Journal of Agricultural Education, 62(1), 17-28
https://doi.org/10.5032/jae.2021.01017

Agricultural Mechanics Preparation: How Much Do School Based Agricultural Education Teachers Receive?

Taylorann K. Clark[1], Ryan Anderson[2], Thomas H. Paulsen[3]

Abstract

The purpose of this quantitative study was to determine the amount of preparation Iowa inservice secondary agricultural education teachers received in agricultural mechanics at the university level. Secondary School Based Agricultural Education instructors attending the Iowa Association of Agricultural Educators' summer conference were given a paper-based survey instrument to report their perceptions of the agricultural mechanics skills and training they had received at the postsecondary level. Agricultural education teachers indicated that safety, welding, and construction were among the skills with highest concentration of instruction received at the postsecondary level. The areas in which teachers received the least amount of preparation were surveying, technology, and tractor skills. The overall lack of instruction in agricultural mechanics at the postsecondary level may lead to inexperienced and underprepared teachers. We recommended weekend or summer training be offered for inservice teachers who did not receive or received very little training at the postsecondary level. It is also recommended postsecondary institutions organize consistent ways in which agricultural mechanics courses are offered so that preservice agriculture teachers receive appropriate training prior to entering the profession.

Keywords: agricultural mechanics; preservice teacher preparation

Author Note: This article is a product of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 3717 and sponsored by Hatch Act and State of Iowa funds. Data were collected while the authors were employed at Iowa State University.

Introduction

The modern agricultural industry is grounded in the use of complex, efficient machinery that accomplish tasks people alone cannot (Herren, 2010). The agricultural industry is searching for entry-level employees who possess basic mechanical skills (Ramsey & Edwards, 2011 who can safely, efficiently, and effectively operate agricultural equipment. Therefore, supporting the importance for preservice students acquiring skills through agricultural mechanics education at the postsecondary level (Wells et al., 2013).

More than 11,000 agricultural education teachers practice in the United States, and of those teachers, 59% offer agricultural mechanics courses (National FFA Organization, 2016). The laboratory component of School-Based Agricultural Education (SBAE) provides curricular opportunities to develop student psychomotor skills and requires application of the principles learned in the classroom (Rosencrans & Martin, 1997). Settings such as the agricultural mechanics laboratory are significant in

[1] Taylorann K. Clark is an Adjunct Instructor in the School of Business at Graceland University, 1 University Place, Lamoni, IA 50140, (tclark1@graceland.edu).
[2] Ryan Anderson is an Assistant Professor of Agricultural Education and Mechanics in the Department of Agricultural Sciences at Texas State University, AG 206, 601 University Drive, San Marcos, TX 78666, (r_a461@txstate.edu).
[3] Thomas H. Paulsen is an Associate Professor and Department Head of the Applied Agricultural and Food Studies Department at Morningside College, Buhler Rohlfs Hall 108, 1501 Morningside Ave, Sioux City, IA 51106, (paulsent@morningside.edu).

connecting classroom instruction to skill development through hands-on learning experiences (Cooper, 1992; Johnson & Schumacher, 1989; Phipps et al., 2008).

Agricultural mechanics is a popular course offering for many secondary students, thus requiring agricultural education teachers who are highly qualified and technically and pedagogically competent (Saucier & McKim, 2011). Who is available to educate these industry-bound students for the ever-growing agricultural mechanics career opportunities? Teacher education programs should be structured to more sufficiently prepare graduates in the area of agricultural mechanics (Burris et al., 2005). With the push from the agricultural mechanics industry and the opportunity for increased time spent in the agricultural mechanics laboratory (Byrd et al., 2015; Hainline & Wells, 2019), agricultural education teachers may be the sole contact for students wishing to pursue careers in the agricultural mechanics field (Alston et al., 2018).

A study of Missouri SBAE teachers found laboratory safety methods used to teach agricultural mechanics and laboratory management as top skills in which SBAE teachers perceived they should be proficient (Saucier et al., 2012). However, are SBAE teachers proficient enough in agricultural mechanics to not only provide a safe laboratory learning environment, but also utilize teaching methods in agricultural mechanics that will prepare their students for entry level positions in the industry? Hubert and Leising (2000) suggested that to do the best job delivering agricultural mechanics content and methods to students, SBAE teachers should receive preservice instruction that is up-to-date and reliable. Shultz et al. (2014) found that agricultural teachers perceived welding, construction, mechanical, and electrical safety to be some of the most important agricultural mechanics skills needed for careers as agricultural educators.

Connors and Mundt (2001) found that of the average 43.4 technical agriculture credit hours required by most agricultural teacher education preparation programs, only 9.13 of those credits involved agricultural mechanics. Agricultural teacher education preparation programs vary in the required coursework and credit hours that preservice teachers must complete to become certified. In a study conducted by Hubert and Leising (2000), the highest amount of agricultural mechanics courses required to become teacher certified was six and above; whereas the number of courses required by the majority of the teacher education programs was only two. Of 46 teacher preparation institutions, one-half of the programs did not require any agricultural mechanics courses for teacher certification (Hubert & Leising, 2000). Further, Rasty and Anderson (2017) found that although SBAE teachers perceived an increasing importance in teaching agricultural mechanics skills, the overall depth of agricultural mechanics instruction has decreased. This is especially concerning when considering the positive impact training can have on SBAE teachers' positive self-efficacy and its correlational effect on their perceived importance of the agricultural mechanics curriculum (Mills et al., 2019).

