Developing an Asynchronous Experiential Learning Professional Development for Emerging Technologies in Agricultural Sciences

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Introduction

Agricultural sectors are experiencing technological advancement through the adoption of emerging technologies such as precision agriculture systems, artificial intelligence (AI), automation, sensors, robotics, and real-time data analysis. These innovations are transforming agricultural production and creating a growing need for agricultural education programs to prepare students with the technological knowledge and skills required for future careers in agricultural technology (King et al., 2019). Secondary agricultural educators must be ready to integrate emerging technologies into classroom and lab instruction to ensure curriculum relevance and workforce readiness.

Despite the importance of emerging technologies, agricultural educators often face barriers to implementation, including limited access to professional development, insufficient training opportunities, lack of confidence with new technologies, and time constraints associated with learning rapidly evolving content (King et al., 2019). Asynchronous professional development has emerged as a new approach to address these challenges by providing flexible, self-paced learning opportunities that can accommodate teachers' schedules while increasing access to instructional resources. Furthermore, educational technologies such as simulations and online learning environments have demonstrated potential to enhance engagement, support experiential learning, and improve learning outcomes within agricultural education settings (Xu et al., 2023).

The development of this professional development program was guided by Kolb's Experiential Learning Theory (1984), which emphasizes learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Experiential learning has been a foundational principle within agricultural education for a long time because it promotes learning through authentic experiences and application of knowledge in real-world contexts (Shoulders & Myers, 2013). By integrating asynchronous instruction with virtual simulations, hands-on activities, and authentic agricultural applications, this project sought to develop a manageable professional development model that supports agricultural educators in teaching emerging technologies to high school students.

How it Works

The curriculum consists of an intentional multi-layered model that utilizes a scaffolded experiential learning approach designed to support high school teacher engagement with emerging agricultural technologies. Instruction begins with the introduction of key concepts through asynchronous learning materials and guided instruction that establish foundational knowledge. Teachers then begin with interactive digital models and simulations that allow them to explore technological systems. This helps them visualize processes and develop conceptual understanding before applying their learning in a physical setting. Utilizing an Arduino Uno microcontrollers curriculum, secondary agriculture teachers complete a two-hour in-person introduction meeting to explain the concept and process. Teachers are provided a hands-on Arduino hardware kit to complete four introductory lesson activities. During the in-person session, teachers receive a demonstration and perform guided practice using the simulation software Tinkercad. The teachers receive a binder with a physical copy of the curriculum and worksheets. After the in-person session, teachers are assigned the four introductory learning activities to complete independently via Canvas learning management system (LMS) within two months. The curriculum scaffolds activities to facilitate understanding of how circuit technology works and where they can apply it in industry applications. Once the introductory modules are completed in Canvas, teachers meet for a second in-person session to review any technical issues. After completion of the training, teachers receive six full hardware kits along with an LMS course export package for student use in their classrooms.

Results to Date

Currently we have created five modules of instruction. The first module are a self-guided Kolb's model of instruction, and the last four are tailored to the specific need of the agricultural educator. The first module is a prerequisite for the remaining modules. The real-world application can begin when choosing one pathway to follow for their specific classroom needs. We have 24 teachers currently sampling the program. The educators are provided a training to go over the basics of the course and then provided the materials to create the projects and models that follow along with the curriculum.

Upon first implementation, some of the veteran teachers struggled to understand the curriculum and model building. While others were quick to understand, it is important to see the need of having curriculum for educators, so there is not a dichotomy of industry need and available skills when students leave to go into their careers in agriculture. Further training will occur before the school year to help educators talk through any problems or friction points; they identified in the self-paced modules.

Future Plans/Advice to Others

In the future, with this idea, the intent is to provide a more readily available model to agricultural educators for the advancement of technology in classrooms. Every sector from greenhouses and nurseries to robotic welders, sensors, and wireless connectivity has given the pathway to build curriculum around student engagement in the material. This method has the potential to create students excited to be in the classroom. Educators and students can learn curriculum together to build a better environment of transparency between the two.

Costs

The cost is relatively minimal for this idea of curriculum implementation. Hardware kits cost around $45 for equipment. There are several programs that allow students to access their platforms and tools for free. Arduino IDE software, Tinkercad, and AI is all readily available and free to the student and teacher. The main cost would be project materials and the LMS the school uses for students. Another cost associated with this type of teaching model would be the cost of recording equipment. Videos help the students troubleshoot and work asynchronously. With recording equipment, lighting equipment may be needed for video quality purposes and potentially microphones as well. This recording setup can create exceptional videos to enhance this portion of the teaching procedure.

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