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The Needs of Oklahoma School-Based Agricultural Education Teachers Related to Teaching Agriculture, Food and Natural Resources Topics

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Abstract

One of the most important factors to developing and sustaining agricultural educators is identifying their highest in-demand needs. Identifying teacher needs on a regular basis is important to continue offering professional development opportunities that are relevant to current situations facing the teaching population. This study, undergirded in Teacher Human Capital Theory, aimed to identify the technical agricultural topics school-based agricultural educators (SBAE) deem as important to their teaching career, as well as their perceived level of knowledge on the 56 identified topics. Ranked Discrepancy Scores (RDS) were utilized to analyze the perceptions of the SBAE teachers across the eight agricultural career and content pathways identified by The Council. Agricultural teachers across Oklahoma were found to have in-demand needs across all technical agricultural topics identified in the instrument. The agricultural career and content pathway of agricultural biotechnology systems was found to have the largest discrepancy across the eight agricultural career and content pathways. Findings from this study could aid Oklahoma State University in identifying purposeful and direct professional development that focuses on the highest in-demand needs of Oklahoma SBAE teachers.

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Introduction

One of the most critical factors in developing and improving agricultural educators is to correctly identify their highest in-demand needs (Layfield & Dobbins, 2002). Research in agricultural education has identified various teachers' training needs as it pertains to classroom management and instruction (Albritton & Roberts, 2020; DiBenedetto et al., 2018; Layfield & Dobbins, 2002; Smalley et al., 2019). As such, "agricultural educators are required to have both subject specific and technical knowledge…while constantly adapting to new technologies and practices in the field" (Albritton & Roberts, 2020, p. 140).

Prior experience in technical agriculture and natural resources, the designated agricultural career and content pathways taught, and a teacher's personal contextual experiences all influence their abilities, knowledge, and potential skill transference in educational settings (Peake et al., 2007; Yopp et al., 2020). Technological advances are continuing at a rapid pace, and as such, teachers need to be continually trained on up-to-date information and systems in content-related areas to remain effective in the classroom (Yopp et al., 2020). This study aims to provide teacher educators, in-service school based agricultural education (SBAE) teachers, and Oklahoma state staff members affiliated with SBAE teachers with information regarding the agriculturally related content SBAE teachers deem a priority for providing professional development opportunities. Results from this study and other research looking at current agriculturally related content teacher needs has the possibility to identify patterns on a regional and national level.

Theoretical/Conceptual Framework

Human capital relates to the knowledge, education, skills, experiences, and training of an individual (Becker, 1964; Schultz, 1971), which can be sector-specific when considering career preparedness (Smith, 2010). Therefore, this study was undergirded by the Teacher Human Capital theory (Myung et al., 2013), which outlined four distinct areas for advancing teaching and improving learning. The Teacher Human Capital framework is presented as a systems approach with four criteria (i.e., acquire, develop, sustain, and evaluate) working together to explore teacher recruitment, development, reward, and retention (Myung et al., 2013). This study focused on the criteria of *develop* specifically. *Develop* outlines the need to "provide individualized PD opportunities in response to demonstrated needs" (Myung et al., 2013, p. 8).

Although teacher induction programs are common across the United States, induction programs that aim to be intensive, sequentially delivered, and comprehensive to individual teachers' needs are typically rare (Myung et al., 2013). Key considerations for developing teachers are to provide opportunities for intense and on-going professional development that focuses on their subject matter, as well as providing mentorship opportunities within their specific field of study (Myung et al., 2013). Additionally, professional development focused on developing key components of teachers should be targeted to meet the needs of the teachers

and be embedded in being able to be integrated immediately into the daily life of the teachers (Myung et al., 2013).

Teachers have the greatest influence on students' future success (Chetty et al., 2014), but with the breadth of agricultural education, school-based agricultural education (SBAE) teachers need continued in-service in content and technical skills to be effective (Sorensen et al., 2010). Additionally, this technical skill gap was found in Oklahoma preservice teachers who lacked the basic financial literacy skills to effectively instruct in the agribusiness pathway (Price et al., 2023). Technical teaching skills were needed for the biotechnology systems to advance general agriscience instruction as well as in focus areas of animal science and plant sciences (Duncan et al., 2006).

Identifying the needs of SBAE teachers can provide opportunities for professional development and pre-service teacher education, which can lead to retention of teachers within the profession (Smalley et al., 2019). Challenges continually facing newly hired and veteran SBAE teachers include teaching practices and curriculum accessibility (Barry et al., 2022; Eck et al., 2019; Smalley et al., 2019). It is important to identify teacher needs on a regular basis to continue offering professional development opportunities that are relevant to current situations facing the teaching population (Avalos, 2011).