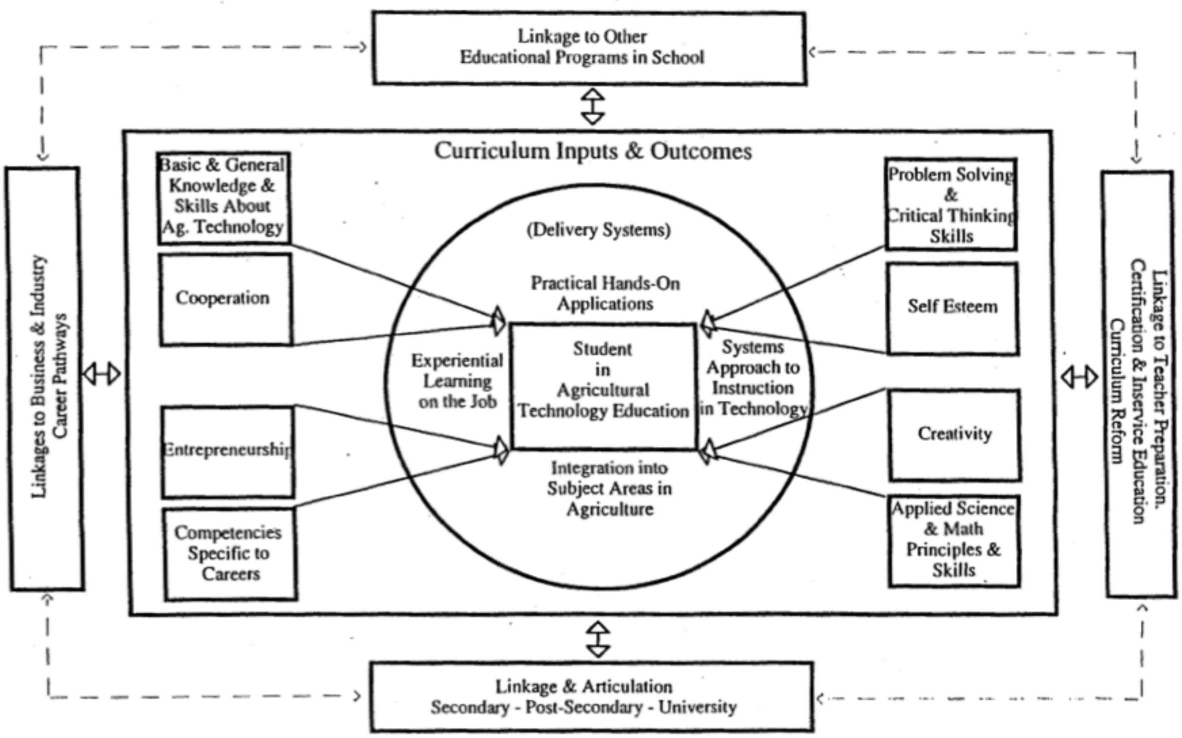
Conceptual Framework

Agricultural mechanics has been integrated into agricultural education programs to provide hands-on application, experiential learning, and a guided approach to technology instruction (Rosencrans & Martin, 1997). The Curriculum Model for Agriculture Technology Education (CMATE) designed by Rosencrans and Martin (1997) was used as a framework for this study and is provided in Figure 1. This model illustrates the eight components that should be included in agriculture curriculum. With increased interest in agricultural mechanics education (Burris et al., 2005; Hubert & Leising, 2000; Wells et al., 2013), Rosencrans and Martin's (1997) CMATE model suggests the need to ensure curriculum development for students enrolled in agriculture technology coursework, which is a category within Basic and General Knowledge and Skills about Agriculture Technology. Curriculum developed within this framework through the use of hands-on application and experiential learning will develop student's competencies specific to careers, as well as their readiness for post-secondary education or entry into business and industry. These goals are listed as outcomes of the integration of agriculture technology in the agricultural education curriculum (Rosencrans & Martin, 1997).

CMATE further illustrates the need to ensure new developments are shared among educators at the secondary and postsecondary levels. Teacher certification programs as presented in the CMATE are important for preparing pre- and in-service teachers to implement the skills and developmental processes needed to successfully teach the agricultural mechanics curriculum. Since "curricular complacency in the form of teaching antiquated technologies fails to address the needs of learners, AFNR systems, and society" (King et al., 2019, p. 800) it is critical that teacher preparation programs stay on the cutting edge of agricultural technologies and provide their teacher candidates with the knowledge and skills necessary for future success in the classroom. Additionally, Burris et al. (2005) recommended research be conducted through a "continual process to ensure that agricultural competencies taught at the secondary level are an adequate reflection of those important to the agricultural industry" (p. 32). Having a thorough understanding of the current state of agricultural mechanics preparation should provide a foundation for its continued improvement.

