Journal of Agricultural Education, 60(2), 85-98
https://doi.org/10.5032/jae.2019.02085

School-based Agricultural Education Teachers' Perceived Professional Development Needs Associated with Teaching, Classroom Management, and Technical Agriculture

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Abstract

Across the nation, there is a large shortage of teachers in several subject areas (Daniel, 2015; Milliard, 2015; Sutcher, Darling-Hammond, & Carver-Thomas, 2016). In agricultural education, many teachers are leaving the profession within the first five years of beginning their teaching careers (Tippens, Ricketts, Morgan, Navaro, & Flanders, 2013). Professional development opportunities for teachers can be utilized to retain teachers in the profession (Touchstone, 2015). The purpose of this study was to evaluate the professional development needs of Iowa school-based agricultural education teachers in the areas of teaching, classroom management, and technical agriculture. Motivating students to learn, teaching in a land laboratory, proper implementation of Individualized Education Program (IEP) for students with disabilities, teaching students decision-making skills, and developing performance-based assessment instruments were the teaching and classroom management items that SBAE teachers expressed the highest perceived levels of professional development needs. The items with the highest perceived training needs were teaching knowledge and skills in biotechnology, integrating current advances in agriculture technology into the curriculum, teaching knowledge and skills in agribusiness, teaching about public issues regarding agriculture, and teaching knowledge and skills in agricultural mechanic. Future research should be conducted to determine what agriculture technology and biotechnology professional development is needed by in-service teachers.

Keywords: in-service educators; professional development needs; teaching; classroom management; technical agriculture

Note: This paper is a product of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. IOWO3813 and sponsored by Hatch Act and State of Iowa funds.

Introduction

Across the nation, there is a large shortage of teachers in several subject areas (Daniel, 2015; Milliard, 2015; Sutcher, Darling-Hammond, & Carver-Thomas, 2016). This shortage continues to increase, and "by 2020, an estimated 300,000 teachers will be needed each year" (Sutcher et al., 2016, p. 16). This shortage in teachers can be attributed to the increase in student enrollment and retirements in the teaching profession (Nebraska State Education Association,

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2011; Sutcher et al., 2016). More teachers are needed to fill this demand created by students; however, many teachers are choosing to leave the profession of teaching (Conneely & Uy, 2009). Teacher shortages are not a new concept in Career and Technical Education (CTE) areas (Camp, Broyles, & Skelton, 2002; De Lay & Washburn, 2013; Myers, Dryer, & Washburn, 2005; Wilkin & Nwoke, 2011).

Since 2003, the teacher shortage has been a major problem in CTE (Wilkin & Nwoke, 2011). CTE teachers, specifically School- based Agricultural Education (SBAE) teachers, not only have extensive responsibilities compared to core content teachers but also have FFA and Supervised Agriculture Experiences (SAE) responsibilities (De Lay & Washburn, 2013). The increase in responsibilities aids in teacher frustration and isolation from other teachers, which doesn't help the teacher shortage (De Lay & Washburn, 2013). Some districts fill CTE teaching positions with less qualified candidates in hopes that the program will not be shut down (Tippens, Ricketts, Morgan, Navaro, & Flanders, 2013).

In agricultural education, many teachers are leaving the profession within the first five years of beginning their teaching careers (Tippens et al., 2013). Previous research indicates first-year SBAE teachers are more likely to leave the profession due to a variety of challenges they face (Myers et al., 2005). These challenges include: (1) classroom management, (2) advising FFA, (3) lesson planning, (4) curriculum development, (5) managing the amount of paperwork and finances, and (6) working with parents, teachers, and administrators (Myers et al., 2005). Mid-career SBAE teachers identified that their largest challenge was a lack of time (Smalley & Smith, 2017). Another barrier with mid-career teachers was course planning and being motivated (Smalley & Smith, 2017). Several factors contribute to teachers leaving the teaching profession (Tippens et al., 2013). These factors include: (1) family, (2) school staffing actions, (3) personal, (4) pursuing another job opportunity, and (5) dissatisfaction with the career (Ingersoll, 2002). More teachers need to be retained in the teaching profession to close the teacher shortage gap (Wilkin & Nwoke, 2011).

