Using Drone Technology to Enhance Student Motivation and Engagement in a Dual-credit Agricultural Mechanics Course

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Introduction

School-based agricultural education (SBAE) has been identified as a prominent context area for the integration of science, technology, engineering, and mathematics (STEM) content (Haynes, Robinson, Edwards, & Key, 2012; Parr, Edwards, & Leising, 2006). As such, SBAE remains a flexible vehicle for the delivery of many different subject areas that employ many STEM facets, such as natural resource and environmental science, plant science, and agricultural technology and mechanical systems (Phipps, Osborne, Dyer, & Ball, 2008). Focusing on agricultural technology and mechanical systems (i.e., agricultural mechanics), this instructional area alone has a significant history of inclusion within SBAE programs (Burris, Robinson, & Terry, 2005; Wells, Perry, Anderson, Shultz, & Paulsen, 2013), and includes numerous content areas, including machinery and equipment systems, power systems, advanced agricultural technologies, and more (McCubbins, Anderson, Paulsen, & Wells, 2016; Shultz, Anderson, Shultz, & Paulsen, 2014). This diversity can provide numerous teaching and learning opportunities for both teachers and students, particularly as changes in available technologies and techniques continue to expand.

Shultz et al. (2014) indicated that many agricultural education teachers regarded soil and water management topics (e.g., global positioning systems, using surveying equipment, etc.) as important to teach. Interestingly, Shultz et al. (2014) reported that, overall, teachers did not express a great degree of competence in teaching soil and water management topics. McCubbins et al. (2016) noted that many teachers reported an inadequate supply of tools and equipment available to teach the content within this particular skill area. Based upon these prior findings, it is conceivable to conclude that soil and water management skills, including surveying, are important for inclusion into agricultural mechanics curricula, but perhaps investment in the tools, equipment, training background, and, perhaps even curricula, necessary to provide instruction in these topics is lacking. Moreover, it could be postulated that lacking adequate resources could result in substandard or obsolete curricula that lacks engagement on the parts of students. Perhaps a new method of addressing soil and water management skills, particularly one that contextually emphasizes STEM content and one that could increase student motivation engagement, could be useful.

How it Works

The land surveying unit taught in the dual-credit agricultural mechanics course [HIGH SCHOOL] utilized content designed by agricultural education teachers in the early 1990's. It consisted of concepts related to land measurement, using surveying equipment, and introductory profile and differential leveling activities using dumpy levels. The content was, as perceived by the teacher and students, outdated. Many students were, anecdotally, disengaged through this unit, citing it as their least favorite component of their dual-credit course. Moreover, students indicated that the information throughout this unit was archaic, indicating frequent boredom due to the lack of rigor and relevance. While many of the skills taught within this content area are often still utilized within certain contexts of agricultural mechanics, the students were desirous of

a new, exciting, and innovative approach to learning these concepts. In an attempt to modernize the surveying content and increase student motivation and engagement, the SBAE program at [HIGH SCHOOL] purchased four mini-drones and a professional DJI Phantom 3 Advanced Quadcopter Drone with a 2.7K HD video camera to use within the course.

The agricultural education teacher at [HIGH SCHOOL] utilized the mini-drones as an interest approach for the surveying unit. The mini-drones were used them to introduce the concept of drone technology and spark further interest through racing. Afterward, the students conducted an inquiry-based activity during which they researched various uses of unmanned aerial vehicles (UAV) and their potential applications within the agricultural industry. This segued into the teacher-developed lesson on the acceptable and safe use of drones within soil and water management and engineering, as well as the relationship to the prior surveying content covered. The students were then able to apply the concepts learned in this unit by learning to operate the professional drone during their agricultural mechanics course.

Implications

Anecdotally, student engagement and motivation improved dramatically when the drones were first introduced within the curricula. The teacher indicated that the students showed excitement about using this technology and it easily became one of the most popular components of the course, as indicated by the course evaluations. Furthermore, student exam scores in the surveying component of the course also showed significant increases over prior years' scores.

Future Plans & Advice to Others

The teacher at [HIGH SCHOOL] plans to continue utilizing drone technology within the agricultural mechanics course, but is also working on developing curricula in order to incorporate the use of drones in additional coursework. Specifically, these other courses include the Environmental Science and Agricultural Leadership and Communications courses. Future goals include incorporating a drone-mounted camera into a wildlife ecology unit within Environmental Science as well as into the video production unit in Agricultural Leadership and Communications courses. However, caution should be taken to ensure compliance with laws and regulations surrounding UAVs, as mandated by the Federal Aviation Administration (FAA).

Costs

The cost of the DJI Phantom 3 Advanced Quadcopter Drone with a 2.7K HD video camera was approximately $1,000. Additional requirements include a modern, Wi-Fi enabled device to utilize as the controller/monitor. A personal iPad or smartphone, in conjunction with the free downloadable app from DJI, can be used as such. If one is not available, a 32-gigabyte (GB) iPad may be purchased for around $330.00. The purchase of an additional battery ($130), as well as spare set of propellers ($20 per set) for the drone, is recommended as well. The mini-drones cost approximately $20 each. While their use served as an effective interest approach and were fun to utilize for practice flights, the skill and procedures used to operate them were considerably different than the professional UAV. The mini-drones didn't appear to adequately prepare many students to fly the Phantom 3, and perhaps should not be recommended for such.

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