DISCIPLINE AREA: AGRICULTURAL EDUCATION

Evaluating the Impact of AgXplore Training on Agriculture Teachers

Chaney Mosley
Middle Tennessee State University
chaney.mosley@mtsu.edu

Ying Jin
James Madison University
jin4yx@jmu.edu

Kevin Ragland
Middle Tennessee State University
kevin.ragland@mtsu.edu

This work was supported by the Professional Development for Agricultural Literacy, project award no. 2023-67037-39939, from the U.S. Department of Agriculture's National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and should not be construed to represent any official USDA or U.S. Government determination or policy.

Introduction and Purpose

In 1992, middle schools across the United States offered agricultural education programs serving 52,968 students (Rossetti, 1992). Nearly 30 years later, that number more than doubled. Around 2020, 442 teachers exclusively taught agriculture to 107,856 middle school students (Jones et al., 2020). Jones et al. (2020) claimed a high-quality teacher is needed at the middle school level to enhance middle school agricultural education programs. Teaching agriculture at the middle school level is different than teaching high school (Talbert et al., 2007); however, postsecondary teacher education programs may emphasize teaching in high school settings, thus depriving agriculture teacher candidates from the middle school teaching experience. Another challenge to ensuring high-quality middle school agriculture teachers is the rapidly increasing number of alternatively certified and non-licensed agriculture teachers (NAAE, 2024) who may lack formal pedagogical training. Also, because middle school is a critical time for youth development, curriculum and instruction should be developed differently than approaches taken in elementary and high school (Teague et al., 2012). The growth of middle school agricultural education has not been matched by corresponding advances in teacher preparation, certification pathways, or access to curriculum tailored to the developmental needs of middle school students. These combined challenges highlight the need for targeted professional development (PD) that equips middle school agriculture teachers with both the pedagogical skills and content knowledge necessary for effective instruction.

One effort to address these challenges is the Curriculum for Agricultural Science Education (CASE), an initiative of the National Council for Agricultural Education (NCAE) which developed the AgXplore Middle School curriculum materials (CASE, 2022a). Through PD, CASE enables teachers to incorporate inquiry-based instructional practices by developing comprehensive curriculum materials that promote rigor and relevance in the classroom; the

training is designed to assist teachers in implementing the curriculum (CASE, 2022b). The AgXplore Middle School (AgX) course facilitates the exploration of the daily impact of agriculture for middle school students, introducing them to animals, plants, energy, and resources we consume due to agriculture (CASE, 2022). The curriculum encourages the exploration of the agricultural value chain from industry to consumer and includes assessment tools with laboratories, games, and other exercises (CASE, 2022). This purpose of this study was to evaluate the impact of CASE training with respect to teacher content knowledge, pedagogical knowledge, and self-efficacy, and was driven by the following research questions:

1. Can CASE training enhance teachers' content knowledge, pedagogical knowledge, and self-efficacy?
2. Upon completion of CASE training, how likely are teachers to implement AgX topics in the subsequent semesters?

Theoretical Framework and Literature Review

Theoretical Framework. This study was guided by Guskey's (2002) Model of Teacher Change, which emphasizes the role of PD in fostering improvements in teacher knowledge, beliefs, and practices. According to Guskey (2002), meaningful changes in teaching practice are most effectively achieved when PD enhances teachers' knowledge and skills, which in turn leads to changes in their beliefs and attitudes, including self-efficacy. Guskey's (2002) model is relevant to agricultural education, where teachers may require targeted training to build content-specific knowledge and pedagogical approaches appropriate for middle school learners. In this study, Guskey's (2002) model informed the evaluation of the AgX training's influence on teachers' content knowledge, pedagogical knowledge, and self-efficacy, which are essential to promoting instructional change (Guskey, 2002) in middle school agricultural education. Within this context, the study applied Guskey's (2002) model to examine both the outcomes of the AgX training and the resulting teacher development. By framing the evaluation through Guskey's model, the study explored how PD can serve as a catalyst for instructional improvement in middle school agricultural education by first enhancing teacher knowledge and skills, thereby influencing beliefs and practice (Guskey, 2002).