Aside from the factors contributing to SBAE teacher attrition, a myriad of needs assessment studies have identified pedagogical and content-based training needs of SBAE teachers (Garton & Chung, 1996; Joerger, 2002; Layfield & Dobbins, 2002; McKim & Saucier, 2011; Sorensen, Lambert, & McKim, 2014). Moreover, agricultural education research has identified teachers' training needs associated with classroom management and instruction, (Boone & Boone, 2007; Myers et. al., 2005), maintaining student interest and motivation (Joerger, 2002), and the use of technology (Layfield & Dobbins, 2002; Joerger, 2002).

Professional development opportunities for teachers can be used to retain teachers in the profession (Touchstone, 2015). Professional development needs vary based on the stage in a teacher's career and their experiences (Smalley & Smith, 2017; Sorensen et al., 2014). Professional development for beginning teachers may need to include mentoring programs (Touchstone, 2015). Beginning teachers also need professional development in classroom instruction, classroom management, and motivating students (Sorensen et al., 2014). According to Sorensen et al. (2014), beginning teachers also need professional development in areas such as grant writing, using their advisory committee, being able to use Agricultural Experience Tracker (AET) system for record keeping, training Career Development Event (CDE) teams for competition, and being able to balance work and life. According to Smalley and Smith (2017), mid-career teachers want several different outcomes from professional development events such as networking, getting reenergized, and understanding how to handle stress.

Theoretical Framework

Teacher adaptive expertise served as the overarching theoretical framework for this study. Developed by Hatano and Inagaki (1986), teacher adaptive expertise posits that the expertise of a teacher is constructed by way of efficiency or innovation. Teachers who have -expertise in efficiency (i.e., routine experts) will tend to accomplish various task with minimal to no attention or effort. Routine experts specialize in efficiency but have limitations such as inflexibility and overconfidence (Crawford & Brophy, 2006).

Conversely, teachers who possess expertise in innovation are more apt to try new things and are more willing to augment their current practices. When teachers possess expertise associated with innovation and efficiency, they are considered to have adaptive expertise (Hammerness, Darling-Hammond, & Bransford, 2005). Hammerness et al. (2005) noted that having expertise in both areas (i.e., innovative and efficiency expertise) is the "gold standard for becoming a professional" (p. 360). A myriad of previous literature signified the development of adaptive expertise is vital for teachers—who encounter unpredictable circumstances on a daily basis (Crawford, Schlager, Toyama, Riel, & Vahey, 2005; De Arment, Reed, & Wetzel, 2013; Hammerness et al., 2005; Lin, Schwartz, & Hatano, 2005).

Hammerness et al. (2005) indicated the process of developing adaptive expertise is complex, and serves as a challenge for new teachers. Moreover, Hammerness et al. (2005) noted beginning teachers' (1) assumptions surrounding their ability to teach based on their learning experiences, (2) struggle to use content knowledge and pedagogical knowledge, and (3) their thought processes regarding teaching complexities for practice improvement are factors which hinder their ability to develop as a teacher.

Motivation has been cited as an important factor in the development of adaptive expertise of teachers (Bell, Horton, Blashki, & Seidel, 2012; De Arment et. al., 2013; Hatano, 1988). Hatano (1988) implied that motivation to engage with content, which serves as an antecedent to adaptive expertise, may be derived from self-evaluation of the learner's conceptualizations of the given content. The concept of evaluating content / pedagogical knowledge and the identification of needs for improvement is closely tied to the tenets of andragogy (Knowles, 1980). Specifically, one assumption tied to the "art and science of helping adults learn" (Knowles, 1980, p. 43) is adult learners are self-directed. Merriam, Caffarella, and Baumgartner (2007) urged that the self-directed nature of adult learners presents the need for the learner to "participate in the diagnosis of their learning needs, the planning, and implementation of the learning experiences, and the evaluation of those experiences" (p. 85). In the context of this study, the self-directed needs of the learners were operationalized using the Borich Needs Assessment Model. The needs assessment sought to identify in-service teachers' needs associated with classroom management, teaching, and technical agriculture.