Figure 1

Curriculum Model for Agriculture Technology Education (CMATE)



Note. Jr., C., & Martin, R. A. (1997). The role of agricultural mechanization in the secondary agricultural education curriculum as viewed by agricultural educators. *Proceedings of the 24th Annual National Agricultural Education Research Meeting.* Reprinted with author permission.

Purpose and Objectives

Because "practical application and successful transfer of knowledge, skills, and attitudes into real-world settings is the goal of instruction" (Phipps et al., 2008, p. 19), it is unlikely novice teachers will be successful if they do not receive adequate training in skills connecting classroom and laboratory instruction to real-world applications (Hubert et al., 2003; Parr et al., 2008; Saucier et al., 2012). Are SBAE teachers receiving the training and skills at the postsecondary level to provide adequate instruction in the agricultural mechanics laboratory? Since Byrd et al. (2015) suggested that agricultural mechanics competence can be impacted by the number of agricultural mechanics courses taken at the postsecondary level, the purpose of this study was to determine the amount of skills and training Iowa secondary agricultural educators received in their preservice teacher education program. This research aligns with the American Association for Agricultural Education's Research Priority Area 4: "Meaningful, Engaged Learning in All Environments" (Roberts et al., 2016, p. 37). The following objective guided this study: Describe the teacher-perceived quantity of training received in agricultural mechanics concepts in Iowa SBAE teachers postsecondary agricultural education preparation program.

Methods and Procedures

This descriptive study was conducted as part of a larger study in agricultural mechanics education and utilized survey research methods to summarize characteristics, attitudes, and opinions to accurately describe a norm (Ary, Jacobs, Razavieh, & Sorensen, 2006). This quantitative study sought the perspectives of in-service secondary agricultural educators in Iowa. Content validity was reviewed by a team of five university faculty members with expertise in the fields of agricultural mechanics and agricultural education. An initial electronic version of the instrument was pretested through a pilot study with a group of 12 agricultural education teachers in a nearby state following the recommendations of Dillman, Smyth, and Christian (2009). Suggestions from this pilot study led us to adopt a paper-based, rather than electronic instrument. The sample was chosen using convenience sampling guidelines and data were collected from attendees during a recent Iowa agricultural education teachers' conference. The purpose behind targeting this sample was based on the likelihood for them to be involved in additional professional development activities. The questionnaire was distributed to each secondary teacher (N= 130) in attendance and respondents were asked that it be completed by the end of the conference. As an incentive to complete and return the questionnaire, each instructor was offered a power tool safety curriculum packet.

The research instrument consisted of three sections. The first section included 15 questions related to the personal and professional characteristics of the teacher including gender, education, teaching experience while section two consisted of nine questions regarding the agricultural program and school characteristics. The third section of the questionnaire listed 54 skills and training areas related to agricultural mechanics. Each skill was categorized by one of five constructs for the teacher's scaled responses: agricultural mechanics; structures and construction; soil and water, electricity, and power and machinery. A five-point Likert-type scale was used to determine the perceived quantity of training received at the postsecondary level and included the scaled frequency response options of *None*, *Some*, *Moderate*, *Strong*, or *Very Strong*. *None*, denoted with the number 1.00 on the Likert-scale, indicated the respondent to have received no training in that particular skill. A *Very Strong* rating, denoted with the number 5.00, indicated the respondent received the greatest amount of training in that particular skill during their preservice program. A panel of experts in agricultural mechanics and instrument development established the face validity of the instrument.

Usable responses (n = 103) yielded a 79.2% response rate. Suggestions from Miller and Smith (1983) guided data collection of personal and program demographics. This data was compared to data available from the Iowa Department of Education (2010) to limit non-response error. A Pearson's χ^2 analysis generated no significant differences ($p > .05$) between respondents and the general population of agricultural educators in Iowa for gender, age, highest degree held, years of teaching experience, and size of school community. Further interpretations of the study should consider the specific target population, as frame error could exist due to the convenience-based sample used. Data were coded and analyzed using JMP Pro Version 9.0.0 and PASW 18.0.

The data for perceived quantity of training in the skills received at the postsecondary level were compiled for each construct. The respondents' perceived quantity of training in each skill per construct was calculated to determine frequencies and percentages, grand means, and standard deviations. Cronbach's alpha coefficient was calculated to determine the internal consistency of the instrument by construct. Results ranged from .907 to .976 and were considered having excellent consistency (George

& Mallery, 2003). Table 1 displays each construct, the number of items, and the alpha coefficient for each construct found in the instrument.

Table 1
Internal Consistency of Instrument by Construct

Constructs	Number of Items	*a**
Structures and Construction	9	.976
Agricultural Mechanics	19	.966
Electricity	6	.960
Soil and Water	5	.907
Power and Machinery	15	.971

Note. *Cronbach's alpha. > .9 = Excellent, >.8 = Good, >.7 = Acceptable, >.6 = Questionable, >. 5 = Poor, and <.5 = Unacceptable (George & Mallery, 2003).