Purpose and Objectives

The purpose of this study was to identify the current level of knowledge and perceived relevance of teaching technical agricultural content topics in agricultural education by Oklahoma SBAE teachers. Specifically, technical agriculture topics across the eight agriculture, food and natural resources (AFNR) content pathways (The Council, 2023) were evaluated. One overarching research question guided this study: What are the needs of Oklahoma SBAE teachers related to teaching technical agricultural topics, based on ranked discrepancy scores (RDS), in the eight technical agricultural content pathways?

Methodology

This non-experimental survey research study employed a census approach to reach all Oklahoma SBAE teachers (N = 462). To achieve this goal, data was collected in-person at 25 regional FFA degree checks across the state. In Oklahoma, all teachers attend FFA degree checks in their designated region over a two-week period in late January and early February of 2023. The research team traveled the state to provide an overview of the needs assessment, distribute the survey instrument and collect completed hand-written questionnaires. Three-hundred and thirty-eight Oklahoma SBAE teachers returned a survey questionnaire, resulting in a 73.2% response rate.

Although this study resulted in a 73.2% response rate, non-response error is still of concern, given the census approach design. Therefore, 55 survey instruments were mailed, along with a

cover letter and pre-paid return addressed envelope to Oklahoma SBAE teachers who did not attend the state degree checks. The 55 Oklahoma SBAE teachers who received the questionnaire did not have a chance to complete the instrument at the degree checks due to weather related cancelations or travel limitations. This effort resulted in five SBAE teachers completing and returning the survey instrument to the research team. After analysis of non-respondents, data were found to be non-differential based on personal and professional characteristics of respondents and collected non-respondents (Miller & Smith, 1983), deeming the data to be representative of Oklahoma SBAE teachers. Incomplete survey questionnaires (i.e., surveys without complete responses to the non-demographic questions) were excluded, resulting in 328 (71.0% response rate) completed instruments for data analysis.

Two-hundred fifty-nine participants were traditionally certified in agricultural education, while an additional seven were found to be traditionally certified in other content areas. Forty-nine participants were identified as having an alternative certification, with an additional 10 having an emergency certification. Participants indicated having achieved either a bachelor's (*n* = 247), master's (*n* = 78), or an Ed.D./Ph.D. (*n* = 1) for their highest degree earned. Respondents were primarily male (*n* = 229), spanning single (*n* = 197) and multi-teacher (*n* = 131) programs. Lastly, participants were able to select all races/ethnicities that constitute their being, resulting in 247 self-identified as white, 56 as Native American, three as Hispanic, two as Black/African American, and one participant self-identified as Asian.

Instrumentation

The questionnaire was developed by Roberts and Dyer (2004) and modified by Saucier et al. (2010), Figland et al. (2019), and Coleman et al. (2020). The adopted instrument was further modified for this study to fit the needs of Oklahoma SBAE teachers. A panel of experts then reviewed the instrument for face and content validity. This panel included (a) one university faculty member of agricultural education, (b) the state FFA advisor, (c) one regional agricultural education program specialist, and (d) two school superintendents who were previously SBAE teachers.

In total, the questionnaire included 56 items related to teaching technical agriculture across the eight content pathways identified by The Council (2023). Each of these items used two, 5-point Likert-type scales (1 = *low agreement*, 2 = *somewhat agree*, 3 = *neutral*, 4 = *somewhat agree*, 5 = *high agreement*). The first scale asked participants to rate their current perceived ability of the item, while the second focused on the degree of perceived importance the item had to their job.

Data Analysis

All data were transcribed from the paper instruments to Microsoft Excel© by a single research assistant prior to data being imported and analyzed using SPSS version 28 and Microsoft Excel©. This study implemented the ranked discrepancy model (RDM) to assess current competencies of SBAE teachers across Oklahoma. This model was selected as an alternative to the Borich (1980) needs assessment model based off the findings of Narine and Harder (2021). Specifically, this method was selected because "instead of positive scores indicating a lack of

competence, the RDM provides a negative ranked discrepancy score RDS when training needs are greater (i.e., there are many individuals lacking sufficient ability and few individuals with an abundance of ability), which more clearly conveys that a problem exists that should be corrected" (Narine & Harder, 2021, p. 108). RDS scores have a maximum potential range from -100 to 100 (Narine & Harder, 2021). This analysis requires the consideration of positive ranks (PR), negative ranks (NR), and tied ranks (TR) to fully understand the needs of the participants, ranging from those deemed experts to others who are novices, resulting in an RDS for each item (Narine & Harder, 2021).