Purpose and Objectives

The purpose of this study was to evaluate the professional development needs of Iowa school-based agricultural education teachers in the areas of teaching, classroom management, and technical agriculture. The following three research objectives served as a guide for this needs assessment study:

1. Determine the background characteristics of Iowa school-based agricultural education (SBAE) teachers.
2. Assess Iowa SBAE teachers' professional development needs associated with teaching and classroom management.

3. Determine the technical agriculture professional development needs of Iowa SBAE teachers.

Methods

Population

A census was attempted on all SBAE teachers (*N* = 263) in the state of Iowa. At the end of data collection, 147 SBAE teachers responded on the survey instrument, yielding a response rate of 55.89%. The average Iowa SBAE teacher who participated in this study was female (*n* = 79, 54.5%), had an average age of 37.45 (*SD* = 12.19) and average teaching experience of 13.32 (*SD* = 11.79) years. The SBAE teachers reported having an average of 94.33 (*SD* = 59.12) unduplicated students in their SBAE program. In regards to the teachers' highest level of education, 92 (62.59%) SBAE teachers reported earning a bachelor's degree and 55 (37.41%) SBAE teachers earned a master's degree.

Instrumentation

Researchers utilized a modified Borich Needs Assessment Model to assess the training needs of current SBAE teachers. "The process of identifying training needs can be conceptualized as a discrepancy analysis that identifies the two-polar position of *what is* and *what should be"* (Borich, 1980, p. 39). The needs assessment instrument used in this study evaluated the needs of Iowa SBAE teachers associated with teaching, classroom management, and technical agriculture. Previously identified in-service needs, identified in previous agricultural education studies (Duncan, Ricketts, Peake, & Uesseler, 2006; Garton & Chung, 1996, 1997; Joerger, 2002; Sorensen et al., 2014), were crosswalked with the Iowa Governor's Council on Agricultural Education General Program Standards to develop the needs assessment instrument for this research study. The crosswalking process with the general program standards allowed the researchers to assess the needs of Iowa SBAE teachers identified in previous studies while contextualizing the wording of items to fit and address the state standards.

The content validity of the instrument was evaluated by having a panel of experts review the items on the survey instrument. Specifically, the panel of experts was comprised of three agricultural education faculty members who specialized in teacher preparation.

Based on recommendations suggested by Dillman, Smyth, and Christian (2009), the items on the online need's assessment instrument were divided into two categories to enhance readability. The teaching and classroom management category had 20 items and the technical agriculture category had 13 items. Each needs assessment item was paired with two Likert-type scales. One scale assessed the teachers' perceived importance associated with the different topics (1 = *Not Important*, 2 = *Slightly Important*, 3 = *Moderately Important*, 4 = *Important*, 5 = *Very Important),* and the other scale evaluated their perceived knowledge on the topic (1 = *I have no knowledge on this issue*, 2 = *Slightly Knowledgeable*, 3 = *Moderately Knowledgeable*, 4 = *Knowledgeable*, 5 = *Very Knowledgeable)*.

Data Collection

The contact information (i.e., teacher's name, school affiliation, and email address) of the SBAE teachers was obtained using the publicly available state SBAE teacher website, iowaagteachers.org. The target population was sent a recruitment email asking for their participation in the study. The recruitment email contained information regarding the study,

instructions to follow if participants chose to partake in the study, and the link to the needs assessment instrument. Data were collected by using the online survey instrument through Qualtrics. All data collected was protected under Qualtrics, which is a password protected survey site. Researchers sent three follow-up email reminders in five-day increments to non-respondents (Yun & Trumbo, 2000).

Data Analysis

Data were analyzed by descriptive statistics through IBM's Statistical Package for Social Sciences (SPSS©) for determining background characteristics pertaining to objective one. Objectives two and three determined the training needs for teacher preparation relating to teaching and classroom management and technical agriculture. The data were analyzed by mean weighted discrepancy scores (MWDS) for each statement. Researchers utilized McKim & Saucier's (2011) Excel-Based Mean Weighted Discrepancy Score Calculator.

Mean Weighted Discrepancy Score Formula

$$\text{MWDS} = \frac{\text{(importance rating - knowledge rating) x importance rating}}{\text{number of observations}}$$

To account for reliability Cronbach's alpha coefficients for the importance ($\alpha = .97$) and knowledge ($\alpha = .97$) were calculated and met the tolerable threshold level (Ary, Jacobs, & Sorensen, 2010). The external validity of the findings were not examined due to limitations associated with the attempted census of SBAE teachers in Iowa. Moreover, caution should be taken when attempting to generalize these findings to any other population.