Literature Review. Prior research suggests that the Curriculum for Agricultural Science Education (CASE) training and associated curricular resources are an effective PD model for agricultural educators. For example, teachers who complete CASE training report significant growth in their ability to facilitate inquiry-based learning and promote critical thinking in agricultural contexts (Lambert et al., 2014; Tummons et al., 2020). Studies of preservice teachers further show that participation in CASE institutes promotes growth content knowledge and in the application of literacy strategies and formative assessment practices (Tummons et al., 2020). Smalley et al. (2023) reported that teachers viewed CASE as a comprehensive and beneficial resource for introducing agriculture, food, and natural resources content to students. CASE's emphasis on inquiry-based methods has also been shown to influence teachers' classroom practices, encouraging the integration of hands-on, experiential learning strategies that align with national science education standards (Bird & Rice, 2021). While research supports the effectiveness of CASE curriculum and training, no research has explicitly focused on the CASE AgX training.

Methods

Five AgX training events were hosted at Middle Tennessee State University over an 18-month period for SBAE teachers ($N = 95$). Teachers were recruited through state and national SBAE teacher listservs, state and national FFA convention expo events, CASE recruitment initiatives, and word of mouth. Selected teachers were provided training, stipends for completion of certification and implementation of the curriculum, classroom materials to help implement the curriculum, and ongoing support. Certified lead teachers were provided by CASE to lead the training. The training curriculum immersed learners in the foundational components of modern agriculture, food, and natural resources (AFNR), highlighting how AFNR support and sustain students' daily lives. Participants were administered pre- and post-training surveys to assess effectiveness and impact of the training.

Among the participants, 84% were female, 96% were white, and 39% were from the state where the training was held. In terms of educational background, 1% held an associate or technical degree, 55% a bachelor's degree, 36% a master's degree, 2% a specialist's degree, and 6% a doctoral degree. The majority (88%) were currently teaching at the middle school level. On average, participants had three years of middle school teaching experience and eight years of overall teaching experience across subjects and grade levels. The training survey included five sections: (a) teacher demographics; (b) knowledge of content areas covered in the CASE curriculum; (c) pedagogical content knowledge; (d) self-efficacy; and (e) intent to teach. The self-efficacy section was adapted from the Innovative Teaching for Effective Learning Teacher Knowledge Survey (Sonmark et al., 2017).

Results

Tables 1 through 3 present descriptive statistics for the pre- and post-survey data. Paired sample *t*-tests revealed that post-survey responses were significantly higher than pre-survey responses across all sections of the training survey, with large effect sizes (Cohen's *d*) observed throughout. These results indicate that the AgX training enhanced teachers' content knowledge, pedagogical knowledge, and self-efficacy, with statistically significant gains across all areas. Notably, as their knowledge increased through the training, teachers reported a stronger intention to implement AgX curricular topics, as shown in Table 4.

Table 1

Descriptive Statistics Content Knowledge

Items	Pre		Post	
	Mean	SD	Mean	SD
Agriculture and environment	4.69	0.98	5.27	0.79
Plants and animals for food, fiber, and energy outcomes	4.64	1.05	5.35	0.81
Food, health, and lifestyle outcomes	3.97	1.24	5.16	0.85
Science, technology, engineering, and mathematics outcomes	3.93	1.13	5.11	0.87

Culture, society, economy, and geography outcomes	3.6	1.31	4.97	0.98
From molecules to organisms: Structures and processes	3.67	1.15	4.74	0.89
Ecosystems: Interactions, energy, and dynamics	4.2	1.11	4.99	0.88
Heredity: Inheritance and variation of traits	4.21	1.23	4.98	0.93
Biological evolution: Unity and diversity	3.71	1.23	4.86	0.96
Earth's place in the universe	3.71	1.21	4.73	0.96
Earth's systems	3.73	1.18	4.69	1.00
Earth and human activity	3.83	1.09	4.82	0.97
Matter and its interactions	3.52	1.13	4.60	1.07
Motion and stability: Forces and interactions	3.45	1.19	4.56	1.07
Energy	3.64	1.11	4.77	1.10
Waves and their application in technologies for information transfer	3.09	1.24	4.50	1.21
Engineering design	3.33	1.3	4.72	1.18

Note. Cronbach's *a* (pretest/posttest) = .95/.97; Cohen's $d = 1.08$, $p < .05$ for the composite scores.

