Utilizing LEDs and Breadboards to Teach Electricity: Emphasizing STEM Principles through Agricultural Education Teacher Professional Development

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Introduction

Timely and appropriate professional development opportunities for teachers remains a priority for the agricultural education profession (Haynes & Stripling, 2014; Lawver, Pate, & Sorensen, 2016; Phipps, Osborne, Dyer, & Ball, 2008). Phipps et al. (2008) posited that professional development opportunities function to increase the human capital of teachers. Rising demands for increased student achievement in STEM content have created opportunities for contextualized learning from other disciplines (i.e., agricultural education) (Haynes & Stripling, 2014; Parr, Edwards, & Leising, 2006). As such, a significant need exists for continuing professional development in Science, Technology, Engineering, and Mathematics (STEM) content within school-based agricultural education (SBAE) (Haynes & Stripling, 2014). This is especially true in contextualized instructional areas that emphasize STEM principles, such as agricultural mechanics (Parr et al, 2006; Shultz, Anderson, Shultz, & Paulsen, 2014; Wells, Perry, Anderson, Shultz, & Paulsen, 2013). Agricultural mechanics remains a diverse, STEM-based field popular with secondary students, and of great value to the agricultural industry. As such, it is imperative high-quality teacher professional development and growth in this area continues (Burris, Robinson, & Terry, 2005; Wells et al., 2013).

Within agricultural mechanics, the teaching and learning of electrical principles, theory, and its application is not uncommon in many modern SBAE programs (Herren, 2010). Remarkably, as Shultz et al. (2014) described, many agricultural education teachers have reported limited competence in teaching the topics (e.g., tool identification and use, basic wiring skills, and electrical safety) within this content area. Could this perhaps be related to the lack of professional development within this important skill area? Moreover, could teacher-perceived competencies in a particular skill area result in limited training in the content for secondary students? As such, student exposure to instructional opportunities in STEM-based, real-world concepts could be lacking (Wells et al., 2013; Shultz e al., 2014; Byrd, Anderson, Paulsen, & Shultz, 2015). As such, involvement in professional development that emphasizes the incorporation of STEM content within the context of agricultural education (e.g., agricultural mechanics) may hold promise for increasing both the technical and academic competence of agricultural education teachers (Parr et al., 2006).

How it Works

At the 2015 National Association of Agricultural Educators (NAAE) convention in New Orleans, Louisiana, agricultural education teachers from across the United States were engaged in professional development opportunities designed to enhance knowledge and competence in agricultural education (NAAE, 2015). One session focused upon enhancing the teaching and learning of STEM content vis a vis contextualized agricultural mechanics. The goals of this professional development session included increasing teacher confidence and competence in teaching STEM content, providing teachers with additional training in the field of electrical technology and, ultimately, increasing secondary student interest and performance in STEM content and agricultural mechanics (B. Gill, personal communication, November 18, 2015).

These goals led the workshop leaders to focus upon an area often overlooked within the field of agricultural mechanics education, the use of light emitting diodes (LEDs) and breadboard solderless circuit systems, often found within a variety of residential and commercial applications. These items are often incorporated in small and large electronic devices and systems used throughout the agricultural industry. Professional development facilitators focused upon training teachers how to interpret blueprints for creating basic functional circuits, teaching strategies for integrating this area into existing electrical technology curriculums, as well as the STEM principles that allowed each LED system to operate. Teachers were paired together and allowed a variety of materials to use in constructing the given LED circuits, ultimately creating several combinations of fully functional circuits. Upon the conclusion of the session, participants were given teaching materials and resources to promote the use of LED circuitry technology and contextually taught STEM content within their respective agricultural mechanics curricula.

Implications

Participating teachers anecdotally reported a high level of engagement and interest in the professional development session topic, its use of technical and academic content, and its delivery. These positive remarks indicated teachers exhibited a great deal of interest in covering like topics within their own SBAE programs, indicating teachers appreciated the coverage of academic content in a familiar and useful context that can be, in turn, used with secondary students. Improving technical competence, such as that related to electrical technology, is an important step in improving the quality of agricultural mechanics education (Shultz et al., 2014). Furthermore, advancing SBAE through effective and engaging teacher professional development is paramount to the continuity and long-term sustainability of programs (Phipps et al., 2008).

Future Plans & Advice to Others

Due to the popularity of this professional development, a demand exists with agricultural education teachers for new, engaging, and emerging session topics that create broader opportunities for themselves and their students. There currently exist plans for the continued inclusion and expansion of STEM-based agricultural mechanics professional development sessions at future NAAE conventions. It is advised that the agricultural education profession look to continue the expansion and diversification of these STEM-based sessions across the country in other ways as well, such as during state- and regional-level agricultural education teacher association meetings. Such efforts will continue to pay dividends toward improving the human capital within SBAE.

Costs

The costs associated with implementing this professional development workshop were small. In total, a budget of $200.00 was utilized to purchase the LED circuitry materials, breadboards, and necessary instruments. Selected session materials, such as online resources, were provided to participating teachers at no cost.

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