Findings

The first objective sought to determine the background characteristics of Iowa SBAE teachers regarding their professional development and in-service training. The SBAE teachers indicated their primary sources of professional development were agricultural teachers' association workshops (n = 100, 68.03%), school in-service events (n = 99, 67.35%), university workshops (n = 45, 30.61%), professional organization workshops (n = 37, 25.17%), and graduate coursework (n = 4, 2.72%; see Table 1).

Table 1

Background Characteristics of Iowa *SBAE Teachers Regarding Involvement in Previous Professional Development*

Characteristic	*f*	%
Primary Source(s) of Professional Development (n = 147)		
Agricultural teachers association workshops	100	68.03
School in-service events	99	67.35
University workshops	45	30.61
Professional organization workshops	37	25.17
Graduate coursework	4	2.72
CASE Certifications (n = 146)		
Introduction to Agricultural, Food, and Natural Resources (AFNR)	95	65.07

Principles of Ag Science-Animal (ASA)	51	34.93

Table 1

Background Characteristics of Iowa *SBAE Teachers Regarding Involvement in Previous Professional Development Continued…*

Principles of Ag Science-Plant (ASP)	49	33.56
Natural Resources and Ecology (NRE)	28	19.18
Food Science and Safety (FSS)	10	6.84
Animal and Plant Biotechnology (APB)	6	4.11
Agricultural Power and Technology (APT)	6	4.11
Agricultural Research and Development (ARD)	2	1.37
Environmental Science Issues (ESI)	2	1.37

The Iowa SBAE teachers reported a large involvement with the Curriculum for Agricultural Science Education (CASE) to further their professional development. In fact, of the 146 SBAE teachers who responded to this item, only 38 (26.03%) teachers reported having no CASE certifications. The largest number of Iowa SBAE teachers had attained these CASE certifications: Introduction to Agricultural, Food, and Natural Resources (AFNR; n = 95, 65.07%), Principles of Ag Science-Animal (ASA; n = 51, 34.93%), Principles of Ag Science-Plant (ASP; n = 49, 33.56%), and Natural Resources and Ecology (NRE; n = 28, 19.18%).

The second objective was to assess the SBAE teachers' professional development needs regarding teaching and classroom management. Of the 20 teaching and classroom management items presented to the teachers, only one item, "conducting parent/teacher conferences" (MWDS = -0.03), was identified as not needing professional development. "Motivating students to learn" (MWDS = 4.32), "teaching in land laboratory" (MWDS = 3.97), "proper implementation of Individualized Education Program (IEP) for students with disabilities" (MWDS = 3.97), "teaching students decision-making skills" (MWDS = 3.96), and "developing performance-based assessment instruments" (MWDS = 3.96) were the top five teaching and classroom management items that the SBAE teachers expressed the highest perceived levels of professional development needs. Aside from the top five items with the highest MWDS, and the item which teachers indicated the lack of training need, the remaining 14 items had MWDS which ranged from 2.10 to 3.84—signifying the need for further professional development in these areas (see Table 2).

Table 2

In-service SBAE Teachers' Perceived Professional Development Needs Related to Teaching and Classroom Management, Using the Borich Needs Assessment Model

Item	n	MWDS
Motivating students to learn.	147	4.32
Teaching in land laboratory.	147	3.97
Proper implementation of IEPs for students with disabilities.	146	3.97
Teaching students decision-making skills.	147	3.96
Developing performance-based assessment instruments.	146	3.96
Teaching students problem-solving skills.	147	3.84
Proper supervision of students to ensure safety.	147	3.58
Managing student behavior problems.	147	3.53

Assessing and evaluating student performance.	146	3.28

Table 2

In-service SBAE Teachers' Perceived Professional Development Needs Related to Teaching and Classroom Management, Using the Borich Needs Assessment Model