Population

Male agricultural education teachers made up 67.0% (*n* = 69) of the responding sample while female teachers represented the remaining 33.0% (*n* = 34). A majority of the respondents held a bachelor's degree (*n* = 64, 62.1%), and 37.9% (*n* = 39) had received a master's degree. The highest percent of respondents had 0 to 5 (*n* = 32, 31.1%) years of teaching experience, followed by 6 to 10 (*n* = 22, 21.4%) years of experience, more than 30 (*n* = 16, 15.5%) years of experience, and those with 21 to 25 years of experience making up 4.8% (*n* = 5) of the responding population. Eighty of the educators (79.2%) were employed in rural school districts. Ten percent of the respondents shared duties with another agricultural science teacher in the department. Table 2 provides a summary of the respondents' personal and professional characteristics.

Table 2
Summary of Respondents' Selected Personal and Professional Characteristics

	f	%
Gender		
Male	69	67.0
Female	34	33.0
Highest level of education		
Bachelor's Degree	64	62.1
Master's Degree	39	37.9
Years of teaching experience		
0 to 5	32	31.1
6 to 10	22	21.4
11 to 15	11	10.7
16 to 20	7	6.8
21 to 25	5	4.8
26 to 30	10	9.7
More than 30	16	15.5
Campus Location Designation		
Rural (population less than 5,000)	80	79.2
Small Urban (population between 5,000 and 20,000)	19	18.8

Table 2
Summary of Respondents' Selected Personal and Professional Characteristics, Continued…

Urban (population greater than 20,000)	2	2.0
Number of SBAE Teachers in Department		
1 Teacher	91	90.0
2 Teachers	7	7.0
3 Teachers	3	3.0

Results

In this study, we sought to describe the teacher-perceived amount of training and skills received pertaining to agricultural mechanics concepts at the postsecondary level. Percentages for each construct were calculated to find an average percentage of respondents who perceived they received *Very Strong* or *Strong* training for all 54 skills. Of the five constructs, none displayed a grand mean of more than 2.36 on a 5.00 scale, indicating teachers received only *Some* to *Moderate* training in these skill areas. Table 3 displays the grand means and standard deviations for each construct.

Table 3
Grand Mean Scores for Quantity Of Agricultural Mechanics Received by Construct

Construct	Grand Mean	Grand Standard Deviation
Structures and Construction	2.36	1.22
Agricultural Mechanics	2.13	0.98
Electricity	2.18	1.08
Soil and Water	1.70	0.84
Power and Machinery	1.92	0.92

Note. Grand means were calculated using the following scaled responses by construct: 5 = Very strong training, 4 = Strong training, 3 = Moderate training, 2 = Some training, 1 = Little or No training.

Table 4 depicts the amount of skills and training received in the agricultural Structures and Construction construct (*GM = 2.36, SD = 1.22*). No training was the most frequent response for all skills in this construct. Table 5 reports findings from the Agricultural Mechanics construct (*GM = 2.13, SD = 0.98*). Teachers perceived to have received no training in the majority of skills in Agricultural Mechanics construct. However, teachers perceived to have moderate training (*n = 25, 25.8%*) in SMAW Welding.

Table 4
SBAE Teachers' Perceptions Of The Quantity Of Structures And Constructions Skills Training Received At The Postsecondary Level

Skills		*f*(%)				
	n	None	Some	Moderate	Strong	V. Strong
Woodworking hand tools	93	29(31.2)	23(24.7)	16(17.2)	12(12.9)	13(14.0)
Woodworking power tools	93	**28(30.1)**	23(24.7)	20(21.5)	10(10.8)	12(12.9)
Drawing & sketching	85	**34(40.0)**	22(25.9)	16(18.8)	9(10.6)	4(4.7)
Concrete	87	**33(37.9)**	19(21.8)	14(16.1)	15(17.2)	6(6.9)
Selection of materials	88	**30(34.1)**	25(28.4)	12(13.6)	13(14.8)	8(9.1)
Bill of materials	89	**28(31.5)**	21(23.6)	18(20.2)	13(14.6)	9(10.1)

Table 4
SBAE Teachers' Perceptions Of The Quantity Of Structures And Constructions Skills Training Received At The Postsecondary Level, Continued…

Fasteners	87	**33(37.9)**	27(31.0)	13(14.9)	10(11.5)	4(4.6)
Construction skills (Carpentry)	91	**31(34.1)**	20(22.0)	16(17.6)	16(17.6)	8(8.8)
Construction & shop safety	92	**24(26.1)**	19(20.7)	16(17.4)	20(21.7)	13(14.1)

Note. Item mode is shown in boldface. Construct grand mean = 2.36. Construct SD = 1.22. 1 = No Training, 2 = Some Training, 3 = Moderate Training, 4 = Strong Training, 5 = Very Strong Training.

