

Hybrid DACUM for development of Precision Agriculture curriculum

Introduction/Need for the innovation

Precision agriculture (PA) has rapidly transformed farming practices by integrating complex technologies to improve daily agricultural operations. PA adoption has shifted the demand for technician labor and has led to increased jobs and wages (Kalva & Janzen, 2026). While the quick adoption of these technologies has created new career opportunities, high school educators, universities, and community colleges often struggle to keep pace with the industry's evolving demands (Bournaris et al., 2022). Specifically, rapid changes in services demanded by farmers, alongside disparate hardware and software platforms, make it difficult for educational institutions to adequately prepare new employees. A 2018 survey conducted by Erickson et al. (2018) identified 10 general PA competency areas needed in the workforce. This innovative project collected information, research, and perspectives from professionals in the PA field about these 10 competencies. We used this information to design a foundational precision agriculture curriculum for use by secondary students in agricultural mechanics classrooms.

How it works

Faculty members from Agricultural Education and Agricultural Systems Technology in Missouri began this project with the goal of identifying foundational skills needed by all professionals employed in precision agriculture. In addition to pursuing literature around the topic, we were interested in foundational skills as perceived by professionals in PA in Missouri. We wanted to understand the knowledge, skills, and attitudes needed for successful employment, and what specific student competencies should be included in a PA course. We used the DACUM (Developing a Curriculum) approach to aid in the design of the PA curriculum. DACUM is an occupational analysis method used to identify duties and tasks relevant to a specific job or occupation (Norton & Moser, 2008). Following the structure of the DACUM process, our team proceeded in multiple phases. First, we invited 13 early-career professionals working in PA to participate in a morning of focus groups and meetings. We asked stakeholders to list available careers and the necessary skills for those roles. Following this initial meeting, a second advisory group of statewide industry specialists and postsecondary educators met to merge these skills into competency areas. Faculty then generated a scope and sequence document. Finally, we asked for feedback from our PA stakeholders and engaged in collaborative discussion with Digital Agriculture Research and Extension Center faculty. Based on feedback from these discussions, faculty members broke content into 10 units. The meetings utilized Zoom to collaborate in real-time with both face-to-face and distance participants.

Results to date and Implications

By leveraging the DACUM process, our faculty team successfully identified knowledge, skills, and attitudes required for successful employment and organized them into a coherent sequence. The resulting 10-unit curriculum helps to prepare secondary students for PA careers by bridging the gap between industry needs and academic training. Each unit includes materials for classroom presentations, active learning experiences, and recommendations for supplemental activities to enhance learning. Ultimately, this curriculum will help build a skilled workforce equipped to navigate the rapidly evolving landscape of precision agriculture.

Figure 1. Precision Ag Instruction Units

<p>Why Precision Agriculture? This unit introduces students to the challenges of growing and harvesting the food we eat. Students will identify the variables in growing crops and how technological advances in PA help farmers address these challenges.</p>
<p>Precision Agriculture Components. Students will identify the key PA technologies and how technologies work together to help producers more efficiently manage plant growth variables.</p>
<p>Soils. Students will evaluate soil variables influencing plant growth and nutrient availability. Students will collect soil samples using grid sampling techniques and analyze data to make management recommendations.</p>
<p>Agricultural machinery. Students will describe the various mechanical processes in growing and harvesting forest, fiber, forage, and grain crops. Additionally, students will demonstrate how to interpret and mix various chemicals, including fertilizers</p>
<p>Electrical control and sensing. Students will analyze how PA improves agricultural machinery processes in growing and harvesting agricultural products. Students will demonstrate how to install and synchronize hardware/software across devices and troubleshoot electrical issues.</p>
<p>GPS spatial data- interpreting data and making decisions. Students will demonstrate the steps in implementing grid sampling, soil test analysis, field mapping, guidance, and fertilizer application for implementing PA practices on a new field.</p>
<p>Economics and risk. Students will analyze the various sources of risk and tools to mitigate risk. Students will identify variables that impact return on investment and suggest management decisions based on these variables.</p>
<p>Careers. Students will identify careers and skills needed for various precision agriculture careers.</p>
<p>Professional communication. Students will demonstrate the strategies needed for effective verbal and written technical communication for careers in precision agriculture.</p>
<p>Emerging technologies. The world of PA is rapidly changing. This unit highlights some of the newest technologies in agriculture and the revolution in efficiency.</p>

Nine high school educators across Missouri were introduced to and trained in how to use this curriculum during the summer of 2025. They are currently piloting the curriculum in their agricultural mechanics classrooms. The curriculum resulting from this innovative project offers high school educators a verified framework to introduce PA concepts effectively. It provides foundational knowledge to secondary students and may prompt students to consider a career in precision agriculture. Industry may benefit by having access to young employees or interns who already have some basic understanding of precision agriculture concepts.

Future plans, advice to others, and resources needed

Teachers who piloted the curriculum will participate in additional PA professional development experiences during the summer of 2026. Other future recommendations include the adoption of this scope and sequence in secondary agricultural education programs to ensure alignment with workforce demands. We advise others who desire to carry out a similar project to rely heavily on their networks. For example, we intentionally reached out to our statewide agricultural co-op and secured meeting space in their headquarters to seek familiar, off-campus spaces for participants. We also utilized alumni networks to identify early-career professionals working in hands-on PA roles and invited them to participate. Finally, we used Zoom technology to facilitate hybrid collaboration, including break out rooms, AI transcripts, and real time editing of the skills identification and subsequent organization.

References

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