Findings

After analysis and organization of the data, it was found that RDS scores ranged between -26.74 and -2.73, with the maximum range of RDS being between -100 to 100, indicating a discrepancy between the perceived level of knowledge and relevance to the SBAE teachers' career field. These discrepancies with negative scores indicated SBAE teachers have a higher perceived relevance to their career field and a lower perceived level of knowledge. Agricultural Biotechnology Systems was found to have the largest discrepancy among its items compared to other pathways at -20.52. Food Products & Processing Systems was found to have the smallest discrepancy among its items compared to the other pathways with a mean RDS of -6.99. Table 1 displays the six technical agricultural topics related to the agribusiness (AB) systems career and content pathway.

Table 1

Ranked Discrepancy Scores for Teaching Agribusiness Systems Topics

Item	RDS
Economics	-26.44
Recordkeeping Skills	-24.62
Issues in Global Agriculture	-22.49
Ag Business Operations	-20.97
Agricultural Sales and Marketing	-18.84
Financial Management	-2.77
Mean RDS	-19.36

The mean RDS for the agribusiness systems grouping of topics was found to be -19.36, which made it the second highest grouping of agricultural topics behind agricultural biotechnology systems. Economics was found to have the highest RDS (-26.44) among the six agribusiness systems technical agricultural topics. Table 2 displays the seven technical agricultural topics related to animal systems (AS).

Table 2

Ranked Discrepancy Scores for Teaching Animal Systems Topics

Item	RDS
Animal Diseases/Parasites	-18.84
Animal Nutrition	-14.59
Animal Production	-12.16
Animal Health	-11.25
Animal Reproduction	-8.21
Specialty Animal Production	-6.38
Show Animals (i.e., care, feeding, fitting, selection)	-6.08
Mean RDS	-11.07

The mean RDS for the animal systems grouping of topics was computed at -11.07. Animal diseases/parasites was identified as having the highest RDS (-18.84), while show animals (-6.08) was found to have the lowest discrepancy between Oklahoma SBAE teachers' knowledge level and the perceived importance to their careers. Table 3 displays the seven technical agricultural topics related to the agricultural biotechnology systems (ABS) career and content pathway.

Table 3

Ranked Discrepancy Scores for Teaching Agricultural Biotechnology Systems Topics

Item	RDS
Genetic Engineering	-25.84
Evolution of Biotechnology	-22.80
Preparing Solutions and Media	-20.97
Aseptic techniques	-20.97
Culturing Cells	-18.84
Bioethics, laws, and public perceptions	-17.63
Principles of Genetics	-16.41
Mean RDS	-20.49

The mean RDS for the topics related to agricultural biotechnology systems was -20.52. Genetic engineering was found to have the highest RDS (-25.84), whereas principles of genetics (-16.41) was found to have the lowest discrepancy between Oklahoma SBAE teachers' knowledge level and the perceived importance to their careers. Table 4 displays the six technical agricultural topics related to the environmental service systems (ESS) career and content pathway.

Table 4

Ranked Discrepancy Scores for Teaching Environmental Service Systems Topics

Item	RDS
Global Positioning Systems (GPS)	-24.01
Water & Wastewater Treatment	-21.28
Biofuels/Alternative Energy	-20.36
Surveying and Mapping	-16.72
Environmental Science	-11.85
Soil Science	-2.74
Mean RDS	-16.16

The mean RDS for the environmental service systems grouping of topics was -16.16. Global positioning systems (GPS) was identified as having the highest RDS (-24.01), while soil science (-2.74) was found to have the lowest discrepancy, which was tied for the lowest RDS, regardless of career and content pathway. Table 5 displays the seven technical agricultural topics related to the food products and processing systems (FPS).

Table 5

Ranked Discrepancy Scores for Teaching Food Products and Processing Systems Topics

Item	RDS
Meat Science	-10.33
Standards and Regulations	-9.12
Food Preparation	-7.60
Food Science and Technology	-7.60
Quality Control	-6.38
Food Storage	-5.17
Food Safety and Sanitization	-2.74
Mean RDS	-5.91

For the food products and processing systems technical agricultural grouping of topics, the mean RDS was found to be -6.99. Meat science was identified as having the highest RDS (-10.33), whereas food safety and sanitization (-2.74) was tied for the lowest discrepancy, regardless of career and content pathway, between Oklahoma SBAE teachers' knowledge level and the perceived importance to their careers. Table 6 displays the seven technical agricultural topics related to the natural resource systems (NRS) career and content pathway.