Determining the content that should be taught in specific courses.	147	3.27
Providing career exploration activities in the agricultural education.	147	3.21
Using technology in teaching.	147	3.14
Developing a variety of agricultural curriculum.	147	2.96
Teaching in an agricultural mechanics laboratory.	145	2.93
Organizing and supervising a teaching laboratory.	147	2.89
Developing articulation agreements with local community colleges.	147	2.79
Teaching in a horticulture/greenhouse facility.	146	2.62
Locating and selecting student references and materials.	146	2.16
Providing guidance to students interested in post-secondary education.	147	2.10
Conducting parent/teacher conferences.	146	-0.03

Note. MWDS = Mean Weighted Discrepancy Score. Importance Scale: 1 = *Not Important*, 2 = *Slightly Important*, 3 = *Moderately Important*, 4 = *Important*, 5 = *Very Important. Knowledge* Scale: 1 = *I have no knowledge on this issue*, 2 = *Slightly Knowledgeable*, 3 = *Moderately Knowledgeable*, 4 = *Knowledgeable*, 5 = *Very Knowledgeable*.

The third research objective sought to determine the professional development needs of Iowa SBAE teachers related to technical agriculture. Teachers reported some level of professional development needs for all items included in the technical agriculture category. The five items with the highest perceived training needs were "teaching knowledge and skills in biotechnology" (MWDS = 5.24), "integrating current advances in agriculture technology into the curriculum" (MWDS = 4.70), "teaching knowledge and skills in agribusiness" (MWDS = 4.01), "teaching about public issues regarding agriculture" (MWDS = 4.00), and "teaching knowledge and skills in agricultural mechanics" (MWDS = 3.83; see Table 3).

Table 3

In-service SBAE Teachers' Perceived Training Needs Related to Technical Agriculture, Using the Borich Needs Assessment Model

Item	*n*	MWDS
Teaching knowledge and skills in biotechnology.	145	5.24
Integrating current advances in agriculture technology into the curriculum.	145	4.70
Teaching knowledge and skills in agribusiness.	145	4.01
Teaching about public issues regarding agriculture.	145	4.00
Teaching knowledge and skills in agricultural mechanics.	143	3.83
Teaching knowledge and skills in agronomy.	145	3.57
Teaching knowledge and skills in natural resources.	145	3.08
Teaching knowledge and skills in horticulture.	145	2.62
Teaching knowledge and skills in the animal sciences.	145	1.53

Note. MWDS = Mean Weighted Discrepancy Score. Importance Scale: 1 = *Not Important*, 2 = *Slightly Important*, 3 = *Moderately Important*, 4 = *Important*, 5 = *Very Important. Knowledge*

Scale: 1 = *I have no knowledge on this issue*, 2 = *Slightly Knowledgeable*, 3 = *Moderately Knowledgeable*, 4 = *Knowledgeable*, 5 = *Very Knowledgeable*.

Conversely, the technical agriculture items with the lowest reported levels of training needs were associated with teaching knowledge and skills in horticulture (MWDS = 2.62) and animal sciences (MWDS = 1.53).

Conclusions, Implications, and Recommendations

The purpose of this study was to evaluate the professional development needs of Iowa school-based agricultural education teachers related to teaching, classroom management, and technical agriculture. The SBAE teachers reported using many sources of professional development to bolster their effectiveness as teachers. Workshops, offered by the agricultural teachers' association, university, and professional organization, and school-based workshops were the sources of professional development most commonly attended by the teachers in this study. A majority of respondents reported that they had previously completed CASE Institutes. Introduction to Agricultural, Food, and Natural Resources (AFNR), Principles of Ag Science-Animal (ASA), and Principles of Ag Science-Plant (ASP) were the CASE Institutes which the teachers reported the highest frequency of certifications.

The SBAE teachers' engagement in professional development might imply that they are motivated to enhance their knowledge of content related to agricultural education. According to Hatano (1988), an individual's motivation to expand their understanding of a given content area serves as a precursor to developing adaptive expertise. Aside from building their content area knowledge, the teachers also engaged in professional development activities which potentially enhanced their pedagogical knowledge. For example, the teachers who participated in CASE Institutes (n = 108, 74%) received content-specific (e.g., AFNR, ASA, APT, etc.) and pedagogical-based training. The CASE Institute sessions "provide teachers important background related to the pedagogy used in CASE curricula and practice teaching various lessons to prepare them for classroom instruction" (The National Council for Agricultural Education, 2016, p. 5). Hammerness et al. (2005) noted that beginning teachers struggle to use content and pedagogical knowledge—hindering their ability to develop as teachers and adaptive experts. The two-pronged nature (i.e., content and pedagogy) of the CASE training provides a holistic professional development experience.

