

METHODOLOGY**Comparison of Classroom
Instruction Versus Use of
Homework Assignments on
Cognitive Knowledge Acquisition
in Physical Education**

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Abstract

Fitness for Life classes, in which a primary goal is for students to acquire health-related fitness knowledge, consist of a lecture session and an activity session. Unfortunately, devoting class time to a lecture reduces the time students are engaged in physical activity (PA). A potential solution to helping students develop cognitive skills without sacrificing their PA time consists of assigning homework to address the material that would otherwise be covered in a lecture. The purpose of this study was to compare the learning outcomes (pre- and posttest scores) of classroom instruction and homework assignments on students' cognitive knowledge acquisition in PE. Three student teachers were randomly assigned to lecture, homework, or lecture-homework groups. Physical education (PE) students ($N = 178$) in grades 9–12 and enrolled in Fitness for Life classes participated. Results indicated each school had a statistical

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increase in score from pre- to posttest. Actual score increases from pre- to posttest by school were not significantly different. Results of the study suggest that in lieu of conducting lectures, teachers can assign homework to allow for more PA time during class without sacrificing other curricular objectives.

In large measure, there has been an increase in obesity and a decrease of physical activity (PA) participation among adolescents in the United States (Centers for Disease Control and Prevention, 2000; Hedley et al., 2004; & Kahn et al., 2008). Youth population studies (Gordon-Larsen, Nelson, & Popkin, 2004; Kahn et al., 2008; Kelder, Perry, & Klepp, 1993; Sallis, 2000; Trost et al., 2002) indicate a downward trend in exercise outside of school-based physical education (PE) beginning with the seventh grade and accelerating through the high school years, as well as declining rates of PA as adolescent's transition into adulthood (Caspersen, Pereira, & Curran, 2000; Gordon-Larsen et al., 2004). In addition, the 1999–2002 Nutrition Health and Nutrition Examination Surveys revealed for youths aged 12 to 19, the percentage with BMI above the 95th percentile rose from 6% in the early 1970s to over 16% in 2002 (Hedley et al., 2004). Nevertheless, developing physically active lifestyle habits in the adolescent years leads to greater social and recreational opportunities in adulthood and a healthier life overall (Biddle, Goreley, & Stensel, 2004; National Association of Sport and Physical Education [NASPE], 2011).

In addition to being a source for developing the knowledge and skills that promote engagement in lifelong PA, PE can provide children with a substantial proportion of the PA recommended for health purposes (McKenzie et al., 2004). However, a constant problem encountered by physical educators consists of balancing the development of cognitive skills necessary to become lifelong practitioners of a healthy and active lifestyle with the need to achieve desired PA goals within the PE context (NASPE, 2004). Although physical educators strive to improve the fitness levels of their students and encourage lifelong PA, most are lucky if they are allotted enough class time to accomplish even minimal physical fitness objectives (Hart, 2001; Mitchell, Barton, & Stanne, 2000). In many schools, PE class time has been reduced (Annesi, Westcott, Faigenbaum, & Unruh, 2005) to focus on other academic subjects to ensure students score high on standardized tests (Maeda & Murata,

2004). Tudor-Locke, Ainsworth, and Popkin (2001) reported students in a 40-min lesson only engaged in 8 min of healthy activity. Due to time allotment issues, physical educators should set goals to increase student engagement in PA outside of class and in PE.

Simons-Morton (1994) suggested the goals of health-related PE should be for students (a) to take part in appropriate amounts of PA during PE lessons and acquire intended content knowledge and (2) to develop skills to be physically active outside of school throughout life. Sallis and McKenzie (1991) feared these diverse aims of PE might hinder achievement of the first goal, as lessons may emphasize students' motor, cognitive, social, moral, spiritual, and cultural development. Although these are valid and worthwhile areas of learning, time devoted to them can conflict with participation in health-enhancing levels of PA (Simons-Morton, 1994). Previous research has shown students spend less than 50% of PE class time in moderate-to-vigorous intensity (MVI) activity, with the majority of class time in sedentary or light activity (Fairclough & Stratton, 2005, 2006). Specifically, McKenzie et al. (2004) observed 430 PE lessons, and results indicated in average lessons of 34.5 min, students were only engaging in MVI for 16.6 min. These results are below the 50% of class time the U.S. Department of Health and Human Services (2010) recommends.