Table 6

Ranked Discrepancy Scores for Teaching Natural Resource Systems Topics

Item	RDS
Entomology	-21.28
Precision Agriculture	-17.02
Renewable Energy Resources	-17.02
Aquaculture	-16.72
Forestry	-15.20
Wildlife Management	-13.07
Natural Resource Management	-11.55
Mean RDS	-15.98

The natural resource systems grouping of topics mean RDS was -15.98. The technical topic of entomology was identified as having the highest RDS (-21.28), while natural resource management (-11.55) was found to have the lowest discrepancy between Oklahoma SBAE teachers' knowledge level and the perceived importance to their careers. Table 7 displays the 10 technical agricultural topics related to plant systems (PS).

Table 7

Ranked Discrepancy Scores for Teaching Plant Systems Topics

Item	RDS
Turfgrass Management	-26.75
Tissue Culturing	-25.53
Landscaping	-19.45
Plant Classification	-17.93
Floriculture	-17.02
Plant Propagation	-14.89
Plant Growth	-12.77
Agronomy	-12.46
Plant Reproduction	-10.94
Nursery/Greenhouse Operations	-9.73
Mean RDS	-16.75

The plant systems grouping of topics mean RDS was -16.74. Turfgrass management was identified as having the highest RDS (-26.75), which was the highest technical agricultural topic among all, regardless of career and content pathway. Whereas nursery/greenhouse operations (-9.73) were found to have the least discrepancy between Oklahoma SBAE teachers' knowledge level and the perceived importance to their careers. Table 8 displays the six power, structural and technical (PST) systems agricultural topics.

Table 8

Ranked Discrepancy Scores for Teaching Power, Structural & Technical Systems Topics

Item	RDS
Agricultural Mechanics Project Construction	-21.28
Electricity	-16.41
Agricultural Structures (i.e., building construction, concrete)	-13.68
Plumbing	-7.90
Arc Welding (i.e., SMAW, GMAW, GTAW)	-5.47
Oxyfuel Cutting/Welding	-3.34
Mean RDS	-11.35

The mean RDS for the power, structural and technical systems grouping of topics was -11.38. Agricultural mechanics project construction was identified as having the highest RDS (-21.28), while oxyfuel cutting/welding (-3.34) was found to have the lowest discrepancy between Oklahoma SBAE teachers' knowledge level and the perceived importance to their careers. Table 9 outlines all technical agricultural topics across the eight AFNR content pathways in ranked order.

Table 9

Ranked Discrepancy Scores for Teaching All Technical Agricultural Topics

Item	RD Scores	Content Area
Turfgrass Management	-26.75	PS
Economics	-26.44	AB
Genetic Engineering	-25.84	ABS
Tissue Culturing	-25.53	PS
Recordkeeping Skills	-24.62	AB
Global Positioning Systems (GPS)	-24.01	ESS
Evolution of Biotechnology	-22.80	ABS
Issues in Global Agriculture	-22.49	AB
Water & Wastewater Treatment	-21.28	ESS
Agricultural Mechanics Project Construction	-21.28	PST
Entomology	-21.28	NRS
Ag Business Operations	-20.97	AB
Preparing Solutions and Media	-20.97	ABS
Aseptic techniques	-20.97	ABS
Biofuels/Alternative Energy	-20.36	ESS
Landscaping	-19.45	PS
Agricultural Sales and Marketing	-18.84	AB
Animal Diseases/Parasites	-18.84	AS
Culturing Cells	-18.84	ABS
Plant Classification	-17.93	PS
Bioethics, laws, and public perceptions	-17.63	ABS
Floriculture	-17.02	PS
Precision Agriculture	-17.02	NRS

Item	RD Scores	Content Area
Renewable Energy Resources	-17.02	NRS
Surveying and Mapping	-16.72	ESS
Aquaculture	-16.72	NRS
Electricity	-16.41	PST
Principles of Genetics	-16.41	ABS
Forestry	-15.20	NRS
Plant Propagation	-14.89	PS
Animal Nutrition	-14.59	AS
Agricultural Structures (i.e., building construction, concrete)	-13.68	PST
Wildlife Management	-13.07	NRS
Plant Growth	-12.77	PS
Agronomy	-12.46	PS
Animal Production	-12.16	AS
Environmental Science	-11.85	ESS
Natural Resource Management	-11.55	NRS
Animal Health	-11.25	AS
Plant Reproduction	-10.94	PS
Meat Science	-10.33	FPS
Nursery/Greenhouse Operations	-9.73	PS
Standards and Regulations	-9.12	FPS
Animal Reproduction	-8.21	AS
Plumbing	-7.90	PST
Food Preparation	-7.60	FPS
Food Science and Technology	-7.60	FPS
Quality Control	-6.38	FPS
Specialty Animal Production	-6.38	AS
Show Animals (i.e., care, feeding, fitting, selection)	-6.08	AS
Arc Welding (i.e., SMAW, GMAW, GTAW)	-5.47	PST
Food Storage	-5.17	FPS
Oxyfuel Cutting/Welding	-3.34	PST
Financial Management	-2.77	AB
Food Safety and Sanitization	-2.74	FPS
Soil Science	-2.74	ESS
Mean RDS	-14.83	

