, & Weinstein, 2001). Therefore, teaching the students about basic nutrition and energy balance is important. Research has shown that developing appropriate strategies for achieving and maintaining a healthy body size and weight can be challenging, but education is necessary for an understanding of energy balance and basic nutrition principles (U.S. Department of Agriculture, 2007). To teach energy balance more effectively in schools, teachers could integrate PA into their nutrition lessons to address the importance of energy balance to the students.

During the focus groups, one student identified that she "learned about how to keep fit and maintain a healthy diet." Another student enjoyed the Active Science lessons because she learned about "nutrition and vitamins such as Vitamin A, E, B12, and B6." These quotes are representative of the overall theme that described how the students felt they learned through incorporating PA into the science lessons.

Teachers' Perceptions

Academic skills. According to the science teachers, the Active Science lessons were taught and reinforced the science inquiry and investigations skills that the Massachusetts state education

frameworks described all science content areas should include. Through the interviews, focus groups, and surveys, the teachers and students described that the Active Science lessons taught scientific inquiry skills effectively during the curriculum. In science, teachers can adopt the pedagogical approach of incorporating PA into the class to promote the learning and understanding of science inquiry skills.

In addition to graphical analysis and interpretation, the teachers commented on how the students improved their scientific investigation skills. Because the way the Active Science lessons were set up, the students were required to state the purpose and create a hypothesis prior to each lesson. Once they collected the data, they answered a set of data analysis questions and made conclusions. The teachers expressed their satisfaction with how the curriculum reinforced the scientific method for each lesson. One teacher said, "The teaching of the scientific process is a major goal of middle school science." The curriculum allowed the students to gain a greater understanding of these concepts.

Enjoyment of physical activity. Positive attitudes toward PA can influence a child's activity participation outside of school (Hagger et al., 2009). The students reported that they enjoyed the physical activities in each Active Science lesson. The teachers reiterated a similar theme and felt that the students "loved all the activities" in the curriculum. When the teachers were asked about how the students viewed PA in class, they described that the students enjoyed PA. One teacher said, "They loved the physical activity because it broke up the class time." Instead of sitting passively in science class for 90 min, the students were able to incorporate PA into class, and the teachers viewed this as a positive aspect of the curriculum. Results from teachers suggest that the Active Science curriculum promoted positive attitudes toward incorporating PA into the classroom.

In addition to encouraging positive attitudes toward PA in the classroom, the Active Science lessons also promoted an overall enjoyment of physical activities according to the teachers. At the beginning of the curriculum, the teachers were concerned with how well the students would respond to performing the varying types of PA. During the interviews, the teachers described that the PA component of the framework was a "huge success." Specifically one teacher felt that the students "loved all the activities, and for a population that is really not exposed to exercise or activities, this

was a risk for them every time they started an activity." According to the teachers, the Active Science lessons were successful at getting a population of students who did not participate in regular PA to enjoy the exercise component of the lesson.

Technology. With the current state of technology, we often take for granted that all children interact with computers regularly. Due to their socioeconomic status, many of the students and families at this particular middle school did not have home computers. The curriculum allowed the students to navigate through an interactive website, where they read background information, recorded data, took quizzes, and wrote lab reports. One teacher addressed the use of the computers when she said, "I think kids like websites, and I think that's a very good way to market a course because it's of interest to them." According to the teachers, part of the success of the Active Science curriculum was the use of the website that allowed the students to improve their online navigation, typing, and reading skills. The teachers identified that the students were successful at using the website as an education tool to teach science. As a result, the science teachers liked the use of computers with the Active Science curriculum because it required the students to become more comfortable interacting with technology.

During the lessons, the students used two activity monitors, heart rate monitor and pedometer, to collect their PA data. The teachers felt the activity monitors were easy to use and provided the students with important information on their PA levels. One teacher said, "[The] pedometers seemed to be the simplest thing for them to use.…Most of them were able to use it, read it, reset it, and adjust it." Another teacher indicated, "The heart rate monitors were a great idea and a great source of interesting data on heart rate, which you don't get from the pedometers." Both the teachers and students expressed their satisfaction with the activity monitors as a tool to measure PA. The teachers felt that if the students can begin to monitor and understand how much activity they are doing, this will provide the appropriate information about the activity levels to inform them whether they have met the daily PA recommendations.

Incorporating physical activity into other academic areas. One of the recommendations from the presidential report on childhood obesity (White House Task Force on Childhood Obesity, 2010) calls for incorporating movement into the curriculum and classroom activities. The literature recommends that schools begin to integrate PA as part of planned academic lessons that teach

subjects through movement. The goal would be to use movement to contribute to students' accumulated PA during the school day. The science teachers were asked whether the Active Science curriculum could be modified and implemented into other academic areas. One teacher said,

> I felt the Active Science curriculum could be interdisciplinary... because I think the girls could certainly write and reflect on their feelings and their journeys through this Active Science adventure. Therefore, they could certainly incorporate into any of their language arts classes. There are all kinds of math embedded in this already. And it could be, in some ways, part of social studies. I think you could research the Olympics or anything else that's gone on in other cultures. What connects many of us in the world is by physical activity and athletics.

As the future develops with integrating PA into classrooms, the opportunity exists for the Active Science model to reach out into other academic disciplines. One teacher said, "I'd like to partner with a physical education teacher because I think it would be stronger that way...A lot of good physical education teachers are interested in this stuff." For classroom-based PA to become more widespread and accepted as a new method of teaching, more teachers in other academic areas (language arts, math, social studies) will have to see the benefits of the this approach. For the science teachers, they suggested that it could cross over into many disciplines as long as the teachers could be creative in how they designed their lessons to incorporate PA into them.

Limitations

One limitation of the study was that we did not use a control group to compare students' and teachers' perceptions of PA and science. The use of qualitative methods is a limitation because the results are not generalizable to the larger population. In addition, the sample size was small and subjects were female students in a private school, limiting the generalizability of the findings. Future research should be conducted that minimizes these limitations to further understand the efficacy of the Active Science framework and other classroom-based PA programs.

Conclusions

Data from this study revealed that the Active Science lessons exposed the students to new ways of being physically active, which they viewed as fun and exciting. In the classroom, the students enjoyed incorporating PA into their lessons because they felt it improved certain classroom behaviors such alertness, focus, and concentration. In addition, the students increased their enjoyment of science and improved their science inquiry skill during the curriculum. The two science teachers in this study felt that it was feasible to incorporate PA into their class with minor setbacks during the lessons. The teachers felt the students improved their science inquiry skills, increased their science content knowledge, and were exposed to the use of technology during the curriculum.

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