A potential solution to the difficulty of helping students develop cognitive skills without sacrificing PA time consists of assigning homework as part of the PE curricula. Assigning homework can be an excellent way to help students achieve curricular objectives, especially because classroom time allotted for PE is often limited (Arbogast & Misner, 1990). In PE, assigned homework will not only enhance the learning that occurs in class but also increase interest and motivation (Docheff, 1990). Homework also has the potential to become part of a student's overall education, as long as it provides an opportunity to integrate and enhance school learning, reinforces work-study skills, and increases self-discipline (Sullivan & Sequeira, 1996). Additionally, homework can provide invaluable benefits such as improving critical thinking, improving study skills, and showing learning can take place anywhere, not just in the classroom (Sullivan & Sequeira, 1996). If assigning homework is an effective tool for cognitive development in other academic areas, why would the same teaching strategy not work in PE?

Mitchell et al. (2000) identified necessary factors for a positive relationship between assigned homework and improved academic

performance. They suggested PE homework needs to be relevant to class content, as well as delivered in such a way that students are motivated and understand what has been assigned. Mitchell et al. further suggested students need to be held accountable for completion of the homework, similar to academic classes. As is typical of homework assigned as part of other academic classes, teachers must design PE homework to be purposeful and to facilitate learning that occurs in class. Just as academic teachers hope to inspire students to pursue additional learning outside of the classroom, physical educators should design homework assignments that will inspire students to pursue learning that will assist in developing lifetime active and healthy lifestyle habits.

A number of articles have examined assigning PA or cognitive assignments as PE homework for elementary and middle school and college students (Gabbei & Hamrick, 2001; Hart, 2001; Hopple, 1993; Leadley, 1994; Pantanowitz, Lidor, Nemet, & Eliakim, 2011; Smith, Cluphf, & O'Connor, 2001). One particular research study included students enrolled in PE activity courses in a university setting. This study aimed to evaluate the cognitive changes of students in PE activity classes and described the affective and behavioral characteristics of the students who were assigned to read and complete weekly take-home reading assignments and worksheets (Jorgenson, George, Blakemore, & Chamberlain, 2001). Results showed cognitive improvement, with respect to fitness-related knowledge, can be realized in physical activity classes with little or no class time devoted to lecture. To the current researchers' knowledge, however, no studies have compared classroom instruction with homework assignments on students' learning of health-related fitness concepts at the secondary level.

Physical educators need to achieve, at minimum, two difficult goals simultaneously: (a) maintain levels of PA in students to meet stated objectives and (b) impart material that will contribute to students' PE cognitive skills, enjoyment, and motivation. Hence, the purpose of this study was to compare the learning outcomes of classroom instruction and homework assignments on students' cognitive knowledge acquisition in PE. The significance of this study addresses a method for developing students' cognitive skills relative to PE material without compromising class time that could be used to achieve PA goals.

Methods

Participants and Setting

Student teachers ($N=3$) from a southwestern university who were student teaching during the Spring 2008 semester were recruited. All student teachers were male Caucasians between ages 22 and 27. Student teacher selection was based upon the quality of teaching during their preservice teaching courses and practicum experiences and whether the student teacher would be teaching Fitness for Life classes during their student teaching practicum. Also, the student teachers were certified Physical Best Health-Fitness Specialists, indicating expertise in the health-related fitness subject area. High school PE students ($N = 178$) from three high schools located in the southwestern United States were recruited based on convenience (currently enrolled in a Fitness for Life class) to participate in this study. The participants were enrolled in ninth to 12th grade and were enrolled in a 90-min Fitness for Life class. The Fitness for Life class is a health-related fitness class required of all high school students in this particular state. This class is designed to teach and apply health-related fitness principles to PA. The structure of this class consists of half lecture and half activity. The lecture component was based upon the *Fitness for Life* textbook by Corbin and Lindsey (2007). Male ($N = 101$) and female ($N = 77$) participants were between ages 15 and 17. The selection of high schools and PE students was based on which schools the student teachers elected to conduct their student teaching and whether the student teachers were teaching a Fitness for Life course.