Table 5
SBAE Teachers' Perceptions Of The Quantity Of Agricultural Mechanics Skills Training Received At The Postsecondary Level

		f(%)				
Skills	*n*	None	Some	Moderate	Strong	V. Strong
Oxy-acetylene welding	97	23(23.7)	**27(27.8)**	13(13.4)	23(23.7)	11(11.3)
Oxy-acetylene cutting	98	21(21.4)	**29(29.6)**	13(13.3)	25(25.5)	10(10.2)
Oxy-propylene cutting	84	**47(56.0)**	19(22.6)	7(8.3)	5(6.0)	6(7.1)
Plasma cutting	92	**43(46.7)**	23(25.0)	14(15.2)	6(6.5)	6(6.5)
SMAW welding (Arc)	97	23(23.7)	24(24.7)	12(12.4)	**25(25.8)**	13(13.4)
GMAW welding (MIG)	95	**38(40.0)**	23(24.2)	12(12.6)	15(15.8)	7(7.4)
GTAW welding (TIG)	85	**41(48.2)**	22(25.9)	10(11.8)	6(7.1)	6(7.1)
Welding safety	97	**25(25.8)**	17(17.5)	11(11.3)	22(22.7)	22(22.7)
Metallurgy and metal work	86	**35(40.7)**	21(24.4)	15(17.4)	9(10.5)	6(7.0)
Hot metal work	85	**35(41.2)**	21(24.7)	17(20.0)	8(9.4)	4(4.7)
Cold metal work	86	**36(41.9)**	20(23.3)	17(19.8)	8(9.3)	5(5.8)
Tool conditioning	85	**32(37.6)**	23(27.1)	18(21.2)	8(9.4)	4(4.7)
Oxy-acetylene brazing	92	**29(31.5)**	22(23.9)	18(19.6)	16(17.4)	7(7.6)
Soldering	91	**44(48.4)**	26(28.6)	12(13.2)	6(6.6)	3(3.3)
Pipe cutting & threading	84	**44(52.4)**	23(27.4)	8(9.5)	5(6.0)	4(4.8)
Plumbing	87	**47(54.0)**	22(25.3)	11(12.6)	4(4.6)	3(3.4)
Fencing	85	**50(58.8)**	19(22.4)	10(11.8)	2(2.4)	4(4.7)
Mechanical safety	89	**30(33.7)**	20(22.5)	19(21.3)	9(10.1)	11(12.4)
Computer-aided design (CAD)	83	**57(68.7)**	15(18.1)	5(6.0)	2(2.4)	4(4.8)

Note. Item mode is shown in boldface. Construct grand mean = 2.13. Construct SD = 0.98. 1 = No Training, 2 = Some Training, 3 = Moderate Training, 4= Strong Training, 5 = Very Strong Training.

Table 6 depicts the quantity of skills and training received in the Electricity construct (*GM = 2.18, SD = 1.08*). The mode of each skill in this construct is representative of the teachers' perception of having no training in Electricity construct skills.

The data summarized in Table 7 shows the teachers' perception of training in Soil and Water skills. Teachers perceived having no training in each skill in this construct (*GM = 1.70, SD = .84*). Table 8 shows the majority of teachers most frequently reported having received no training in all of the skills making up the Power and Machinery construct (*GM = 1.92, SD = .92*). Teachers perceived to have no or some training in small Engine Services—2-cycle (*n* = 27, 31.8%).

Table 6
SBAE Teachers' Perceptions Of The Quantity Of Electricity Skills Training Received At The Postsecondary Level

Skill		None	Some	Moderate	Strong	V.Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Electricity controls	87	**31(35.6)**	29(33.3)	16(18.4)	7(8.0)	4(4.6)
Wiring skills (Switches & Outlets)	89	**28(31.5)**	27(30.3)	16(18.0)	15(16.9)	3 (3.4)
Electrician tools	89	**29(32.6)**	28(31.5)	17(19.1)	12(13.5)	3(3.4)
Types of electrical motors	85	**33(38.8)**	27(31.8)	14(16.5)	8(9.4)	3(3.5)
Cleaning motors	81	**35(43.2)**	22(27.2)	16(19.8)	5(6.2)	3(3.7)
Electrical safety	87	**26(29.9)**	24(27.6)	17(19.5)	9(10.3)	11(12.6)

Note. Item mode is shown in boldface. Construct grand mean = 2.18. Construct SD = 1.08. 1 = No Training, 2 = Some Training, 3 = Moderate Training, 4= Strong Training, 5 = Very Strong Training.

Table 7
SBAE Teachers' Perceptions Of The Quantity Of Soil And Water Skills Training Received At The Postsecondary Level

	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Global positioning systems (GPS)	84	**45(53.6)**	25(29.8)	10(11.9)	2(2.4)	2(2.4)
Use of survey equipment	84	**39(46.4)**	27(32.1)	12(14.3)	2(2.4)	4(4.8)
Differential leveling	77	**47(61.0)**	23(29.9)	3(3.9)	2(2.6)	2(2.6)
Profile leveling	78	**47(60.3)**	23(29.5)	3(3.8)	3(3.8)	2(2.6)
Legal land descriptions	86	**34(39.5)**	25(29.1)	13(15.1)	7(8.1)	7(8.1)

Note. Item mode is shown in boldface. Construct grand mean = 1.70. Construct SD = 0.84. 1 = No Training, 2 = Some Training, 3 = Moderate Training, 4= Strong Training, 5 = Very Strong Training.