Table 2

Descriptive Statistics for Pedagogical Knowledge

Items	**Pre**		**Post**	
	Mean	**SD**	**Mean**	**Mean**
Lesson design (e.g., planning and structuring activities)	4.84	1.11	5.50	0.83
Lesson objectives and goals (e.g., learning outcomes, aligning design to goals)	4.81	1.07	5.53	0.86
Time management in the classroom (e.g., optimizing instructional time)	4.51	1.05	5.30	0.82
Curriculum development (e.g., course materials development)	4.34	1.1	5.35	0.88
Forms of working in the classroom (e.g., assigning and managing individuals, pair, group, and whole class work)	4.69	1.02	5.46	0.85
Long-term planning (e.g., weekly, thematic unit planning)	4.55	1.23	5.47	0.81
Project work and other types of student assignments that require more than one week to complete or for students to work in groups	4.52	1.09	5.42	0.83
Differentiated instruction	4.32	1.12	5.27	0.86
Classroom discourse (e.g., initiating, managing, and promoting discourse/dialogue)	4.44	1.07	5.31	0.82
Peer review and peer support	4.29	1.13	5.31	0.85
Gamification (e.g., application of game-design elements and game principles in teaching)	3.74	1.45	5.15	1.06

Use of internet and software tools in class	4.71	1.17	5.36	0.86
Use of media and various resources for teaching	4.67	1.26	5.42	0.82
Different teacher roles (information provider, facilitator, mediator, planner)	4.67	1.22	5.43	0.78

Note. Cronbach's *a* (pretest/posttest) = .95/.98; Cohen's $d = 1.10$, $p < .05$ for the composite scores.

Table 3

Descriptive Statistics for Teacher Self-Efficacy

Items	Pre		Post	
	Mean	SD	Mean	SD
How much can you do to motivate students who show low interest in class work?	5.18	0.99	5.90	0.70
How much can you do to get students to believe they can do well in class work?	5.52	0.91	5.91	0.74
How much can you do to help your students' value learning?	5.31	0.86	5.95	0.73
To what extent can you craft good questions for your students?	4.99	1.03	5.83	0.80
How much can you use a variety of assessment strategies?	5.08	1.01	5.89	0.79
To what extent can you provide an alternative explanation or example when students are confused	5.2	0.93	5.91	0.74
How well can you implement alternative strategies in your classroom	5.05	0.89	5.96	0.72
How much can you do to control disruptive behavior in the classroom	5.21	1.16	5.92	0.78
How much can you do to get students to follow classroom rules	5.31	1.02	5.95	0.72
How much can you do to calm a student who is disruptive or noisy	5.19	1.12	5.85	0.82
How well can you establish a classroom management system with each group of students	5.32	1.03	5.96	0.68
I can get any of my students to make excellent progress throughout the course I teach	4.6	1.08	5.66	0.87
I can get any of my students to learn the required materials	4.64	1.09	5.58	0.93
I can prevent any of my students from having very low achievement	4.36	1.19	5.46	1.03

Note. Cronbach's *a* (pretest/posttest) = .94/.96; Cohen's $d = 1.17$, $p < .05$ for the composite scores.