Instrumentation

Ten developmentally appropriate lessons focusing on muscular strength and endurance were developed by the primary investigators from Chapters 11 and 12 of *Fitness for Life* (Corbin & Lindsey, 2007). From those 10 lessons, 10 homework assignments were designed based on the lesson content. All lessons and homework assignments were similar in length. The content of the homework assignments were based on the development of cognitive skills (knowledge and comprehension) in the area of muscular strength and endurance. The assignments included readings and questions designed to assess student knowledge regarding the content they had read. Example questions to the homework assignments are as follows: (a) What

two exercises are recommended for teens to estimate 1RM strength? (b) Explain which one is better for muscular endurance: doing multiple sets or one set of reps to failure? As identified by Doyle and Barber (1990), the assignments used in this study would be classified as preparation homework. Preparation homework refers to reading and written assignments that are given prior to the class in which the material is discussed. Preparation assignments were chosen because the students would be able to come to class with the appropriate knowledge to apply to the class activity session. The student teachers created the lectures based on the 10 lessons and homework assignments designed by the primary investigators. The primary investigators observed several of the lectures to verify the content from the lessons and homework assignments were taught. The lectures were designed to take up half of the allotted class time.

The primary researchers designed a 50-question, multiple choice pre- and posttest was based on the muscular strength and endurance lessons and homework assignments. Once the test questions were created, the researchers reviewed the test questions and deemed the test was appropriate based on the lessons and assignments. The pre- and posttest had identical questions. However, the order of the questions was different for each test. Each question was worth 1 point for a total of 50 points per test.

Data Collection Procedures

Prior to the start of data collection, the student teachers and primary investigators met to discuss the content of the 10 lessons and 10 homework assignments. The three student teachers were randomly assigned to one of the following three groups: homework only, lecture only, or both homework and lecture. The student teacher assigned to the homework-only group would not conduct lectures during classes and would provide the homework assignments at the end of class. The student teacher assigned to the lecture-only group would provide students with lectures but homework assignments. The student teacher assigned to the homework–lecture group provided both lectures and homework assignments. The teachers in the homework and homework–lecture group devoted time at the end of each class to review the assignments. All students required to complete homework assignments were held accountable by submitting their homework the following class period. Homework was graded and returned to the students in a timely fashion. Completed homework assignments were not reviewed in class.

Prior to the start of the muscular strength and endurance unit, the student teachers administered the pretest to students. Students were instructed to answer the questions to the best of their knowledge and that their teacher wanted to verify the students' prior knowledge to help the teachers design the most appropriate activities, lectures, and homework assignments. Students were also informed there would be a posttest after the unit to determine their knowledge acquisition in the muscular strength and endurance unit. Because cognitive testing was not part of the students evaluation devices for PE outlined in the class syllabus for all three schools, the pre- and posttest did not count toward the students' final grade. The muscular strength and endurance unit lasted 4 weeks. Upon completion of the unit, the student teachers administered the posttest to students. The pre- and posttests were graded by the primary investigators.

Data Analysis

Statistical analysis for pre- and posttest scores in this study was conducted using SPSS 16.0 (SPSS, Inc., Chicago, IL). Data were entered and confirmed by the primary investigators. Descriptive statistics were used to describe participants' gender, ethnicity, and age. A 3 x 2 factorial ANOVA was conducted to determine a school-by-gender effect on score difference.

