

# Determining the Classroom Needs of School-Based Agricultural Education Teachers in Minnesota

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## Abstract

*Retaining quality SBAE teachers is key to the success and growth of the agricultural industry. Given the connection between SBAE teacher perceived competence and professional commitment (Palmer, 2020; Rada, 2023), it is vital to explore the perceptions of competence of teachers concerning their classroom. Using a Borich needs assessment model, the purpose of this study was to evaluate the perception of Minnesota SBAE teachers in the areas of teaching, classroom management, and technical agriculture to identify professional development needs. The SBAE teachers who participated in this study utilized various sources of professional development to enhance their competence as educators. Agriculture teachers' association workshops and school in-service workshops were their main sources of professional development. Most respondents (69.2%) had also participated in the Teacher Induction Program (TIP) as an early-career teacher. Managing student behaviors, motivating students to learn, proper implementation of IEPs for students with disabilities, integrating current advances in agricultural technology into the curriculum, teaching in an agricultural mechanics laboratory, and teaching knowledge and skills in biotechnology were identified as the top six professional development needs. Our results showed limited differences in professional development based on years of SBAE teaching experience. In addition to continued content-focused trainings, professional development focused on pedagogy and student engagement are recommended as focus areas for professional development.*

## Introduction

A shortage of teachers exists in numerous disciplines and has impacted education (Learning Policy Institute, 2024). With a shortage of school-based agricultural education (SBAE) teachers, reaching and preparing students can be challenging as teaching positions remain vacant (Smith et al., 2023). A shortage of SBAE teachers has been identified since the 1970s and has persisted for decades (Camp, 2000). Ingersoll et al. (2018) indicated 44% of classroom teachers leave the profession within five years. Though Minnesota has lower attrition than the national average, more than one-third (34.1%) of SBAE teachers departed the profession within the first five years (Minnesota Professional Educator Licensing and Standards Board (PELSB), 2023; Rada & Haddad, 2021; Smith et al., 2023). As a result, SBAE continues to experience a teacher shortage (PELSB, 2023). Teacher turnover also has a significant fiscal impact, potentially exceeding \$20,000 for some school districts when accounting for expenses associated with recruiting, hiring, and training a new teacher (Carver-Thomas & Darling-Hammond, 2017; Learning Policy Institute, 2024). Unfilled positions hinder student access: therefore, teacher retention is a critical priority for SBAE.

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The majority of the annual supply of SBAE teachers are retained teachers (Smith et al., 2023); however, there is a notable level of attrition each year. Given the prevalence of teacher attrition and the challenges associated with recruitment, emphasis has been placed on teacher retention (Guffey & Young, 2020; Korte & Simonsen, 2018; Smalley & Smith, 2017; Touchstone, 2015). Reducing SBAE teacher attrition would reduce teacher shortages more than any other single factor, excluding retirement (Smith et al., 2023). Teacher retention efforts have concentrated on aspects such as teacher work life balance, induction programs, engagement, mentoring, and training (De Lay & Washburn, 2013; Eck & Edwards, 2019; Haddad et al., 2020; Hasselquist et al., 2017; Lemons et al., 2015; Moser & McKim, 2020; Smith & Smalley, 2018; Solomonson et al., 2018; Solomonson & Retallick, 2018; Sorensen & McKim, 2014). However, further investigation into additional factors effecting retention is warranted.

SBAE literature identifies several factors which influence teacher retention in the profession. Solomonson and colleagues (2021) identified three primary factors as: “(1) the teacher’s ability to engage students, (2) the confidence level to adequately teach students, and (3) the confidence level to adequately teach the curriculum” (p. 132). Igo and Perry (2019) identify work-life balance, competitive compensation, and adequate training as factors contributing to SBAE teacher retention. Retention strategies are enhanced by an understanding of influential personal factors (Crutchfield, 2010; Crutchfield et al., 2013; Day, 2008). The perception of competence is such a factor that impacts an SBAE teacher's decision to stay in the classroom (Igo & Perry, 2019; Rada, 2023; Solomonson et al., 2021).

The innate human need to feel competent is a basic psychological need (Deci & Ryan, 1985). SBAE teachers who perceive higher competence within the discipline-specific teacher competence areas also reported a higher perceived commitment to teaching (McKim et al., 2017; Palmer, 2020; Rada, 2023), and competence was specifically identified to have a significant and negative effect on turnover intention of Minnesota SBAE teachers (Rada, 2023). However, development and support are required for these human tendencies to be strong (Ryan & Deci, 2020).

The capabilities and deficiencies of SBAE teachers have been assessed through needs assessments, considering the competencies required to manage the discipline-specific expectations of an SBAE teacher (Clemons et al., 2018; Coleman et al., 2020; Smalley et al., 2019; Smalley & Smith, 2017; Sorensen et al., 2014), but these perceptions had not been assessed in Minnesota. Discipline-specific teacher expectations encompassed in SBAE research include pedagogy, program management, technical knowledge, professional growth, and personal qualities (McKim et al., 2017; Roberts & Dyer, 2004). Additional research assessed SBAE teachers’ perceived competence regarding specific content, including agricultural mechanics (Byrd et al., 2015; Wells et al., 2021). Given competence has been a strong predictor of psychological functioning at work (Collie et al., 2016) and turnover intention (Rada, 2023), a needs assessment of the perceived competence of Minnesota’s SBAE teachers was warranted.

This research aimed to identify the gaps in perceived competence of SBAE teachers in Minnesota in relation to their teaching, classroom management, and technical agricultural knowledge. Identifying perceived gaps in competence was the preliminary phase for developing competence-enhancing professional development (PD) programs to investigate the direct impact of competence development on teacher retention.

### **Framework**

Deci and Ryan’s (1985, 2000) self-determination theory (SDT) is a macro human motivation theory focused on how human motivation and personality are shaped with intrinsic and extrinsic factors. SDT assumes humans have natural, innate tendencies toward psychological growth and development (Ryan & Deci, 2002). This theory explores how human motivation and personality address the three universal psychological needs of competence, autonomy, and relatedness (Deci & Ryan, 1985). It clarifies how people perceive their surroundings and contends that human motivational processes are supported by psychological

needs satisfaction (Deci & Ryan, 2000). SDT is built on an understanding that conflicting factors between human nature and their environment aid or hinder growth (Ryan & Deci, 2002). Based on the SDT (Ryan & Deci, 2002), individuals possess a natural propensity toward psychological growth.

