Inservice Needs of Selected Arkansas Agriculture Teachers Related to Precision Agriculture

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Precision Agriculture (PA) ensures that the right quantity of agricultural inputs like fertilizer, water, pesticides, and insecticides are applied at the right amount in specific locations in a field to ensure optimal economic yields and continuous sustainability (UNDP, 2021). Despite the promising features of PA, it is reported that PA education is primarily taught at universities or colleges (Reichardt et al., 2009) and it is not common at the high school level (Chad, 2022). According to Chad, the absence of PA coursework in teacher preparation programs makes it difficult for high school agriculture teachers to acquire PA knowledge during their teacher education preparation. This hinders secondary agricultural educators from developing PA competencies and makes it difficult for them to teach PA-related courses. Currently, in agricultural education, there is a call to incorporate 21st-century competencies in the agriculture curriculum (DiBenedetto et al., 2018) and this will call for trained teachers. According to DiBenedetto et al., conducting needs assessments and delivering relevant in-service education have been identified as necessary steps in enhancing the competencies of school-based agriculture teachers.

Conceptual/Theoretical Framework

This study was designed using Shulman's (1986) Teacher Knowledge theory, which posits that teachers need seven specific types of knowledge to proficiently oversee teaching and learning. However, for this research, only two of the knowledge components, content knowledge (CK) and pedagogical content knowledge (PCK) were employed. CK refers to mastery of a specific content and PCK is knowing how to effectively teach that content to students (Shulman, 1987). This study assessed agriculture teachers' perceptions of their CK and PCK in PA.

Purpose

The purpose of this study was to determine the in-service needs of Arkansas agriculture teachers in PA. The results will be used to plan and deliver relevant in-service education.

Methods

The researchers, in collaboration with three PA experts from the University of Arkansas, organized a PA workshop for agriculture teachers in Arkansas. Before the workshop, participating teachers (n = 44) completed a PA needs assessment instrument. This instrument was designed using Borich's (1980) needs assessment model which allows for the prioritization of in-service needs based on calculated mean weighted discrepancy scores (MWDS). With MWDS, skills deemed highly important but with low competence ratings will be given higher rankings compared to skills with low importance ratings and high competence ratings (Courson, 1999). To ensure reliability, a test-retest was conducted with 13 pre-service agriculture teacher education students at the University of Arkansas, resulting in a coefficient of stability of .91. A panel of four experts in PA and survey research evaluated the instrument and judged it to possess face and content validity. Participating teachers evaluated the perceived importance of selected PA topics for high school-level instruction, as well as their ability to teach these topics. The survey contained 29 competencies categorized under seven PA technologies: Real-time Kinematic GPS, Variable Rate Technology (VRT), Unmanned Aerial Vehicles (UAVs), Guidance and Auto Steering Systems, Soil Sensing Systems, Yield Monitoring and Mapping, and Geographic Information Systems (GIS). A brief description of each technology was provided. Each competency was measured on a

Likert scale ranging from 1 to 5, where 1 denoted "No Importance (or Ability)" and 5 signified "High Importance (or Ability)." All teachers provided usable responses.

Results

Among the seven PA technologies, the mean importance of teaching ranged from 3.98 (“Above Average" on the Likert Scale) to 4.40 (deemed "High" on the Likert Scale). Unmanned Aerial Vehicles emerged as the top priority, while Geographic Information System ranked second, and Guidance and Auto Steering Systems topics were considered the least important. In terms of teaching ability, all received mean scores below 2, indicating a "No" response on the Likert scale. This implied that none of the teachers possessed the ability to teach any of the 29 competencies. In addressing in-service needs, GIS emerged as the top priority area with a MWDS of 11.85, followed by Soil Sensing Systems at 10.76 MWDS. UAVs ranked third with a MWDS of 10.61, while Real-time Kinematic GPS came in fourth with 10.28 MWDS. VRT followed closely with 10.25 MWDS, and Yield Monitoring and Mapping obtained a MWDS of 9.71. Guidance and Auto Steering Systems topics were identified as the area requiring the least in-service training, garnering a MWDS of 8.16 (Table 1).

Table 1

Mean Weighted Discrepancy Score of Inservice Needs of Selected Arkansas Agriculture Teachers Related to Precision Agriculture

Area	Importance		Ability		
	M	*SD*	*M*	*SD*	*MWDS*
Geographic Information System	4.39	0.63	1.70	0.95	11.81
Soil Sensing Systems	4.23	0.66	1.68	0.88	10.76
Unmanned Aerial Vehicles	4.40	0.60	1.99	1.09	10.61
Real-time Kinematic GPS	4.17	0.66	1.71	0.82	10.28
Variable Rate Technology	4.20	0.75	1.76	0.89	10.25
Yield Monitoring and Mapping	4.07	0.88	1.68	0.96	9.71
Guidance and Auto Steering Systems	3.98	0.89	1.93	1.22	8.16

Conclusions and Recommendations

Overall, the teachers recognized the importance of the chosen topics and recognized the need to include them in the high school curriculum. However, they expressed a deficiency in the requisite content knowledge and skills needed to effectively teach these topics. Based on the MWDSs, in-service education is needed in all seven areas with immediate priorities in GIS, Soil Sensing Systems and UAVs. Therefore, it is recommended that PA in-service education on these highest priorities be organized for the Arkansas agriculture teachers. Subsequent inservice workshops should be offered for the lower-rated priorities. Additionally, Arkansas agricultural education leaders, teachers, teacher educators, and PA experts should partner to develop PA curriculum on the identified topics. This would enable agriculture teachers to develop PA competencies and provide relevant PA educational opportunities for Arkansas agricultural education students.

References

Borich, G. D. (1980). A needs assessment model for conducting follow-up studies. *Journal of Teacher Education*, *31*(3) 39-42. https://doi.org/10.1177/002248718003100310

Chad, R. (2022). Barriers to adoption of precision agriculture competencies in secondary agriculture education programs: a case study. [Doctoral dissertation, University of Missouri]. https://mospace.umsystem.edu/xmlui/handle/10355/93986

Courson, J. (1999). An assessment of the computer-related skills needed and possessed by county extension professionals in the Mississippi Arkansas University Extension Service. [Doctoral dissertation, Mississippi Arkansas University]. https://www.proquest.com/dissertations-theses/assessment-computer-related-skills-needed/docview/304510792/se-2

DiBenedetto, C. A., Willis, V. C., & Barrick, R. K. (2018). Needs assessments for school-based agricultural education teachers: A review of literature. Journal of Agricultural Education, *59*(4), 52-71. https://doi.org/10.5032/jae.2018.04052

Reichardt, M., Jürgens, C., Klöble, U., Hüter, J., & Moser, K. (2009). Dissemination of precision farming in Germany: Acceptance, adoption, obstacles, knowledge transfer and training activities. Precision Agriculture, *10* (2009), 525-545. https://doi.org/10.1007/s11119-009-9112-6

Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14. https://doi.org/10.3102/0013189X015002004

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review 57* (1), 1-22. http://dx.doi.org/10.17763/haer.57.1.j463w79r56455411

UNDP. (2021). *Precision agriculture for smallholder farmers.* United Nations Development Programme. https://www.undp.org/publications/precision-agriculture-smallholder-farmers