The content focus of the professional development the teachers chose to engage in provides some insight on their self-perceived needs. The SBAE teachers' self-diagnosis of their training needs accounts for the self-directedness of these adult learners. This study provides a broad view on the types of professional development the teachers chose to engage in, yet the scope of the study failed to inquire about variables which motivated teachers to participate in professional development events. In future studies, the teachers' intrinsic motivations (e.g. personal desire to gain knowledge related to their content area) and extrinsic motivations (e.g., professional development hours for teacher certification) related to professional development should be explored. Further exploration of teachers' motivations to participate in various professional development events would help to identify if the teachers possess expertise in efficiency, innovation, or both (i.e., adaptive expertise).

The self-perceived training needs of the SBAE teachers, associated with teaching and classroom management, aligned with previous findings on the professional development needs of SBAE teachers in other states. Motivating students to learn, proper implementation of Individualized Education Program (IEP) for students with disabilities, teaching students in a

laboratory setting (Clemons, Heidenrich, & Linder, 2018; Garton & Chung, 1996, 1997; Joerger, 2002; Layfield & Dobbins, 2002; Sorensen et al., 2014), developing performance-based assessment instruments (Clemons et al., 2018; Garton & Chung, 1996, 1997; Joerger, 2002; Layfield & Dobbins, 2002), and teaching students decision-making skills (Garton & Chung, 1996, 1997; Joerger, 2002; Layfield & Dobbins, 2002) were the items which had the highest MWDS which coincide with previously expressed needs of SBAE teachers.

The teachers' self-perceived training needs related to classroom management and teaching issues (e.g., motivating students to learn, implementing IEPs, and teaching decision making skills, etc.) signify that the teachers' professional development needs are not limited to content knowledge training. Based on the tenets of andragogy, self-directed learners desire to determine their own learning needs and personally plan learning experiences to bolster their abilities. Therefore, SBAE teachers should have the freedom to select the trainings they want to attend. Various professional development entities (e.g., Iowa Association of Agricultural Educators) and university personnel (e.g., teacher educators specializing in agricultural education and special education) can assist in providing further training to these SBAE teachers.

For professional development to be engaging and successful, the professional development event needs to ensure it is correct for the audience, the duration time is adequate to allow for engagement, and there is room for participation (Birman, Desiomne, Porter, & Garet, 2000). Therefore, the professional development events should not be presenter-centered; rather, the in-service teachers themselves should be recognized as a rich resource for learning based on their "growing reservoir of experience" (Knowles, 1980, p. 45).

The findings of SBAE teachers' professional development needs associated with technical agriculture mirrored previous findings in agricultural education research. More specifically, teaching knowledge and skills in biotechnology (Clemons et al., 2018), agribusiness, agricultural mechanics, agronomy (Clemons et al., 2018; Garton & Chung, 1997; Joerger, 2002; Layfield & Dobbins, 2002), integrating current advances in agriculture technology into the curriculum (Clemons et al., 2018; Joerger, 2002; Layfield & Dobbins, 2002), and teaching about public issues regarding agriculture (Garton & Chung, 1997; Joerger, 2002; Layfield & Dobbins, 2002), were the items with the highest reported MWDS by Iowa SBAE teachers in this study which closely aligned with previous findings.

Duncan et al., (2006) found in-service educators struggled with integrating and utilizing the current agricultural technology advances into their classroom curriculum along with teaching biotechnology. According to Steele and Aubusson (2004), two main reasons teachers choose not to teach biotechnology is because (1) students perceive the subject to be too challenging and (2) teachers struggle to develop and provide practical applications of biotechnology content in the classroom. However, Steele and Aubusson (2004) indicated that teachers' lack of knowledge related to biotechnology was not found to be a reason for not teaching biotechnology. Therefore, professional development associated with biotechnology should be focused on the delivery of practical biotechnology lessons.

