Chapter 14
Exploring Physics and Technology:
A Study in Teaching Kinematics to Student-Athletes

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ABSTRACT

It is becoming increasingly important to incorporate engaging and relevant interactive technologies into the physics and general study curricula of K-12 students. Theoretical principles of kinematics can be brought to life by including complementary technologies and activities that require manipulation and construction of textbook knowledge. This chapter explores the use of Adidas Smart Ball technology, the Physics Education Technology (PhET) online simulation, and Apex Digital Learning in grades nine through twelve enrolled in a small private college preparatory academy. The chapter is centered on the development of a kinematics unit that encourages higher-order cognitive skills in the classroom by focusing on how a combination of technologies and non-technology modalities demonstrate Bloom's cognitive skills: remembering, understanding, applying, analyzing, evaluating, and creating. Furthermore, it is shown that the combination of all three technologies, rather than independent use of a singular technology, can achieve higher-order thinking in science. This was demonstrated through the culmination of the project with student-designed and -driven physics experiments. This chapter further supports the widely held belief that teachers should employ the interests and passions of students in the context of teaching STEM subjects.

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INTRODUCTION

This chapter describes a seven-week project developed for student-athletes in physics classrooms. The goal of the project was two-fold. First, to assess whether the incorporation of three specific technologies designed to enhance content acquisition would also encourage higher order cognitive skills according to Bloom's Revised Taxonomy (Anderson & Krathwohl, 2001). Second, to determine whether an authentic application of great interest to the students would improve their motivation to learn physics principles.

Soccer Academy (pseudonym) is an all boys private school with a population of sixty-seven students from grades eight through twelve. The Academy combines world-class soccer training with a rigorous college preparatory program. The uniqueness of the student body offers the opportunity to teach physics principles through an authentic application by capitalizing on a passion shared by every student at the institution. Thirty students enrolled in four classes participated in the applied physics unit taught by two teachers. There were thirteen students in grade nine, eleven in grade ten, three students in grade eleven, and three students in grade twelve. The students' ages ranged from fourteen to eighteen. Each class met twice a week for one hour with additional work time on Fridays as needed. All students played soccer on an elite club team and participated in one and one-half hour soccer training sessions in the morning, and an approximately two-hour practice after school everyday. The students had soccer games every weekend during the season, and often traveled long distances. Occasionally, there was weekday travel; when this occurred the students completed their assignments through a blended learning program provided by Apex Online Learning. The Academy provided a take-home laptop computer for every student.

Academy students start playing soccer at a young age, and most aspire to be professional soccer players. Under the tutelage of coaches and trainers, they improve their skills by imitating demonstrations of proper technique, trial and error, and a great deal of practice. What most student-athletes are seldom taught is the science behind the sport, and how they can use science principles to understand the underpinnings that rule the motion of the ball. To this end, the physics courses at the Academy were designed to include an applied kinematics unit employing specific technologies in an effort to enhance learning the basic principles of motion and to promote higher order thinking skills.

The primary technologies used in this project were the Adidas miCoach Interactive Personal Training and Coaching System soccer ball (the "Smart Ball"), the Physics Education Technology Project (PhET) online simulations, and Apex Digital Learning. The Adidas miCoach Smart Ball is a Major League Soccer (MLS) size 5-regulation weight (0.445 kg) ball. The Smart Ball has an embedded sensor that captures the ball's launch speed, spin velocity, spin type, strike area on the ball, and the flight path data within 0.75 seconds after it is kicked. PhET is a free online library of over seventy-five interactive simulations created for students and teachers to use as a visual tool for learning principles in physics, chemistry, biology, earth science, and mathematics. Apex Online Learning, a National Collegiate Athletic Association (NCAA) approved provider of blended and virtual online learning platforms, was used to complement Smart Ball and PhET instruction.

The final assessments in this project were student-designed experiments used to determine the effectiveness of technology in content acquisition and the development of higher-order cognitive skills. A teacher-designed rubric was used to assess content knowledge of the final evaluation. Additionally, a scale was made for the Revised Bloom's Taxonomy of Educational Objectives to evaluate the degree to which each technology helped the students to achieve higher order thinking. The students provided anecdotal comments to informally describe their level of motivation in this unit as compared with their previous classroom experience using traditional textbook examples in physics.