Table 4

Intent to Teach CASE AgX Topics in AFNR Classes

Topics	Pre	Post
Agriculture in the past	88%	96%
Plants we grow	86%	96%

Resources we use	64%	92%
Resources we recycle	40%	90%
Energy we consume	44%	85%
Animals we care for	92%	96%
Food we eat	79%	99%
Agriculture in the future	62%	96%

Conclusions and Implications

Findings from this study affirm that AgX training significantly enhances teacher content knowledge, pedagogical knowledge, and self-efficacy in implementing inquiry-based agricultural curriculum, aligning with the theoretical foundation provided by Guskey's (2002) Model of Teacher Change. These results support the model's assertion that changes in teacher beliefs follow improvements in knowledge and practice and reinforce literature documenting CASE's effectiveness as a PD model (Lambert et al., 2014; Tummons et al., 2020; Smalley et al., 2023). While previous research has shown CASE's impact on high school and preservice teachers, this study extends that body of work by focusing on middle school content and pedagogy in the AgX course. The statistically significant improvements suggest that CASE training can help overcome some of the known barriers facing middle school agricultural education, including limited pedagogical preparation and a lack of content-aligned curriculum. Moreover, participants' increased intention to implement the CASE curricular topics suggests strong potential for sustained instructional change, a core outcome emphasized in Guskey's (2002) model. Ongoing AgX support can equip agriculture teachers to provide rigorous and relevant instruction.

References

Bird, T. D., & Rice, A. H. (2021). The influence of CASE on agriculture teachers' use of inquiry-based methods. *Journal of Agricultural Education*, *62*(1), 260–275. https://doi.org/10.5032/jae.2021.01260

Curriculum for Agricultural Science Education. (2022a). *AgXplore curriculum overview*. Curriculum for Agricultural Science Education. https://www.case4learning.org

Curriculum for Agricultural Science Education. (2022b). Implementation and Learning Environment Guide. https://www.case4learning.org/case/document-server/?cfp=CASE/assets/File/Implementation%20and%20Learning%20Environment%20Guide.pdf

Guskey, T. R. (2002). Professional development and teacher change. *Teachers and Teaching*, *8*(3), 381–391. https://doi.org/10.1080/135406002100000512

Jones, S., Doss, W., & Rayfield, J. (2020). Examining the status of middle school agricultural education programs in the United States. *Journal of Agricultural Education, 61*(2), 41-56. *https://doi.org/10.5032/jae.2020.02041*

Lambert, M. D., Velez, J. J., & Elliott, K. M. (2014). What are the teachers' experiences when implementing the Curriculum for Agricultural Science Education? *Journal of Agricultural Education*, *55*(4), 100–115. https://doi.org/10.5032/jae.2014.04100

National Association of Agricultural Educators. (2024). *2024 agriculture teacher supply and demand overview nationwide* [Infographic]. https://www.naae.org/naae/document-

server/?cfp=/naae/assets/file/public/advocacy/profiles/2024%20profiles/2024-nsd-naaeregions.pdf

Rossetti, R. (1992). A nationwide examination of middle school enrollment in agricultural education and membership in the national FFA organization. The Ohio State University.

Smalley, S., Rice, A. M., & Hasselquist, L. (2023). The effectiveness of virtual CASE institute professional development: A participant perspective. *Journal of Agricultural Education*, *64*(2), 85–98. https://doi.org/10.5032/jae.v64i2.89

Sonmark, K., Reiss, F., Klieme, E., & OECD. (2017). *Understanding teachers' pedagogical knowledge: Report on an international pilot study* (OECD Education Working Papers No. 159). OECD Publishing. https://doi.org/10.1787/43332ebd-en

Talbert, B. A., Vaughn, R., & Croom, B. D. (2007). *Foundations of agricultural education* (2nd ed.). Pearson Prentice Hall.

Teague, G., Anfara, V., Wilson, N., Gaines, C., & Beavers, J. (2012). Instructional practices in the middle grades. *NAASSP Bulletin*, *96*(3), 203–227. https://doi.org/10.1177/0192636512458451

Tummons, J. D., Hasselquist, L., & Smalley, S. W. (2020). Exploring content, pedagogy, and literacy strategies among preservice teachers in CASE institutes. *Journal of Agricultural Education*, *61*(2), 289–306. https://doi.org/10.5032/jae.2020.02289