Aside from teachers' indication of training needs related to biotechnology, agricultural mechanics was another technical area where teachers indicated a high need for training. The lack of teacher (i.e., pre-service and in-service) competency in agricultural mechanics has been expressed in a myriad of previous research (Burris, Robinson, & Terry, 2005; McCubbins, Wells, Anderson & Paulsen, 2017; Tummons, Langley, Reed, & Paul, 2017). Byrd, Anderson, Paulsen, and Shultz (2015) reported finding a positive correlation between agricultural mechanics courses completed in their teacher preparation program and perceived level of competence with agricultural

mechanics content. Specifically, Byrd et al. (2015) found that "the more courses [agricultural mechanics] taken the higher the self-perceived competence level of the teacher" (p. 20). The notion of requiring more agricultural mechanics coursework in teacher preparation programs might be a solution to mitigate the teachers' knowledge gap in this subject matter, but the rise of credit requirements in other content areas and a lack of pre-service agricultural mechanics courses serves as a barrier for teacher preparation programs to provide adequate training (Burris et al., 2005). Burris et al. (2005) recommended that teacher preparation programs need to "develop creative and innovative solutions to ensure that program graduates, as well as practicing teachers, are given the opportunity to develop technical competencies in the field of agricultural mechanics" (p. 33). Periodic professional development events should be offered by professional development entities (e.g., Iowa agricultural teachers association, trade schools, teacher educators, industry representatives) to assist teachers in building their competence in agricultural mechanics.

The Iowa in-service teachers reported a high need for professional development related to agribusiness. A need for teacher training associated with agribusiness has been expressed over the past decades (Clemons et al., 2018; Garton & Chung, 1997; Joerger, 2002; Layfield & Dobbins, 2002) which implies that this is a perpetual area of need for agricultural science teachers. In 2000, Joerger and Andreasen sought to determine the core agribusiness standards to guide agribusiness curriculum development in Utah SBAE programs. The agricultural science teachers and agribusiness/industry representatives reported the highest levels of agreement on the importance of the following agribusiness standards: written and verbal skills, agricultural business and management computer technologies, general agricultural business, and management principles, record keeping procedures and practices, and basic economic principles (Joerger & Andreasen, 2000). The agribusiness standards put forth by Joerger and Andreasen (2000) are considerably dated, yet they might serve as a good foundation to guide various professional development events in this content area. Further investigations will need to be conducted to determine the specific agribusiness topic which should be addressed in future trainings.

The technical agriculture content areas which in-service teachers expressed the lowest level of training needs (e.g., teaching knowledge and skills in animal science or horticulture), were the same content areas which the teachers expressed high frequencies of previous training. Although no analysis was conducted to determine the direct impacts of training sources on teachers' perceived knowledge levels, it can be implied that the SBAE teachers have previously addressed content specific needs in prior trainings. On the other hand, the low levels of indicated needs, and the indication of previous training might indicate that the teachers might choose to attend trainings associated with topics they already have an interest and competence in.

From an immediacy of application standpoint, an implication can be made that the teachers' professional development pursuits are closely aligned with the subject matter they currently teach. According to Knowles (1980), as a learner matures their time perspective for learning changes from "one of postponed application of knowledge to immediacy of application" (p. 45). Future needs assessment studies of SBAE teachers should analyze the teachers' perceived needs as they relate to immediacy of application. This will assist in directing the subject matter of future professional development events to best align with the needs of the SBAE teachers.

Based on previous literature, it is also important to consider the professional life cycles of teachers when developing and delivering professional development events (Easterly & Myers, 2017; Eros, 2011; Fessler & Christensen, 1992; Huberman, 1989; Smalley & Smith, 2017; Sorensen et al., 2014; Steffy, Wolfe, Pasch, & Enz, 2000). Eros (2011) emphasized the importance of "the presence of different career stages [of teachers] and to build on this knowledge to design stage-appropriate professional development" (p. 68). Future needs assessment studies should focus

on determining potential differences in the professional development needs of Iowa SBAE based on their current career cycle. The proposed inquiry would assist professional development entities (e.g., administrators, professional development coordinators, postsecondary teacher educators, etc.) in providing appropriate training events for teachers who identify with varying stages of the professional life cycle.

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