Table 8
SBAE Teachers' Perceptions Of The Quantity Of Power And Machinery Skills Training Received At The Postsecondary Level

Skill		None	Some	Moderate	Strong	V.Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Small engine services - 2 Cycle	85	**27(31.8)**	**27(31.8)**	16(18.8)	10(11.8)	5(5.9)
Small engine services - 4 Cycle	86	**26(30.2)**	25(29.1)	16(18.6)	11(12.8)	8(9.3)
Small engine overhaul	86	**28(32.6)**	23(26.7)	14(16.3)	14(16.3)	7(8.1)
Small engine safety	86	**28(32.6)**	26(30.2)	10(11.6)	12(14.0)	10(11.6)

Table 8
SBAE Teachers' Perceptions Of The Quantity Of Power And Machinery Skills Training Received At The Postsecondary Level, Continued…

Tractor service	82	**41(50.0)**	26(31.7)	8(9.8)	5(6.1)	2(2.4)
Tractor maintenance	81	**42(51.9)**	22(27.2)	10(12.3)	4(4.9)	3(3.7)
Tractor overhaul	80	**43(53.8)**	27(33.8)	5(6.3)	3(3.8)	2(2.5)
Tractor selection	79	**42(53.2)**	26(32.9)	5(6.3)	4(5.1)	2(2.5)
Tractor operation	80	**41(51.2)**	27(33.8)	6(7.5)	4(5.0)	2(2.5)
Tractor safety	83	**41(49.4)**	25(30.1)	7(8.4)	7(8.4)	3(3.6)
Tractor driving	81	**43(53.1)**	26(32.1)	5(6.2)	5(6.2)	2(2.5)
Service machinery	80	**39(48.8)**	28(35.0)	8(10.0)	3(3.8)	2(2.5)
Machinery selection	81	**39(48.1)**	24(29.6)	10(12.3)	6(7.4)	2(2.5)
Machinery operation	82	**39(47.6)**	27(32.9)	8(9.8)	6(7.3)	2(2.4)
Power & machinery safety	85	**37(43.5)**	27(31.8)	9(10.6)	7(8.2)	5(5.9)

Note. Item mode is shown in boldface. Construct grand mean = 1.92. Construct SD =.92. 1 = No Training, 2 = Some Training, 3 = Moderate Training, 4= Strong Training, 5 = Very Strong Training.

Conclusions, Recommendations, and Implications

Of the five constructs studied, teachers indicated the highest level of training as reflected by grand mean was 2.36 for Structures and Constructions, while the lowest was in Soil and Water (GM = 1.70). Of all the skills presented, four were perceived by the respondents to have received *Some* or *Moderate* training (Oxy-Acetylene welding, Oxy-Acetylene cutting, SMAW welding, and Two-stroke small gas engines). This population of agricultural education teachers perceived they did not receive training in these agricultural mechanics skills in their preservice training programs, which are skills required of them to teach agricultural mechanics at the secondary level. It can be concluded that the limited amount of instruction in agricultural mechanics at the postsecondary level may have led to inexperienced and underprepared agricultural mechanics instructors, potential safety issues, or an avoidance to include agricultural mechanics instruction in their programs altogether.

Teachers indicated having received strong training in arc welding. Arc welding is often thought of as a common agricultural mechanics skill; therefore, it may have been taught consistently across postsecondary institutions. Shultz et al. (2014) found secondary teachers perceived welding, machinery, and electrical safety to be important skills within agricultural mechanics coursework. Therefore, it was expected skill safety areas would have been consistently taught at the postsecondary level (Shultz et al., 2014); however, item mode scores indicated that the training was virtually nonexistent.

As identified in the Rosencrans and Martin's (1997) CMATE model, a key input for curriculum development includes the development of knowledge and skills related to agricultural technology. As a link in the model, Teacher Preparation and Certification is a critical component in ensuring students are prepared in agriculture technology (Rosencrans & Martin, 1997). Agricultural education teachers perceived preservice instruction in agricultural mechanics to be important, but the preparation they received at the postsecondary level was not adequate for the duties a SBAE position requires (Burris et al., 2005; Saucier & McKim, 2011; Stripling et al., 2014). Much of the learning that takes place in an agricultural mechanics course occurs in a laboratory, requiring educators to be proficient in agricultural mechanics skills (Saucier et al., 2012). These skills should be taught at the postsecondary level in a manner of high quality to ensure preservice teachers are trained in appropriate safety techniques, technologies, and strategies to ensure teacher proficiency and self-efficacy. Proper training has a positive impact on SBAE teachers' positive self-efficacy and its correlational effect on their perceived importance of the agricultural mechanics curriculum (Mills et al., 2019), and further, the development of their students.