SDT examines how social contexts support people's needs and motivations, including work motivations (Deci et al., 2017). Basic psychological needs, a mini-theory of SDT, emphasizes the three basic psychological needs: competence, autonomy, and relatedness. Satisfaction of psychological needs has implications in the workplace as people gravitate toward environments that fulfill their needs when possible (Deci & Ryan, 2000, 2014; Deci et al., 2017; Ryan & Deci, 2002; Vansteenkiste et al., 2020). Job satisfaction, commitment, motivation, and well-being all improve when employees' psychological needs are met (Deci et al., 2017). However, unmet psychological needs increases attrition and burnout (Albrecht & Marty, 2017). Psychological need satisfaction at work is dependent on the environment and influences teacher work satisfaction, choices, and commitment as teachers desire a workplace that meets their psychological needs (Lee & Nie, 2014; Mabekoje et al., 2016).

The three psychological needs of autonomy, competence, and relatedness are essential to human development and motivation (Ryan & Deci, 2002, 2020). Autonomy refers to the ability to take initiative and ownership of one's activities. It is fostered by experiences a person finds interesting and valuable (Deci & Ryan, 2012; Ryan & Deci, 2020). Competence refers to a sense of mastery and the belief one can succeed and develop. This feeling is fulfilled by facing appropriate challenges, receiving positive feedback, and having possibilities for personal progress (Ryan & Deci, 2020). Relatedness refers to a feeling of "belonging and connection" (Ryan & Deci, 2020, p. 1) that is established via the presence of mutual respect, dependence, and concern with other individuals and collectives. According to SDT, if these three conditions are fulfilled, well-being is maintained and improved; otherwise, individuals would suffer significant psychological setbacks (Deci & Ryan, 2012; Ryan & Deci, 2020). The absence of any of these three fundamental needs is perceived to damage motivation and employee retention.

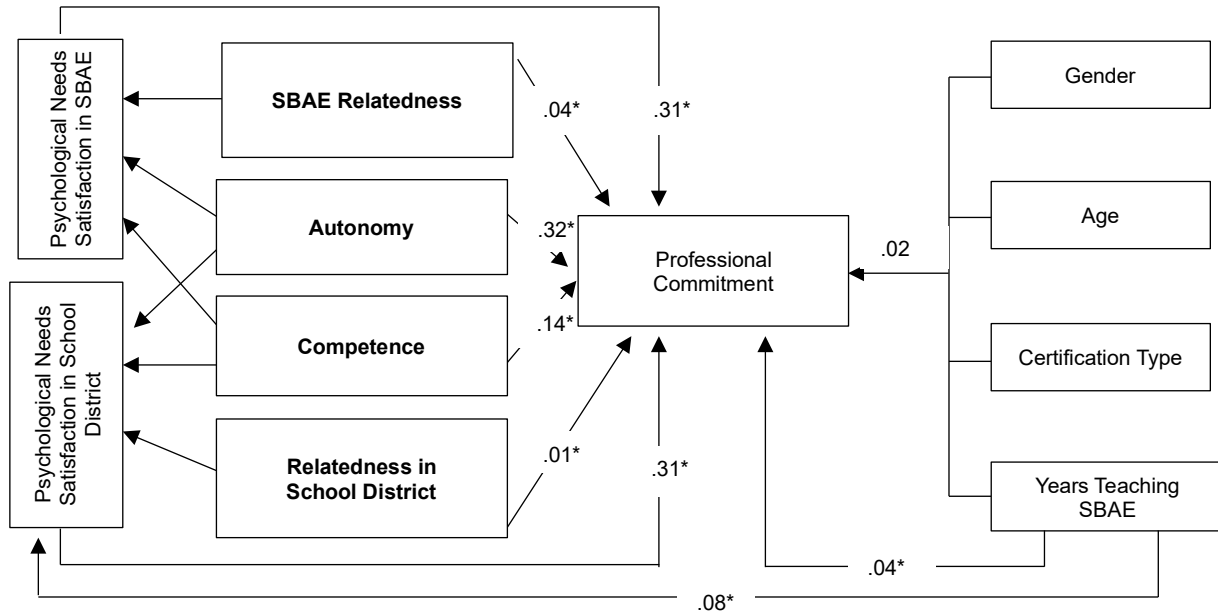
### **Psychological Need of Competence**

Competence is the psychological need for effectiveness and affects a person's psychological well-being (Ryan & Deci, 2020). When there is a disparity between what people must do and can perform in the workplace, psychological frustration can occur, resulting in feelings varying from anxiety to boredom (Pink, 2009). Perceived competence at work influences a teacher's belief in their effectiveness based on psychological needs fulfillment.

This perception of competence is a critical component to evaluate when exploring teacher retention. Collie et al. (2016) attested competence provided the most insight into teachers' psychological functioning at work. A statistically significant relationship between teachers' perceived competence satisfaction and years of service has been documented (Hobson & Maxwell, 2017; Palmer, 2020) and confirmed with Minnesota SBAE teachers (Rada, 2023; see Figure 1). Competence was also a significant predictor of Minnesota SBAE teachers' turnover intention (Rada, 2023). When developing competence, an individual must work to learn and grow (Pink, 2009). To identify the growth areas, teachers' perceptions of competence must be measured. Understanding SBAE instructors' views of their competence at work is crucial to retention due to the link between perceived competence and turnover intention.

Figure 1

Relationship Among Psychological Needs Satisfaction, Professional Commitment, and Teacher Demographic Variables as Determined by Regression Analysis (Rada, 2023)



Note. \* $p < .01$

### Purpose and Objectives

The purpose of this study was to identify the PD needs of Minnesota SBAE teachers through a needs assessment evaluating perceived competence in relation to teaching, classroom management, and technical agricultural knowledge. The following five research objectives served as a guide for this needs assessment study:

1. Determine the background characteristics (i.e., education and training in agricultural education, completion of CASE certification, participation in PD) of Minnesota SBAE teachers.
2. Determine the perceptions of competence of Minnesota SBAE teachers related to teaching, classroom management, and technical agricultural knowledge.
3. Determine the perceptions of competence of Minnesota SBAE teachers with fewer than five years of teaching experience compared to those with five or more years of experience related to teaching, classroom management, and technical agricultural knowledge.
4. Assess Minnesota SBAE teachers' PD needs related to teaching, classroom management, and technical agricultural knowledge.
5. Assess Minnesota SBAE teachers' PD needs with fewer than five years of teaching experience compared to those with five or more years of experience related to program design and management, teaching, and classroom management.