Results

The final sample consisted of 101 male and 77 female students with a mean age of $15.6 \pm .88$ years, with 64% Caucasian, 18% Hispanic, and 18% Asian, African American, Native American, and/or Pacific Islander. A one-way ANOVA found significant differences, $F(2, 198) = 13.44, p < .001$, between the three groups on pretest scores (see Table 1). Because there was a significant difference in pretest scores between the groups, the difference in pre- to posttest scores was calculated and used as the dependent variable in the preceding analysis. A 3 x 2 (Group x Gender) factorial ANOVA found no significant difference in pre- to posttest scores difference by group ($p = .425$) or gender ($p = .381$), but found a significant main effect for Gender x Group, $F(2, 167) = 4.60, p = .011$. Males in the lecture-homework group improved more ($M = +3.89$) than females ($M = +.88$), but females in the lecture-only ($M = +5.00$) and homework-only ($M = +4.69$) groups improved more than males in the lecture-only ($M = +2.52$) and homework-only ($M = +1.93$)

groups. Paired sample *t* tests revealed all groups demonstrated significant increases in pre- to posttest scores (lecture, $p < .001$; homework, $p < .001$; lecture–homework combined, $p = .001$).

Table 1

Pre–Post and Mean Content Knowledge Scores (M ± SD)

	School 1		School 2		School 3	
	Lecture Only		Homework Only		Lecture & Homework	
	Males	Females	Males	Females	Males	Females
<i>n</i>	35	26	30	33	36	18
Pretest	25.1 ± 5.6	22.1 ± 6.2	27.7 ± 6.6	25.9 ± 5.6	21.8 ± 6.2	23.5 ± 5.7
Posttest	27.5 ± 8.4	26.4 ± 9.1	29.7 ± 8.1	30.6 ± 8.4	25.7 ± 7.3	24.2 ± 6.3

Discussion

The purpose of this study was to compare the learning outcomes of classroom instruction and homework assignments on students' cognitive knowledge acquisition in PE. The results of this study may have implications for having more allotted time for PA without sacrificing cognitive acquisition in Fitness for Life PE classes. Results from this study indicated PE students in each group had equal or similar levels of comprehension. This suggests students who receive homework in lieu of lecture or class discussion may demonstrate equal or similar levels of understanding. Results of this study were similar to Jorgenson et al. (2001) in that health-related fitness knowledge can be realized through homework assignments in PA classes without devoting time to lecture. Although eliminating all lectures from a Fitness for Life class might not be a realistic option, knowing students can still gain similar levels of cognitive knowledge through homework assignments allows teachers the opportunity to choose between lectures and homework. Despite most students failing the pre- and posttest, there was a significant increase in scores in all three groups with no difference between the three groups' scores. This result may suggest teachers may elect to assign homework in lieu of devoting class time to lecture to allow for the possibility of greater PA time during a Fitness for Life or health-related fitness class without sacrificing cognitive objectives. Having more time to devote to PA in class will help physical educators meet the first goal of health-related PE defined by Simons-Morton (1994), which is for students to take part in appropriate amounts of PA during

lessons. Additionally, having more time devoted to PA could help meet the U.S. Department of Health and Human Services (2010) recommendation of having students engaged in at least 50% MVI during PE classes. Previous research has shown students spend less than 50% of PE class time in MVI, with the majority of class time in sedentary or light activity (Fairclough & Stratton, 2005, 2006).

Arguments have been made both for and against the notion that PA during PE can make a meaningful difference to students' overall PA (Corbin & Pangrazi, 2003; Simons-Morton, 1994) due to skill development and cognitive and affective goals of PE. However, many students choose sedentary behaviors over PA once they leave school. The National Youth Risk Behavior Survey (YRBS) of 2009 indicated 23.1% of students between the ninth and 12th grades failed to participate in at least 60 min of PA on any day, 32.8% watched 3 or more hours of television, and 24.9% spent 3 or more hours on a computer per day. Only 18.4% participated in 60 min of PA per day on all 7 days. In regard to the aforementioned statistics, it is vital that physical educators look for ways to maximize class time to devote to PA participation. Knowledge regarding frequency, intensity, time, and type of activity required for health benefits is abundant; however, the minimal amount of time allotted for PE and the broad curricular goals make it difficult to reach those health benefits in PE. Although the current study did not collect data on students' PA levels during classes, the results suggest using homework to meet cognitive outcomes could allow more time during class to focus on PA outcomes. With more time allotted specifically for PA, the chance of increasing MVI and health benefits increases.