We suggest syllabi or course information be collected and compared from required agricultural mechanics-related courses in teacher preparation programs across the nation to determine the gaps in instruction in Iowa teacher preparation programs. Saucier et al. (2012) specifically studied what Missouri agricultural education teachers found of most importance in agricultural mechanics preparation. Iowa inservice teacher needs identified through training gaps identified in this study should inform the development of new course offerings at the postsecondary level. Until an agricultural mechanics curriculum is established and adopted nationwide, it is essential to gain the perspective of local teachers who most recently graduated from Iowa institutions and are preparing students for agricultural mechanics Career Development Events and entry into agricultural mechanics career pathways. This input will initially help guide postsecondary institutions in designing coursework that better meets the needs of the teachers within their state. However, to build upon the findings of this study, we recommend similar studies be conducted in other states to determine what agricultural education teachers perceive as the most important agricultural mechanics skills. This, in turn, may lead to more consistent postsecondary agricultural mechanics course offerings nationwide.

It is apparent agricultural mechanics teachers should seek additional training if they are not receiving adequate preparation to teach agricultural mechanics prior to entrance into the profession. Continued professional development should be based upon the proficiency level of the agricultural education teacher. For those in-service school-based agricultural education teachers, we recommend short training sessions be offered to introduce or refresh SBAE teachers' skills in several of these agricultural mechanics skills. Such training would serve as professional development and could be done in the summer or on weekends throughout the school year. However, it would be most effective if these trainings were taught based on agricultural mechanics constructs where similar skills are taught simultaneously. This may increase the interest from teachers who may perceive they lack the skill development in specific areas. According to McKim and Saucier (2011) "In–service education is necessary to address discrepancies that exist between the teachers' perceived importance of agricultural mechanics laboratory management competencies and their ability to perform the competencies" (p. 84). Such inservice or preservice professional development may be offered by universities, local businesses or National programs such as the Curriculum for Agricultural Science Education courses Agriculture, Power and Technology or Mechanical Systems in Agriculture (Curriculum for Agricultural Science Education, 2020).

Further research would help determine the best avenue for determining the scope of postsecondary agricultural mechanics courses. Further research could explore postsecondary institutions' changes in required agricultural mechanics coursework and the changes in content offered in response to the low levels of self-efficacy to teach agricultural mechanics. An analysis of the time needed to quantify the development SBAE teachers' self-efficacy to be prepared to enter their classroom and laboratory would be appropriate. CMATE considers the importance of curricular reform in Agricultural Mechanics through overt linkages to business and industry career pathways, secondary and postsecondary articulation, connections to other educational programs in the school, as well as linkages to teacher preparation programs, certification and inservice education. By providing agricultural education teachers with an opportunity to increase their skills and training in agricultural mechanics, teacher preparation institutions may increase teachers' self-efficacy in agricultural mechanics related skills. Having the confidence and knowledge to teach agricultural mechanics can also improve the likelihood of safe environments for student learning and provide an investment into student interest for and success in agricultural mechanics prior to entering the workforce. This new-found teacher confidence will become the impetus for success when considering the ever-changing, exponential growth of technological innovations in agriculture. Providing preservice candidates and inservice SBAE teachers with these skills is paramount.

References

Alston, A., Anderson, R., English, C.W., & Wakefield, D. (2018). Employability Skills and Trends in Outdoor Power and Equipment. *Journal of Research in Technical Careers. 2*(1), 22-31. https://doi.org/10.9741/2578-2118.1021

Burris S., Robinson, J. S., & Terry, R. (2005). Preparation of pre-service teachers in agricultural mechanics. *Journal of Agricultural Education, 46*(3), 23-24. https://doi.org/10.5032/jae.2005.03023

Byrd, A. P., Anderson, R. G., Paulsen, T. H., & Schultz, M. J. (2015). Does the number of post-secondary agricultural mechanics courses completed affect teacher competence? *Journal of Agricultural Education*. *56*(1), 20-31. https://doi.org/10.5032/jae.2015.01020

Connors, J. J., & Mundt, J. P. (2001). Characteristics of preservice teachers education programs in agricultural education in the United States. *Proceedings for the 28th Annual National Agricultural Education Research Conference. New Orleans, LA.*

Cooper, E. L. (1992). *Agricultural mechanics fundamentals & applications* (2nd ed.). Albany, NY: Delmar Publishers, Inc.

Curriculum for Agricultural Science Education. (2020). Curriculum for Agricultural Science Education. https://www.case4learning.org/

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update* (4th ed.). Boston, MA: Allyn & Bacon.

Hainline, M. S., & Wells, T. (2019). Identifying the agricultural mechanics knowledge and skills needed by Iowa school-based agricultural education teachers. *Journal of Agricultural Education*, *60*(1), 59-79. https://doi.org/jae.2019.01059

Herren, R.V. (2010). *Agricultural mechanics fundamentals and application.* (6th ed.). Clifton Park, NY: Delmar, Cengage Learning.