## Methods

### Population

A census was attempted of all Minnesota SBAE teachers ( $N = 326$ ). Of the 140 teachers with complete responses to this instrument, the majority of Minnesota SBAE teachers were female ( $f = 77$ , 55.0%). Their average age was 38.00 years ( $SD = 12.52$ ). Fifty-six teachers had fewer than five years of teaching experience, while the majority (60.0%,  $n = 84$ ) had more than five years teaching SBAE.

### Instrument

Researchers utilized a Borich Needs Assessment Model to assess the PD needs of SBAE teachers in Minnesota. The Borich model is used to prioritize competencies for PD by identifying gaps between a respondent's perceived ability to perform a competency and its importance to job effectiveness (Borich, 1980). The model quantifies the discrepancy between ability and importance using ordinal scales to determine if an individual has sufficient ability to perform an important competency.

The needs assessment instrument was developed and validated by Smalley et al. (2019) and evaluated Minnesota SBAE teacher perceptions in the areas of teaching, classroom management, and technical agricultural knowledge. The items of the online instrument were organized with each topic on a distinct page, improving the readability (Dillman et al., 2014; Revilla & Ochoa, 2017). The area of teaching and classroom management focused on teaching and student learning had 18 items. The technical agriculture section had nine items focused on knowledge and skills relevant to SBAE program pathways. Each needs assessment item was paired with two Likert-type scales. One assessed the teachers' perceived importance associated with the different topics (1 = *No Importance*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Essential*). Importance in this statement refers to the perceived importance of all SBAE teachers being knowledgeable of the topic in their classroom or program. The other scale evaluated their perceived ability to perform the skill in their classroom or program (1 = *No Ability*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Exceptional*). The instrument also contained items to determine the professional and personal characteristics of the participants.

### Data Collection

All SBAE teachers in the profession in Minnesota as of October 2022 were subjects of this research. Contact information of the SBAE teachers teaching in the fall of 2022 was obtained using the Minnesota Agricultural Education Teacher Directory. Each contact with respondents was personalized, with no more than three contacts made to encourage participation, and included study information, participation instructions, and a link to the Qualtrics needs assessment instrument. The message, time, and day of the week in which the messages were delivered varied for each contact (Dillman et al., 2014). Each teacher was assigned a randomized code, and their completion of the instrument was tracked. The instrument was administered online using Qualtrics®. This allowed for the tracking of respondents, ensured the integrity and security of survey data, and prevented duplicated submissions (Dillman et al., 2014).

### Data Analysis

Data were analyzed using descriptive statistics in IBM's Statistical Package for Social Sciences (SPSS®) to establish the background characteristics related to objective one. Objectives two through five were analyzed using mean weighted discrepancy scores (MWDS) for each competency.

The Borich model incorporates the collective assessment of the participant group to mitigate any potential flaws in individual assessment (Borich, 1980). When the calculation of a MWDS is performed, responses missing one of the two scores for each item are unusable and removed. According to Borich (1980), it is necessary to first calculate the discrepancy score for each competency, which represents the gap between the perceived importance and level of ability. Next, a weighted discrepancy score is calculated for each participant by multiplying the participant's discrepancy score by the average perceived importance

for that item among all participants (Borich, 1980). Ultimately, the MWDS can be determined by adding all weighted discrepancy scores for the competency and then dividing by the total number of responses. The MWDS measures training needs, with positive scores suggesting a need for PD and negative values indicating no need since ability surpasses importance. We used McKim & Saucier's (2011) Excel-Based Mean Weighted Discrepancy Score Calculator.

According to Smalley et al. (2019), the instrument has acceptable internal consistency with a Cronbach alpha coefficient reported for importance ( $\alpha = .97$ ) and ability to perform ( $\alpha = .97$ ). In this study reliability Cronbach's alpha coefficients for the importance ( $\alpha = .96$ ) and ability ( $\alpha = .96$ ) were calculated and met the tolerable threshold level (Hair et al., 2014; Johnson & Christensen, 2014). These findings are consistent with the psychometric properties in prior research (Hainline & Smalley, 2023; Smalley et al., 2019). Response options were limited to five balanced categories to improve reliability, validity, and provide meaningful distinctions for analysis (Dillman et al., 2014). The external validity of the findings was not assessed due to constraints associated to the attempted census of SBAE teachers in Minnesota. Therefore, it is important to use caution when trying to generalize these findings to any other population.

### Findings

The first objective sought to determine the background characteristics (i.e., education and training in agricultural education, completion of Curriculum for Agricultural Science Education (CASE) certification, participation in PD) of Minnesota SBAE teachers. Minnesota SBAE teachers indicated participation in Minnesota's teacher retention programs. Of the 140 teachers with complete responses to this instrument, 138 (98.6%) SBAE teachers indicated they held a bachelor's degree, while 67 (47.9%) SBAE teachers completed a master's degree. Of those with a bachelor's degree, 25.0% ( $f = 35$ ) did not have a bachelor's degree in agricultural education.

The SBAE teachers indicated 24 (17.1%) had participated in the state's Future AgriScience Teacher Symposium as a pre-service teacher, 97 (69.2%) had participated in the Teacher Induction Program (TIP) as an early-career teacher, and 33 (23.6%) participated in the Resources for Professional Learning retention program for teachers with 3-7 years of experience. As shown in Table 1, the primary sources of PD identified by SBAE teachers were: (a) agricultural teachers' association workshops (87.9%,  $n = 123$ ), (b) school in-service events (77.1%,  $n = 108$ ), (c) university workshops (14.3%,  $n = 20$ ), (d) professional organization workshops (47.1%,  $n = 66$ ), and (e) graduate coursework (22.9%,  $n = 32$ ). Additionally, 66 (47.1%) had attended at least one CASE Institute.

**Table 1**

*Primary Sources of PD for Minnesota SBAE Teachers*

Primary Source(s) of PD ( $n = 140$ )	$f$	%
Agricultural teachers' association workshops	123	87.9
School in-service events	108	77.1
University workshops	20	14.3
Professional organization	66	47.1
Graduate coursework	32	22.9
CASE institutes	36	25.7

The second objective was to determine perceptions of competence of Minnesota SBAE teachers related to teaching, classroom management, and technical agriculture. The perception of ability and importance were necessary to determine the PD needs of Minnesota teachers. Table 2 provides a summary of the perceived importance and ability to perform associated with each teaching and classroom

management item. The three competencies with the highest perceived importance were (a) managing student behavior problems; (b) motivating students to learn; and (c) teaching students problem-solving skills. The three competencies with the lowest perceived importance were (a) developing articulation agreements with local community colleges; (b) conducting parent/teacher conferences; and (c) teaching in land laboratory. The three competencies in which teachers had the highest mean ability in teaching and classroom management were (a) providing career exploration activities in the agricultural education; (b) providing guidance to students interested in post-secondary education; and (c) organizing and supervising a teaching laboratory. The three competencies in which teachers identified the lowest mean ability were (a) developing articulation agreements with local community colleges (b) teaching in land laboratory; and (c) teaching in an agricultural mechanics laboratory. The importance and ability standard deviation for the competency of teaching in an agricultural mechanics laboratory was highest.