The use of homework is an appropriate assessment tool to assess student cognitive knowledge. NASPE (2004) has identified six national standards that guide teachers' instructional methods to ensure student learning in PE. However, not all physical educators use assessment procedures to determine if their students are meeting these standards. Evidence suggests physical educators do not assess students due to a lack of time associated with large class sizes and allotted class time and a lack of training and knowledge in assessment (Hensley, 1990; Lund, 1993; Veal, 1988). The national standards recommend physical educators should assess all standards in the cognitive, psychomotor, and affective domains, and homework allows them to assess the cognitive domain without using valuable class time that could be devoted to the psychomotor domain. Through the implementation of homework, teachers are

and will be able to evaluate student cognitive performance and are able to increase student effort and achievement on PE (Matanin & Tannehill, 1994).

Limitations and Future Recommendations

The results of the current study suggest using homework in lieu of lectures may allow more time for PA; however, it is only assumed students will increase their levels or amount of PA. A limitation to this study was no in-class PA data of students in the three groups were collected. All students in this study regardless of school were enrolled in a 90-min Fitness for Life class. A typical Fitness for Life class spends half the class time devoted to cognitive learning (lecture) and the other half applying that knowledge in activity participation. Because each group had the same allotted class time, the homework group had the full 90 min to potentially devote to PA, whereas the other two groups only had 45 min. As this study showed no difference in knowledge acquisition between the groups, a teacher could assign homework to allow more time for PA. Although the increase in allotted class time allows the potential to increase student PA levels, it is not the only variable that contributes to students PA levels. Other variables should be considered, such as lesson content, teacher, environment, student motivation, skill ability, and class size. It is recommended future studies collect PA data of students and data on the variables mentioned above.

Although there was a significant change between pre- and posttest scores of the three groups, the majority of the students did not pass either test. Possible reasons for low scores could be the quality of the lectures and/or student accountability to return homework assignments. Student teachers in the groups who provided students with the lecture component were allowed to design their own lectures based on the lesson and homework assignments created by the primary investigators. Although the primary investigators monitored the lectures, it is suggested for future research to administer the same lectures to all groups or have the same teacher for all groups. With regard to the homework assignments, students were only held accountable to turning in their assignment. However, data on the percentage of homework turned in were not kept accurately and were not included in this study. The student teachers administering the homework graded and returned the homework, but did not review the homework with the whole class after it was submitted. Low scores on the tests also could be contributed to cognitive testing not

being a part of the students' evaluation for PE (in all three groups) outlined in the class syllabus and would not count toward their final grade. This suggests the students might not have put forth their full effort to do well on the test. It is recommended for future studies that test scores should count toward the students' final grade or that teachers should provide an incentive to do well.

Generalizations of the results of this study should not be made to all PE classes. Data were collected with only three schools and only during Fitness for Life classes within the unit focused on muscular strength and endurance. Additional studies using homework assignments in other health-related fitness units, such as aerobic endurance, flexibility, and body composition are warranted. To test the hypothesis that use of homework would increase PA, this study should be replicated with the addition of measuring and comparing student PA through the use of pedometers or accelerometers. Also, to control for potential teacher effect, the study should be replicated with one teacher only for all groups.

Conclusion

In summary, results of this study suggest students who receive homework in lieu of lecture or class discussion may demonstrate equal or similar levels of comprehension. Although providing lectures and homework assignments might be ideal, it might not be possible due to time constraints and the many objectives of PE. Teachers may use this information to support their implementation of homework in their PE classes to eliminate lecture time that potentially could be devoted to increasing student PA time.

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