Note. AB = Agribusiness Systems. AS = Animal Systems. ABS = Agricultural Biotechnology Systems. ESS = Environmental Service Systems. FPS = Food Products and Processing Systems. NRS = Natural Resource Systems. PS = Plant Systems. PST = Power, Structural and Technical Systems.

The final rank order of the technical agricultural content pathways, based upon the mean RDS, was (a) agricultural biotechnology systems (*M* = -20.52), (b) agribusiness systems (*M* = -19.36), (c) plant systems (*M* = -16.74), (d) environmental service systems (*M* = -16.16), (e) natural resource systems (*M* = -15.98), (f) power, structural & technical systems (*M* = -11.38), (g) animal systems (*M* = -11.07), and (h) food products & processing systems (*M* = -6.99).

Conclusions, Implications, and Recommendations

SBAE teachers in Oklahoma identified a need related to all 56 items associated with teaching technical agricultural topics across the eight content pathways, aligning with nationwide training needs related to classroom instruction (Albritton & Roberts, 2020; Layfield & Dobbins, 2002; Smalley et al., 2019). The greatest need, based on RDS, was in agribusiness systems followed by plant systems and biotechnology systems. This aligns with the long-standing focus of SBAE programs in Oklahoma being related to animal science and agricultural mechanics. Agribusiness and biotechnology are newer focus areas as many programs expand their capacity with additional SBAE teachers (Rankin et al., 2024). This change in focus areas could be an implication of the change in technical and teaching needs in a post-COVID pandemic era.

Overall, the statewide needs assessment provided an opportunity for the research team to *evaluate* the teacher human capital, by allowing SBAE teachers to provide input based on their personal decision making and needs within their classroom (Myung et al., 2013). Providing SBAE teachers with an opportunity to self-evaluate and reflect on their practice leads to increasing their overall career specific human capital and their teaching effectiveness (Eck et al., 2021). In this case of this study, the needed career specific human capital relates to technical agriculture content knowledge to further student engagement in relevant content and curriculum (Barry et al., 2022; Eck et al., 2019; Smalley et al., 2019).

Implications of agricultural biotechnology systems having the highest mean RDS could be that SBAE teachers in Oklahoma see a need to learn more about the career and content pathway, as they previously may not have had coursework or training. Additionally, with the rise in popularity of agriscience research supervised agricultural experiences (SAEs) in Oklahoma, SBAE teachers could potentially see a benefit to having agricultural biotechnology systems training for future SAE opportunities and course content offerings across other agriculturally related career and content pathways.

Ultimately, the findings of this study should be used to guide professional development in Oklahoma, as these are the current needs associated with the majority (71.0%) of SBAE teachers in Oklahoma (Avalos, 2011). Focusing on teacher development (Myung et al., 2013) through the lens of the needs assessment helps to advance and improve participating teachers (Layfield & Dobbins, 2002). Furthermore, this purposeful professional development targeted at teacher's needs, corresponds with the *develop* function of the teacher human capital framework (Myung et al., 2013). Additional research is needed to determine the preferred method of receiving professional development to best meet the needs of SBAE teachers across Oklahoma. It is recommended that this study be replicated in states where a needs assessment has not been conducted in the past five years. Conducting needs assessments provide SBAE supporters (i.e., SBAE teacher preparation faculty, state FFA and agricultural staff, and career and technical education directors) an opportunity to determine state specific needs and provide purposeful professional development, resulting in impactful research.

It is also imperative to identify pre-service teacher needs as they journey through their post-secondary coursework. It is recommended that a modified version of this study be implemented to identify perceived knowledge level of different technical agricultural topics in the eight AFNR content pathways and their perceived importance to their teaching career. Conducting this study semesterly can allow for a longitudinal view of different teaching cohorts and allow for faculty advisors to assist pre-service teachers in course selection as they proceed through their post-secondary educational programs.

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