**Table 2**

*SBAE Teachers' Perceptions Related to Teaching and Classroom Management*

Item	Importance		Ability		f	MWDS	
	M	SD	M	SD		M	Rank
Managing student behavior problems.	4.55	.60	3.68	.69	139	3.96	1
Proper implementation of IEPs for students	4.28	.78	3.43	.77	138	3.62	2
Motivating students to learn.	4.42	.65	3.61	.71	137	3.62	2
Teaching in an agricultural mechanics laboratory.	3.82	.97	3.01	1.15	136	3.09	4
Teaching students problem-solving skills.	4.38	.73	3.71	.74	138	2.95	5
Teaching students decision-making skills.	4.35	.73	3.70	.71	138	2.84	6
Determining the content that should be taught in specific courses.	4.25	.73	3.61	.70	138	2.71	7
Teaching in horticulture/greenhouse facility.	3.83	.80	3.16	.96	138	2.55	8
Assessing and evaluating student performance.	4.18	.71	3.63	.72	138	2.30	9
Using technology in teaching.	4.12	.77	3.64	.79	138	1.97	10
Providing career exploration activities in the agricultural education.	4.22	.71	3.78	.79	138	1.87	11
Teaching in land laboratory.	3.43	.87	2.88	.93	138	1.86	12
Developing performance-based assessment instruments.	3.88	.77	3.42	.80	137	1.79	13
Organizing and supervising a teaching laboratory.	4.13	.72	3.73	.76	137	1.66	14
Developing articulation agreements with local community colleges.	3.16	.82	2.87	.97	136	0.93	15
Locating and selecting student references and materials.	3.71	.79	3.46	.80	138	0.91	16
Providing guidance to students interested in post-secondary education.	3.93	.67	3.79	.73	138	0.57	17
Conducting parent/teacher conferences.	3.42	.86	3.50	.79	137	-0.25	18

*Note.* Scale for Perceived Importance: 1 = No Importance, 2 = Below Average, 3 = Average, 4 = Above Average, 5 = Essential. Scale for Perceived Ability to Perform the Skill: 1 = No Ability, 2 = Below Average, 3 = Average, 4 = Above Average, 5 = Exceptional.

Table 3 provides a summary of the average perceived importance and average perceived ability to perform each skill associated with technical agricultural knowledge. The three items with the highest

perceived importance were (a) integrating current advances in agriculture technology into the curriculum; (b) teaching about public issues regarding agriculture; and (c) teaching knowledge and skills in animal sciences. The three competencies with the lowest perceived importance were teaching knowledge and skills in (a) biotechnology; (b) agronomy; and (c) natural resources. The three competencies in which teachers had the highest mean ability in technical agricultural knowledge were teaching knowledge and skills in (a) animal sciences; (b) horticulture; and (c) natural resources. The three competencies with the lowest mean ability were teaching knowledge and skills in (a) biotechnology; (b) agricultural mechanics; and (c) agronomy. The importance and ability standard deviation for the competency of developing knowledge and skills in agricultural mechanics was highest.

**Table 3***Minnesota SBAE Teachers' Perceptions Related to Technical Agricultural Knowledge*

Item	Importance		Ability		<i>f</i>	MWDS	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		<i>SD</i>	<i>M</i>
Integrating current advances in agriculture technology into the curriculum.	3.98	.74	3.10	.79	139	3.49	1
Developing knowledge and skills in biotechnology.	3.52	.77	2.64	.91	140	3.12	2
Developing knowledge and skills in agricultural mechanics.	3.68	.83	2.92	1.00	139	2.78	3
Developing knowledge and skills in agribusiness.	3.68	.76	3.01	.86	139	2.49	4
Teaching about public issues regarding agriculture.	3.95	.78	3.37	.81	139	2.27	5
Developing knowledge and skills in agronomy.	3.55	.77	2.99	.89	140	2.00	6
Developing knowledge and skills in natural resources.	3.65	.76	3.41	.82	140	0.86	7
Developing knowledge and skills in horticulture.	3.74	.71	3.51	.83	140	0.85	8
Developing knowledge and skills in animal sciences.	3.78	.72	3.71	.83	139	0.27	9

Note. Scale for Perceived Importance: 1 = *No Importance*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Essential*. Scale for Perceived Ability to Perform the Skill: 1 = *No Ability*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Exceptional*.

The third objective was to determine perceptions of competence of Minnesota SBAE teachers comparing those with fewer and more than five years of teaching experience. The perception of ability and importance were necessary to determine if the PD needs varied based on SBAE teaching experience. Table 4 provides a summary of the perceived competence of teachers with fewer than five years of SBAE teaching experience associated with each teaching and classroom management item. The four competencies in which both groups of SBAE teachers had the highest mean considering the importance of the teaching and classroom management competency were (a) managing student behavior problems; (b) teaching students problem-solving skills; (c) teaching students decision-making skills; and (d) motivating students to learn (see Table 5). The three competencies in which teachers identified the lowest importance were: (a) developing articulation agreements with local community colleges; (b) conducting parent/teacher conferences; and (c) teaching in land laboratory regardless of teaching experience.