Hubert, D. J., & Leising, J. (2000). An assessment of agricultural mechanics course requirements in agriculture teacher education programs in the United States. *Journal of Southern Agricultural Education Research, 50*(1), 24-31.

Hubert, D. J., Ullrich, D., Lindner, J., & Murphy, T. (2003). An examination of Texas agriculture teacher safety attitudes based on a personal belief scale from common safety and health practices. *Journal of Agricultural Systems, Technology and Management, 17,* 1-13.

Iowa Department of Education. (2010). FY10 Iowa High School Agricultural Education contract summary. Retrieved from https://docs.google.com/a/iowa.edu/viewer?a=v&pid=sites&srcid=dGVhbWFnZWQuy29tfHd3d3xneDpmZjI4Mzc4OWViMjM0M2Q

Johnson, D. M., & Schumacher, L. G. (1989). Agricultural mechanic specialists identification and evaluation of agricultural mechanics laboratory management competencies: A modified Delphi approach. *Journal of Agricultural Education, 30*(3), 23-28. https://doi.org/10.5032/jae.1989.03023

King, L. G., McKim, A. J., Raven, M. R. & Pauley, C. (2019). New and emerging technologies: Teacher needs, adoption, methods, and student engagement. *Research paper conference proceedings, American Association for Agricultural Education*, Des Moines, Iowa, May 21-24, 2019.

McKim, B. R., & Saucier, P. R. (2011). Agricultural mechanics laboratory management professional development needs of Wyoming secondary agriculture teachers. *Journal of Agricultural Education, 52*(3), 75-86. https://doi.org/10.5032/jae.2011.03075

Miller, L. E., & Smith, K. L. (1983). Handling nonresponse issues. *Journal of Extension, 21*(5), 45-50. Retrieved from: http://www.joe.org/joe/1983september/83-5-a7.pdf

National FFA Organization. (2016). FFA Statistics. No Author. Retrieved from https://www.ffa.org/about/what-is-ffa/statistics

Parr, B. A., Edwards, M. C., & Leising, J. G. (2008). Does a curriculum integration intervention to improve the mathematics achievement of students diminish their acquisition of technical competence? An experimental study in agricultural mechanics. *Journal of Agricultural Education, 49*(1), 61-71. https://doi.org/10.5032/jae.2008.01061

Phipps, L. J., Osborne, E. W., Dyer, J. E., & Ball, A. (2008). *Handbook on agricultural education in public schools* (6th ed). Clifton Park, NY: Thomson Delmar Learning.

Ramsey, J. W., & Edwards, M. C. (2011). Entry-level technical skills that agricultural industry experts expected students to learn through their supervised agricultural experiences: A modified Delphi study. *Journal of Agricultural Education, 52*(2), 89-94. https://doi.org/10.5032/jae.2011.02082

Rasty, J. R., & Anderson, R. G., (2017). A Cross-sectional Analysis of the Importance of Agricultural Mechanics Skills Taught. *Career and Technical Education Research*, *42*(2), 103-116. https://doi.org/10.5328/cter42.2.103

Roberts, T. G., Harder, A., & Brashears, M. T. (Eds). (2016). *American Association for Agricultural Education national research agenda: 2016-2020*. Gainesville, FL: Department of Agricultural Education and Communication.

Rosencrans, C., & Martin, R. A. (1997). The role of agricultural mechanization in the secondary agricultural education curriculum as viewed by agricultural educators. *Proceedings of the 24th Annual National Agricultural Education Research Meeting. LasVegas, NV.*

Saucier, P. R., & McKim, B. R. (2011). Assessing the learning needs of student teachers in Texas regarding management of the agricultural mechanics laboratory: Implications for the professional development of early career teachers in agricultural education. *Journal of Agricultural Education, 52*(4), 24-43. https://doi.org/10.5032/jae.2011.04024

Saucier, P. R., McKim, B. R., & Tummons, J. D. (2012). A Delphi approach to the preparation of early-career agricultural educators in the curriculum area of agricultural mechanics: Fully qualified and highly motivated or status quo? *Journal of Agricultural Education, 53*(1), 136-149. https://doi.org/10.5032/jae.2012.01136

Shultz, M. J., Anderson, R. G., Shultz, A. M., & Paulsen, T. H. (2014). Importance and capability of teaching agricultural mechanics as perceived by secondary agricultural educators. *Journal of Agricultural Education, 55*(2), 48-65. https://doi.org/10.5032/jae.2014.02048

Stripling, C. T., Thoron, A. C., & Estepp, C. M. (2014). Learning activities utilized and readiness for the student teaching internship. *Journal of Agricultural Education, 55*(4), 148-161. https://doi.org/10.5032/jae.2014.04148

Wells, T., Perry, D. K., Anderson, R. G., Shultz, M. J., & Paulsen, T. H. (2013). Does prior experience in secondary agricultural mechanics affect pre-service agricultural education teachers' intentions to enroll in post-secondary agricultural mechanics coursework? *Journal of Agricultural Education, 54*(4), 222-237. https://doi.org/10.5032/jae.2013.04