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The Impact of Integrating Math Skills into Physical Education Lessons on the Math Achievement of Undergraduate Students

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Abstract

This study investigated the impact of integrating math skills into physical education lessons on the math achievement of Undergraduate students in two classes. Statistical analysis revealed no significant differences in math performance between the experimental group, which received the integrated PE/Math instruction, and the control group. Despite the lack of statistical significance, practical observations indicated a need for further research to better understand the potential benefits and effectiveness of this instructional approach.

Keywords: Math Achievement; Physical Education; Undergraduate Students; Math Skills Integration; Interdisciplinary Learning

1. Introduction

Two primary goals of most quality physical education programs are to enhance individual fitness and to develop motor skills through movement activities. Since young adults enjoy engaging in movement and playing games, most undergraduate students eagerly anticipate participating in physical education classes. However, physical education is often regarded as a peripheral subject within educational settings. Many college administrators, instructors, and parents do not view physical education as a critical component of the academic curriculum. This perception is widespread across educational systems for two main reasons. First, many people do not recognize the value of what is being taught in the gymnasium, leading them to see physical education as merely an extended recreational period. The second reason is that integrated lesson planning between classroom and physical education instructors is typically minimal, if it occurs at all. This lack of integration limits instructors' understanding of what happens in various instructional settings and across different academic areas.

Physical education programs are crucial for the holistic development of students, as learning outcomes are achieved across several domains. In addition to addressing psychomotor objectives by developing fitness and sport skills, many undergraduate physical education curricula include learning experiences aimed at promoting cognitive development in students. This is partly accomplished through perceptual motor activities, which are movement-based and focus on enhancing balance, spatial awareness, temporal awareness, directional understanding, and body awareness in individuals. These activities are believed to support the cognitive and academic development of students (Payne & Isaacs, 1999). Although the cognitive and academic benefits of participating in perceptual motor programs have been debated in the literature, they serve as a method for teaching academic subjects to students in an engaging way (Gallahue & Ozmun, 1998; Payne & Isaacs, 1999). However, for this to be effective, integrated lesson planning between classroom and physical education instructors is necessary.

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The practice of integrative and cooperative lesson planning among instructors is gaining traction in educational environments due to the professional and emotional benefits it provides to educators. Instructors often experience enhanced instructional energy when they are professionally and emotionally connected with their colleagues (Graves, 2001). Interactions among instructors create natural social support networks and environments that are conducive to collaborative planning. Nevertheless, connections between physical education and classroom instructors are often challenging to establish and maintain because of the physical separation of their planning and instructional settings. Another challenge to integrative planning is that the connections between subject areas are not always readily apparent, which may be partly due to differences in learning environments (e.g., open vs. closed settings). Many instructors may not realize that teaching methods and instructional strategies are similar across content areas and instructional settings (Graham, Holt-Hale, & Parker, 2001; Pangrazi, 2000). Given that motor performance variables have been shown to correlate with the academic abilities of students (Harris & Jones, 1982), overcoming barriers to integrative planning between classroom and physical education instructors is essential for promoting holistic student learning.

Learning is most enjoyable when students find it fun. Sometimes, the joy of learning is lost when students do not find the content meaningful. Creating meaningful and engaging learning environments remains a challenge for many instructors, especially in subjects like mathematics (Kajander, 1999). Instructors may forget that young adults learn most effectively through kinesthetic activities. Often, instructors use highly structured organizational formats to maintain appropriate "indoor" behaviors, opting for instructional formats that involve sedentary, independent, or small group learning rather than movement-oriented, playful arrangements (Corso, 1999). The best instructors often employ purposeful play as a teaching method (Greenberg, 1993). Academic subjects such as math, reading, and social studies can be taught to students in an enjoyable way using movement and games (Gallahue & Ozmun, 1998; Payne & Isaacs, 1999). Play and other movement activities that require students to use age-appropriate cognitive processes help strengthen those processes (Lee, Silverman & Montoya, 2002; Pasnak, 1999). Specifically, in the context of this study, experts in teaching mathematics encourage the use of strategies that make math physical (Moss, 1997). Such learning strategies and related instructional methods are commonly found in developmentally appropriate physical education curricula (Graham, Holt-Hale, & Parker, 2001; Pangrazi, 2000). During physical education classes, students are presented with numerous activities where math concepts can be applied. For instance, students might be asked by their physical education instructor to divide themselves evenly into groups, calculate the area of a basketball court, or compute their gains or losses on fitness tests. Play, fitness, and movement activities, such as modified sports games, enable students to exercise and develop cognitive processes in an engaging manner (Weininger & Daniel, 1992). Despite the promise of these approaches, few studies have focused on embedding classroom subjects into the physical education curriculum. The purpose of this study was to examine the impact of incorporating math skills into physical education classes on the math achievement of undergraduate students.

2. Methods

2.1. Participants

Two undergraduate classes from a public university were selected to participate in this study. Each class consisted of 28 students, heterogeneously grouped by their academic performance levels.