**Table 4**

*Perceived Competence Related to Teaching and Classroom Management of Minnesota SBAE Teachers with Fewer Than Five Years Experience*

Item	Importance		Ability		n	MWDS	
	M	SD	M	SD		M	Rank
Managing student behavior problems.	4.50	.66	3.41	.71	56	4.96	1
Proper implementation of IEPs for students with disabilities.	4.27	.85	3.25	.75	55	4.35	2
Teaching in an agricultural mechanics laboratory.	3.62	1.10	2.55	1.03	55	4.09	3
Motivating students to learn.	4.33	.73	3.43	.77	54	4.01	4
Teaching students decision-making skills.	4.35	.80	3.56	.76	55	3.40	5
Teaching students problem-solving skills.	4.35	.80	3.58	.79	55	3.35	6
Determining the content that should be taught in specific courses.	4.18	.84	3.40	.78	55	3.32	7
Teaching in horticulture/greenhouse facility.	3.78	.90	2.93	.96	55	3.27	8
Assessing and evaluating student performance.	4.02	.73	3.36	.78	55	2.74	9
Teaching in land laboratory.	3.38	.95	2.64	.97	55	2.56	10
Organizing and supervising a teaching laboratory.	4.05	.78	3.45	.77	55	2.48	11
Developing performance-based assessment instruments.	3.85	.89	3.22	.85	55	2.47	12
Providing career exploration activities in the agricultural education.	4.18	.80	3.73	.78	55	1.92	13
Developing articulation agreements with local community colleges.	3.09	.85	2.50	.97	54	1.87	14
Using technology in teaching.	4.04	.82	3.65	.87	55	1.57	15
Locating and selecting student references and materials.	3.55	.83	3.15	.85	55	1.48	16
Providing guidance to students interested in post-secondary education.	3.93	.77	3.76	.69	55	0.64	17
Conducting parent/teacher conferences.	3.31	.84	3.31	.79	55	0.00	18

The perceived ability associated with each teaching and classroom management item in also summarized in Table 4 for teachers with fewer than five years SBAE teaching experience. The three competencies with the highest perceived ability for early-career teachers were (a) providing guidance to students interested in post-secondary education; (b) providing career exploration activities in the agricultural education; and (c) using technology in teaching. In comparison, Table 5 summarizes that teachers with five or more years of experience had the highest-ranking competencies for (a) organizing and supervising a teaching laboratory; (b) managing student behavior problems; and (c) providing career exploration activities in the agricultural education. The four competencies with the lowest perceived ability of both groups were (a) developing articulation agreements with local community colleges; (b) teaching in an agricultural mechanics laboratory; (c) teaching in land laboratory; and (d) teaching in a horticulture/greenhouse facility.

**Table 5**

*Perceived Competence Related to Teaching and Classroom Management of Minnesota SBAE Teachers with Five or More Years Experience*

Item	Importance		Ability		n	MWDS	
	M	SD	M	SD		M	Rank
Motivating students to learn.	4.48	.59	3.72	.65	83	3.36	1
Managing student behavior problems.	4.59	.56	3.87	.62	83	3.29	2
Proper implementation of IEPs for students with disabilities.	4.28	.74	3.54	.77	83	3.14	3
Teaching students problem-solving skills.	4.41	.68	3.80	.71	83	2.69	4
Teaching students decision-making skills.	4.35	.69	3.78	.66	83	2.46	5
Teaching in an agricultural mechanics laboratory.	3.95	.86	3.32	1.13	81	2.40	6
Determining the content that should be taught in specific courses.	4.29	.65	3.75	.60	83	2.30	7
Using technology in teaching.	4.18	.73	3.64	.74	83	2.24	8
Teaching in horticulture/greenhouse facility.	3.86	.73	3.31	.94	83	2.07	9
Assessing and evaluating student performance.	4.29	.69	3.81	.63	83	2.01	10
Providing career exploration activities in the agricultural education.	4.25	.66	3.82	.80	83	1.83	11
Teaching in land laboratory.	3.46	.82	3.05	.88	83	1.41	12
Developing performance-based assessment instruments.	3.90	.70	3.56	.74	82	1.33	13
Organizing and supervising a teaching laboratory.	4.18	.69	3.91	.71	82	1.11	14
Locating and selecting student references and materials.	3.82	.75	3.67	.70	83	0.54	15
Providing guidance to students interested in post-secondary education.	3.94	.61	3.81	.76	83	0.52	16
Developing articulation agreements with local community colleges.	3.21	.80	3.11	.90	82	0.31	17
Conducting parent/teacher conferences.	3.50	.88	3.62	.78	82	-0.42	18

*Note.* Scale for Perceived Importance: 1 = No Importance, 2 = Below Average, 3 = Average, 4 = Above Average, 5 = Essential. Scale for Perceived Ability to Perform the Skill: 1 = No Ability, 2 = Below Average, 3 = Average, 4 = Above Average, 5 = Exceptional.

Perceived importance and ability to perform technical agricultural knowledge competencies of teachers with fewer (see Table 6) and more than five years of SBAE teaching experience (see Table 7) were also compared. Early career teachers reported highest importance for competencies developing knowledge and skills in (a) integrating current advances in agriculture technology into the curriculum; (b) teaching about public issues regarding agriculture; and (c) developing knowledge and skills in animal science. The group reported lowest importance for developing knowledge and skills in (a) biotechnology; (b) agronomy; and (c) natural resources. Teachers with five or more years SBAE teaching experience had similar high and low importance rankings.

**Table 6**

*Perceived Competence Related to Technical Agricultural Knowledge of Minnesota SBAE Teachers with Fewer Than Five Years Experience*

Item	Importance		Ability		MWDS		
	M	SD	M	SD	M	SD	Rank
Developing knowledge and skills in agricultural mechanics.	3.54	.89	2.52	.91	56	3.74	3.47
Integrating current advances in agriculture technology into the curriculum.	3.86	.77	2.93	.83	56	3.70	3.93
Developing knowledge and skills in biotechnology.	3.36	.80	2.52	.85	56	2.95	3.47
Developing knowledge and skills in agribusiness.	3.59	.80	2.82	.92	56	2.83	3.58
Developing knowledge and skills in agronomy.	3.41	.71	2.66	.88	56	2.66	3.60
Teaching about public issues regarding agriculture.	3.80	.84	3.29	.85	56	2.05	4.06
Developing knowledge and skills in horticulture.	3.63	.73	3.41	.80	56	0.80	3.16
Developing knowledge and skills in natural resources.	3.52	.79	3.34	.88	56	0.65	3.42
Developing knowledge and skills in animal sciences.	3.68	.69	3.54	.91	56	0.54	3.41

Note. Scale for Perceived Importance: 1 = *No Importance*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Essential*. Scale for Perceived Ability to Perform the Skill: 1 = *No Ability*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Exceptional*.

**Table 7**

*Perceived Competence Related to Technical Agricultural Knowledge of Minnesota SBAE Teachers with Five or More Years Experience*

Item	Importance		Ability		MWDS		
	M	SD	M	SD	M	SD	Rank
Integrating current advances in agriculture technology into the curriculum.	4.06	.70	3.22	.75	83	3.36	3.60
Developing knowledge and skills in biotechnology.	3.63	.74	2.71	.94	84	3.23	3.71
Teaching about public issues regarding agriculture.	4.05	.73	3.43	.78	83	2.43	3.31
Developing knowledge and skills in agribusiness.	3.75	.73	3.13	.81	83	2.26	3.76
Developing knowledge and skills in agricultural mechanics.	3.77	.77	3.19	.97	83	2.13	3.68
Developing knowledge and skills in agronomy.	3.64	.80	3.20	.83	84	1.56	3.28
Developing knowledge and skills in natural resources.	3.74	.73	3.46	.78	84	1.00	3.27
Developing knowledge and skills in horticulture.	3.81	.69	3.57	.84	84	0.89	3.46
Developing knowledge and skills in animal sciences.	3.84	.74	3.82	.75	83	0.09	3.44

Note. Scale for Perceived Importance: 1 = *No Importance*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Essential*. Scale for Perceived Ability to Perform the Skill: 1 = *No Ability*, 2 = *Below Average*, 3 = *Average*, 4 = *Above Average*, 5 = *Exceptional*.

The comparison based on years of SBAE teaching experience for perceived ability to perform are summarized in Tables 6 and 7. Teachers with fewer than five years of teaching experience perceived their highest abilities as developing knowledge and skills in (a) animal science; (b) horticulture; and (c) natural resources. Lowest abilities for early-career teachers were developing knowledge and skills in (a) biotechnology; (b) agricultural mechanics; and (c) agronomy. Teachers with five or more years SBAE teaching experiences had similar perceptions with high ability but had lowest perceived ability with developing knowledge and skills in (a) biotechnology; (b) agribusiness; and (c) agricultural mechanics.

The fourth objective was to assess Minnesota SBAE teachers' PD needs related to teaching, classroom management, and technical agriculture. The MWDS for each teaching and classroom competency and the rank in order of PD priority are summarized in Table 2. The top three PD priorities related to teaching and classroom management were (a) managing student behavior problems; (b) proper implementation of IEPs for students with disabilities; and (c) motivating students to learn. In comparison, the three competencies with the least need for PD include (a) providing guidance to students interested in post-secondary education; (b) locating and selecting student references and materials; and (c) developing articulation agreements with local community colleges. The competency of conducting parent/teacher conferences is not a PD need as perceived ability exceeds importance.

The MWDS for each technical agricultural knowledge competency and the rank in order of PD priority are summarized in Table 3 for the final objective. The top three PD priorities related to technical agricultural knowledge were (a) integrating current advances in agricultural technology into the curriculum; (b) teaching knowledge and skills in biotechnology; and (c) teaching knowledge and skills in agricultural mechanics. In comparison, the three competencies with the least need for PD were teaching knowledge and skills in (a) animal sciences; (b) horticulture; and (c) natural resources.

Overall when combining all competencies, the top six identified needs for PD were: (a) managing student behaviors (*MWDS* = 3.96); (b) motivating students to learn (*MWDS* = 3.62); (c) proper implementation of IEPs for students with disabilities (*MWDS* = 3.62); (d) integrating current advances in agricultural technology into the curriculum (*MWDS* = 3.49); (e) teaching knowledge and skills in biotechnology (*MWDS* = 3.12); and (f) teaching in an agricultural mechanics laboratory (*MWDS* = 3.09).

When PD needs were also compared for those SBAE teachers with fewer than five years to those with five years or more of teaching experience for the final objective, the need for PD was typically higher for teachers with fewer years of experience. The MWDS for each teaching and classroom management competency for teachers compared by years of experience are summarized in Tables 4 and 5. When comparing the competencies related to teaching and classroom management, the top three PD priorities related to teaching and classroom management were (a) managing student behavior problems; (b) proper implementation of IEPs for students with disabilities; and (c) teaching in an agricultural mechanics laboratory. More experienced teachers had a higher PD need for three competencies: (a) motivating students to learn; (b) managing student behavior problems; and (c) proper implementation of IEPs for students with disabilities.

The MWDS for each technical agriculture knowledge competency for teachers compared by years of experience are summarized in Tables 6 and 7. The need for PD was typically higher for teachers with fewer years of experience when comparing the competencies related to technical agriculture knowledge; however, less experienced teachers had a lower need for PD for the competencies of developing knowledge and skills in biotechnology, natural resources and horticulture. More experience teachers also had a higher need for PD for teaching about public issues regarding agriculture. Both groups identified integrating current advances in agriculture technology into the curriculum and biotechnology as a PD need, but less experience teachers need PD in agricultural mechanics while experienced teachers prioritized PD about public issues regarding agriculture.

An independent-samples t-test was conducted to explore differences in professional development needs for teachers with fewer than five years teaching experiences and those with five or more. An alpha level of .05 was utilized. Descriptive statistics for teaching and classroom management PD needs are in Table 8. All groups were normally distributed. When exploring differences in teaching and classroom management PD needs, a statistically significant difference was evident between teachers with more or less than five years of experience for six items: (a) managing student behavior problems,  $t(137) = -2.49, p = .014, d = -.09$ ; (b) developing articulation agreements with local community colleges,  $t(98.11) = -2.87, p = .005, d = -.17$ ; (c) developing performance-based assessment instruments,  $t(135) = -2.04, p = .044, d = -.01$ ; (d) organizing and supervising a teaching laboratory,  $t(135) = -2.31, p = .022, d = -.06$ ; (e) teaching in an agricultural mechanics laboratory,  $t(134) = -2.26, p = .025, d = -.05$ ; and (f) teaching in a land laboratory,  $t(87.38) = -1.99, p = .050, d = -.03$ . All statistically significant differences have a small effect size.