2.2. Procedure

*T*he math instructors for the two participating classes developed pre- and post-instructional math assessments specifically for this study. These assessments included math concepts, questions, and problems that mirrored the math portion of the standardized achievement test prepared by experts. The pre- and post-tests each included 20 math problems covering topics such as addition, subtraction, data charting, and symmetry. Students were given 45 minutes to complete each test. No significant differences were found between the pre-instructional math test scores of the two undergraduate classes (PE/Math: M = 13.81; Control: M = 13.62).

The study was conducted over four weeks. After the pre-instructional math test, each class received one hour of math instruction daily and participated in physical education twice a week for 30 minutes. The math and physical education instruction was consistent across both classes. Each class engaged in similar physical education activities, including cooperative games, fitness exercises, sport skills training, and rhythm movements. The only notable difference in physical education between the two classes was that math concepts were integrated into the lessons of the PE/Math class. For instance, the physical education instructor in the PE/Math class would ask students to divide into four equal groups. If the groups were not equal, the instructor would prompt the students to calculate the difference between the groups. In contrast, the physical education instructor in the Control class assigned students to groups without incorporating math concepts.

The educational objectives for math and physical education, based on the state's academic standards, were included in the lesson plans for the PE/Math class. Examples of lesson objectives for the PE/Math class are provided in the Appendix.

After the four-week instructional period, the post-instructional math test was administered to both classes.

3. Results and Discussion

There were no statistically significant differences between the two classes (PE/Math: M = 15.23; Control: M = 14.10). However, some outcomes of practical importance emerged. First, the math instructors were not coordinating their teaching with the physical education instructor, which meant that math concepts were not consistently reinforced and practiced in both the math and physical education classes simultaneously. For instance, one math instructor was surprised to find that her students were already familiar with the concept of symmetry when she introduced it, as they had encountered it earlier in their physical education class. This highlights the need for more collaboration in curriculum planning across the educational program.

Beyond unit planning, teachers should continually discuss learning objectives, focusing on the current progress of students. This practice would provide better opportunities for teachers across different subjects to reinforce or adjust learning objectives to meet the students' needs. Additionally, more research is necessary to determine the true impact of collaborative planning and the integration of academic content into physical education lessons. The short duration of this study—only four weeks, with students participating in just eight physical education lessons where math concepts were embedded—might have limited the results. A longer study, perhaps extending over a semester or an entire academic year, could potentially yield more significant outcomes.

A natural outcome of this study was that students in both physical education classes enjoyed themselves. As previously mentioned, students best grasp concepts when they are presented in meaningful and enjoyable contexts. Physical education classes and activities offer an excellent framework for exploring new concepts from various areas of the educational curriculum. It is crucial for teachers across different disciplines to work together and collaborate to ensure this integration occurs effectively.

4. Conclusion

This study found no statistically significant differences in math achievement between undergraduate students who received integrated math and physical education instruction and those who did not. However, practical observations suggest that the integration of academic content into physical education may have untapped potential, particularly if there is better coordination and collaboration between instructors across disciplines. While the short duration of the study may have limited the observed outcomes, the positive student engagement highlights the value of exploring interdisciplinary teaching methods further. This study contributes to understanding how combining physical and academic education could enhance learning experiences, suggesting that future research should explore long-term effects and broader applications, ultimately benefiting educational practices and student development in society.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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Appendix

Lesson Plan

Unit Focus: Bowling & Fractions (Cricket)

Standards:

Physical Education:

Demonstrate functional patterns of bowling in cricket

Use proper techniques for bowling in cricket

Mathematics:

Solve problems involving fractions and percentage, using appropriate representations

Relate percentage to fractions and decimals, and justify reasoning

Lesson Plan:

During a cricket bowling lesson, students will focus on both motor and cognitive skills. Each student will use the correct technique to bowl and will have ten attempts. They will then record the number of successful deliveries (e.g., hitting the stumps). To make it easier for understanding, the total number of attempts is set to ten. For instance, if a student successfully hits the stumps 4 out of 10 times, they will record this as the fraction 4/10. Students will then simplify the fraction and learn how to convert it into a percentage. In this case, the student was successful in 40% of their attempts. To extend the lesson, students can calculate the percentage of unsuccessful deliveries.

Unit Focus: Throwing and Measuring

Standards:

Physical Education:

Demonstrate various techniques for throwing different objects

Recognize proper techniques for an overhand throw

Understand that appropriate practice improves performance

Mathematics:

Verify estimated measures for length

Lesson Plan:

While practicing throwing and catching, students will measure the distance of their throws. Each group will be provided with a measuring tape. One student throws the ball into an open field while another student marks where the ball lands. The group will then measure the distance and record their findings.

Unit Focus: Relay Races and Math Equations

Standards:

Physical Education:

Define track and field terms and identify events

Run while placing a baton into the hand of a moving receiver

Exhibit good sportsmanship

Mathematics:

Explain the difference between sprint, relay, and distance races

Use mental math to find sums

Lesson Plan:

In this relay race activity, instead of simply running and tagging the next person, students will pick up cards with math equations and matching answer cards during the race. Once all students have a card, they must work together to match the questions with the correct answers. The team that completes the task first wins the race. This approach provides an equal opportunity for both physically fast students and those who excel at mental math.