**Table 8***Comparison of Teaching and Classroom Management PD Needs of Minnesota SBAE Teachers*

Item	Less Than 5 Years		5 Years or More		df	t	p	Cohen's d
	M	SD	M	SD				
Managing student behavior problems.	4.96	4.28	3.29	3.58	137	-2.49	.014	-.09
Determining the content that should be taught in specific courses.	3.32	4.38	2.30	3.34	136	-1.55	.124	.07
Motivating students to learn. <sup>a</sup>	4.01	4.65	3.36	3.13	84.23	-.91	.364	.17
Providing guidance to students interested in post-secondary education.	0.64	3.77	0.52	3.52	136	-.19	.847	.31
Developing articulation agreements with local community colleges. <sup>a</sup>	1.87	3.34	0.31	2.75	98.11	-2.87	.005	-.17
Assessing and evaluating student performance.	2.74	3.53	2.01	3.16	136	-1.26	.212	.12
Providing career exploration activities in the agricultural education.	1.92	3.53	1.83	3.56	136	-.14	.887	.32
Locating and selecting student references and materials. <sup>a</sup>	1.48	3.61	0.54	2.10	78.30	-1.76	.083	.01
Teaching students problem-solving skills.	3.35	3.77	2.69	3.68	136	-1.01	.313	.17
Teaching students decision-making skills.	3.40	3.52	2.46	3.41	136	-1.56	.121	.07
Conducting parent/teacher conferences.	0.00	3.02	-0.42	3.06	135	-.79	.433	.21
Proper implementation of IEPs for students with disabilities.	4.35	4.07	3.14	3.28	136	-1.93	.056	.01
Developing performance-based assessment instruments.	2.47	3.53	1.33	3.00	135	-2.04	.044	-.01
Organizing and supervising a teaching laboratory.	2.48	3.69	1.11	3.18	135	-2.31	.022	-.06
Teaching in an agricultural mechanics laboratory.	4.09	4.46	2.40	4.16	134	-2.26	.025	-.05
Teaching in horticulture/greenhouse facility.	3.27	3.86	2.07	3.84	136	-1.79	.076	.03
Teaching in land laboratory. <sup>a</sup>	2.56	3.75	1.41	2.57	87.38	-1.99	.050	-.03
Using technology in teaching.	1.57	4.08	2.24	3.66	136	.99	.323	.51

<sup>a</sup> Welch test is reported because Levene's test indicated that the homogeneity of variances assumption was not met for this variable.

Descriptive statistics for technical agricultural knowledge PD needs are in Table 9. All groups were normally distributed. When exploring differences in technical agricultural knowledge PD needs, a statistically significant difference was evident between teachers with more or less than five years of experience for one item: developing knowledge and skills in agricultural mechanics,  $t(137) = -2.60, p = .010, d = -.45$ . The difference in years of experiences teaching SBAE had a medium effect on the need for PD in agricultural mechanics.

**Table 9***Comparison of Technical Agricultural Knowledge PD Needs of Minnesota SBAE Teachers*

Item	Less Than 5 Years		5 Years or More		df	t	p	Cohen's d
	M	SD	M	SD				
Integrating current advances in agriculture technology into the curriculum.	3.70	3.93	3.36	3.60	137	-.53	.600	-.09
Developing knowledge and skills in agribusiness.	2.83	3.58	2.26	3.76	137	-.88	.378	-.15
Developing knowledge and skills in agronomy.	2.66	3.60	1.56	3.28	138	-1.87	.064	-.32
Developing knowledge and skills in natural resources.	0.65	3.42	1.00	3.27	138	.61	.546	.10
Developing knowledge and skills in agricultural mechanics.	3.74	3.47	2.13	3.68	137	-2.60	.010	-.45
Developing knowledge and skills in animal sciences.	0.54	3.41	0.09	3.44	137	-.76	.450	-.13
Developing knowledge and skills in horticulture.	0.80	3.16	0.89	3.46	138	.15	.878	.03
Developing knowledge and skills in biotechnology.	2.95	3.47	3.23	3.71	138	.44	.663	.08
Teaching about public issues regarding agriculture.	2.05	4.06	2.43	3.31	137	.61	.544	.11

**Conclusions, Implications, and Recommendations**

Teacher retention is a continuous issue in SBAE and intentional work is needed to limit attrition when possible. Developing the skills and knowledge of SBAE teachers through PD is an intentional step towards improving their perceptions of the competence as an SBAE teacher. SBAE teachers' high level of engagement in PD may demonstrate they are motivated to develop their knowledge or mastery of a topic to fulfill their psychological need for competence. The satisfaction of a teacher's psychological needs at work is determined by their perceived competence (Palmer, 2020). According to McKim et al. (2017) and Rada (2023), SBAE teachers who perceive higher competence in the discipline-specific teacher competence areas also reported a higher perceived commitment to teaching. To most efficiently and directly address the areas in most need of competence development, teachers' perceptions of competence related to teaching, classroom management, and technical agricultural knowledge were measured.

The SBAE teachers' assessment of their PD needs takes into consideration the self-directed nature of adult learners. This study offers an overview of the PD in which instructors opted to participate. Minnesota SBAE teachers utilize a variety of PD opportunities to enhance their competence. The chosen sources and methods of PD shed light on the teachers' self-perceived needs and preferred sources of PD, yet the scope of the study failed to inquire about the content focuses of the chosen PD or other motivating factors influencing PD participation. Future studies should explore factors influencing engagement in PD and the long-term impact of PD in relationship perceived competence and overall retention.

To support teachers in PD selection, PD events need to make sure the time, length, and topics are correct for the audience and there is active participation (Birman, et. al., 2000). Further research should be conducted to identify the needs addressed by each type of PD in order to direct instructors to the sources that effectively meet their needs. A clear alignment between PD sources and the skills they address would help teachers select the sources that best suit their needs and promote the growth of their psychological need for competence. This research focused on two key areas of SBAE teacher perceived competence.

### **Teaching and classroom management**

Minnesota teachers place high importance on managing student behavior, motivating students to learn, and implementing IEPs, yet they identified it as an area of need as they do not feel confident in their ability to meet expectations. The self-perceived PD needs of Minnesota SBAE teachers pertaining to teaching and classroom management aligned with previous findings in other states. The highest MWDS items included motivating students to learn (Garton & Chung, 1996, 1997), proper implementation of IEPs for students with disabilities (Clemons et al., 2018; Garton & Chung, 1996; Smalley et al., 2019; Sorensen et al., 2010), and teaching students decision making skills (Garton & Chung, 1996; Layfield & Dobbins, 2002), aligning with the previously established needs of SBAE teachers.

Teacher self-perceptions of competence related to teaching and classroom management (e.g., managing student behavior problems, motivating student to learn, implementing IEPs) indicate that SBAE teacher PD needs go beyond content knowledge and skill development. Given that SBAE teachers reported state provided PD as a key source, it is critical for those developing PD programming to prioritize the pedagogical needs of the teachers. Much of Minnesota's PD workshops focus on developing the technical agricultural knowledge and skills (Minnesota Association of Agriculture Educators, 2024), but additional development is needed regarding general teaching and classroom management to support what teachers need to feel more competent. The state PD planning committee should focus on the creation of PD with pedagogical focus areas. This would enhance perceived competence in the areas which teachers need most. Minnesota leaders should prioritize PD topics that develop the skills and knowledge necessary to engage all students to prepare them for their future through developing problem-solving skills.

The majority of respondents also identified the state's induction program, TIP, as a key source of PD. TIP leaders and mentors should support early-career teachers in the development of teaching and classroom management skills to address student engagement and provide specific support on working with students with disabilities in an SBAE classroom. Further research should explore the similarities and differences in PD needs for those who participated in TIP and those who did not.

A notable difference from past research (Smalley et al., 2019) was the majority of Minnesota teachers ( $n = 77$ ; 53.8%) did not receive PD from CASE certifications. Though CASE was identified as a PD sources for nearly half of participants, only 25.7% of participants ( $n = 36$ ) claim it as a primary source of PD. CASE has numerous opportunities for development in specific content areas, so there are PD opportunities available. CASE certification also provides both content and pedagogy development opportunities which support holist PD. Many CASE certifications have been offered in-state; however, additional research is needed to see if there is a relationship between those who have attended relevant CASE courses and the perceived competence of those CASE certified. Additional information is also needed to explore the factors that deter or encourage teachers to attend certain types of PD such as CASE.

### **Technical agricultural knowledge**

Teacher's placed high priority on developing the skills needed to engage students in the classroom, but they also identified the need for PD related to specific agricultural pathways. Areas which were identified as being important for technical agricultural knowledge aligned with the areas which have the largest enrollment within the state: (a) power, structural and technical systems ( $n = 10,617$ ), (b) animal

systems ( $n = 8,207$ ), and (c) plant systems ( $n = 7,317$ ) according to the Minnesota Department of Education (MDE; 2023). The identified PD needs of Minnesota SBAE teachers related to technical agricultural knowledge reflect earlier findings in SBAE research. This study identified that participants reported the highest MWDS for integrating current advances in agriculture technology into the classroom (Clemons et al., 2018; Layfield & Dobbins, 2002; Smalley et al., 2019), teaching knowledge and skills in biotechnology (Clemons et al., 2018; Smalley et al., 2019), and agricultural mechanics (Smalley et al., 2019). These results parallel prior research findings.

Power, structural and technical systems courses are in the largest number of programs within the state (MDE, 2023); however, the need for PD related to agricultural mechanics and advances in agriculture technology are needed. The lack of perceived competence in preservice and inservice SBAE teachers has been well documented (Burriss et al., 2005; McCubbins et al., 2017; Tummons et al., 2017). While teacher preparation program agricultural mechanics courses improve perceived competence with the topic (Byrd et al., 2015), limitations of credit requirements and course availability limit access (Burriss et al., 2005). To meet the needs of the teachers who are already in the field, targeted PD in agricultural mechanics is needed. Frequently, Minnesota's PD workshops focus on agricultural mechanics skill and knowledge development (Minnesota Association of Agriculture Educators, 2024), but the impact of those workshops on perceived competence has not been evaluated. Agricultural technology and mechanics are also very broad topics. McKim and Saucier (2011) looked at five different agricultural mechanics constructs: (a) laboratory safety, (b) laboratory and equipment maintenance, (c) laboratory teaching, (d) tool, equipment, and supply management, and (e) program management. Wells and Hainline (2021) assessed agricultural mechanics PD needs, including tools and their use. Further research is recommended to explore PD needs considering specific agricultural mechanics constructs and tools.

Biotechnology course offerings in Minnesota are limited with 415 students enrolled in biotechnology courses (MDE, 2023); however, SBAE teachers identified it as a priority need. Similarly, Smalley et al. (2019) found Iowa SBAE teachers identified biotechnology as a PD need. Duncan et al. (2006) observed teachers struggled to incorporate biotechnology and agricultural technology into their classroom. Conversely, Steele and Aubusson (2004) indicated that teachers' lack of knowledge was not a reason for not teaching biotechnology. Additional insight into the challenges of offering biotechnology courses is needed to understand the relationship between the limited course offering and the high training need expressed by teachers. Periodic PD events should be explored by PD providers (e.g., agricultural teachers association, postsecondary partners, industry representatives) to assist teachers in building their competence in agricultural mechanics and biotechnology. Furthermore, as technology advances, ongoing support is needed to incorporate important developments in agriculture technology to help grow teacher skills and perceived competence.

Animal science, horticulture, and natural resources were the technical agricultural knowledge areas teachers expressed the lowest need for PD, but courses in these areas are the most common in Minnesota, excluding power, structural, and technical courses (MDE, 2023). The agricultural content area was not analyzed in PD courses, but the high student enrollment and high perceived competence related to these content areas may indicate that SBAE teachers have adequate experience and coursework related to these topics or that teachers have addressed their technical agricultural knowledge needs through prior PD. Further research should explore the connection between perceived competence and coursework, work experiences, and PD experiences to identify potential options for competence development.

The professional development needs of early career SBAE teachers has been explored (Christensen et al., 2009; Hainline & Wells, 2024; Saucier & McKim, 2011), but limited research (Smalley & Smith; 2017; Sorensen et al., 2014) had compared the needs by years of experience. When comparing the PD needs of teachers with fewer than five years of experience to those with more, seven of the items had a statistically significant difference and all except one has a small effect size. Though some intentional PD could be

focused on meeting the needs of teachers based on years of experience, overall PD needs were similar and focused on maintaining relevance with industry and technology advancements, engaging all students in learning, and developing pedagogical knowledge and skills. Though Sorensen et al. (2014) recommended PD by career stage, given limited PD opportunities and funding, specific PD based on years of experience is not recommended for Minnesota teachers. Further exploration is needed as there is a larger range of perceptions in specific areas like agricultural mechanics. To explore causes of the range in needs, future needs assessment studies should focus on determining potential differences in the PD needs of the SBAE educators based on their pathway to licensure, professional experiences, and coursework experiences. By being able to identify the causes of variation related to PD needs of the teacher, research could assist in identifying targeted needs of the specific teachers.

This research provides important information regarding the PD needs of Minnesota SBAE teachers. As state leaders in Minnesota set priorities for PD, this study provides valuable insight into the perceptions of teachers about teaching, classroom management, and technical agricultural knowledge. We recommend other states and regions investigate the PD needs of teachers to align PD with teacher needs in each state or region. Needs assessments in additional states would also provide valuable information for those developing regional and national PD. Exploration should include the identification of potential collaboration opportunities to meet PD needs that may be unique to Career and Technical Education teachers and not just SBAE, focusing on pedagogy, engaging all students, and advances in technology in the classroom and workplace could strengthen programs and benefit teachers and students.

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