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Teacher-perceived Adequacy of Tools and Equipment Available to Teach Agricultural Mechanics

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Abstract

Agricultural mechanics is an important component of a well-rounded school-based agricultural education (SBAE) program. Within agricultural mechanics courses lies a plethora of topics and skills to be covered. Adequate tools and equipment are vital in preparing students to fill an expanding, 21st century workforce. The issue of inadequate teaching materials has been well documented throughout the entire educational system, and such inadequacies may leave gaps in students' ability to become proficient within agricultural mechanics. A paper-based questionnaire was distributed to all teachers in attendance at the Iowa teachers' conference. This descriptive study sought to identify teacher-perceived adequacy of available tools and equipment to teach agricultural mechanics in Iowa. The researchers found that many agricultural education teachers in Iowa are ill-equipped to teach many concepts within agricultural mechanics due to a reported lack of adequate tools and equipment. Agricultural education teachers in SBAE programs should ensure adequate tools and equipment to meet curricular and industry standards. It is recommended to examine purchasing decisions of tools for inclusion in the agricultural mechanics laboratory as well.

Keywords: agricultural mechanics, tools, equipment, adequacy, laboratory

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Introduction

Ineffective teachers, because of a lack of appropriate training (Darling-Hammond, 2000), and the scantiness of adequate teaching materials can be detrimental to the educational process (Darling-Hammond, 2007). The inadequacy of available instructional materials can be a major concern for educational stakeholders and may stem from numerous factors. In agricultural education, such factors could include: 1) lack of funding (Saucier, Vincent & Anderson, 2011), 2) outdated materials (Saucier, Terry, & Schumacher, 2009), 3) lack of adequate training (McKim & Saucier, 2011), and 4) lack of perceived importance (Shultz, Anderson, Shultz, & Paulsen, 2014). An insufficient supply and poor quality of instructional materials can create significant obstacles as teachers attempt to help students meet state-mandated content standards, pass examinations required for grade-to-grade promotion and high school graduation, and qualify for competitive opportunities in college and the workforce (Oaks & Saunders, 2002).

Educators often face additional challenges when lacking adequate teaching materials, and with ever-changing standards and initiatives such as the No Child Left Behind Act (NCLB) (2002) the challenges become arduous. Ramsey-Gassert, Shroyer, and Staver (1996) studied internal (i.e.,

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within immediate control of the participant) and external (i.e., beyond immediate control of the participant) factors related to teaching self-efficacy and found resource availability as a determining factor. Teaching agricultural mechanics with inadequate resources may have the same result for secondary agricultural education teachers. Doerfert (2011) indicated that agricultural education teachers, in order to provide high-quality instruction, must have access to adequate resources. Agricultural education teachers often face many challenges in acquiring the proper tools for superior laboratory instruction (Phipps, Osborne, Dyer, & Ball, 2008). In response to this challenge, a concern regarding how Iowa agricultural education teachers perceive the adequacy of the tools and equipment in their agricultural mechanics facilities has arisen.

Niemann (1970) indicated that equipment and facilities were major areas of dissatisfaction of English elementary and secondary educators. Phipps et al. (2008) noted the same principles hold true in secondary agricultural education. Phipps et al. (2008) further posited that the primary goal of agricultural mechanics education is the development of skills necessary to perform mechanical activities within agriculture. High-quality learning experiences are necessary for students to reach their full potential with curriculum integrated in the agricultural mechanics laboratory (Wells, Perry, Anderson, Shultz, & Paulsen, 2013). Without adequate teaching materials, students are limited in their ability to master related skills, and the quality of instructional activities may also be hindered.

Lankford and Mims (1995) found that 47% of elementary art teachers felt that funding available for teaching resources was "very modest–needs to be larger" (p. 87). One respondent from the study stated, "… I use my own money to buy these things because they're important to me." (p. 88-89). The effects of inadequate resources are numerous and are not limited to elementary schools. The lack of resources has also been documented in medical schools in Australia (Crotty, 2005). The potential for low student achievement due to a lack of resources, particularly in the medical field, is unsettling. Crotty (2005) determined that Australia needed more medical graduates because of a workforce shortage, but pointed out that there are not enough clinical hospitals, or patients in the hospitals for all the medical students to be adequately trained. These medical students are required to complete training, but do not have adequate training programs or resources to do so. In agricultural education programs, funding concerns can negatively influence student achievement (Martin, Fritzsche, & Ball, 2006). Student achievement levels falter when "good teaching, a strong curriculum, and adequate resources" (Darling-Hammond, 2007, p. 258) are absent from the educational setting.

Connors and Mundt (1999) investigated the challenges and problems teachers faced early in their career. They found that the vast majority of agricultural education teachers (80.9%) classified obtaining and inventorying teaching materials, shop tools, and equipment as "important/ very important" to their position. Not only are adequate tools and equipment vital in effectively teaching a topic, the resulting competency and skills are important for employability within the agricultural industry (Slusher, Robinson, & Edwards, 2011).

Access to adequate teaching material can impact student learning opportunities as well as affect teacher self-efficacy. Researchers often ask teachers to rate their own efficacy in an attempt to understand their beliefs about specific topics (e.g., self-efficacy, motivations, etc.). Tschannen-Moran and Woolfolk Hoy (2002) found that adequate availability of teaching resources positively affects teacher efficacy. This issue becomes especially important in regards to retaining highly qualified teachers in the classroom (Darling-Hammond, 2007).

When considering laboratory supplies specific to agricultural mechanics instruction, McKim and Saucier (2013) found that acquiring teaching resources has been impeded by budgetary restrictions. Specifically, consumable supply budgets in the agricultural mechanics laboratory did not keep up with the rate of inflation over a 20-year period (McKim & Saucier, 2013). Therefore teachers have typically been expected to do more with less. Research in agricultural education has reported a need for increased funding for school-based agricultural education (SBAE) programs (Connors, 1998). In order to meet national standards and adhere to educational policy requirements such as NCLB (2002), focus should be placed upon ensuring that educators are qualified and that they have access to adequate teaching materials and resources (Darling-Hammond, 2007). Are secondary agricultural education programs adequately equipped to teach the plethora of topics and skills needed in the agricultural mechanics laboratory?

Theoretical Framework

Bandura's theory of self-efficacy guided this research. Bandura (1997) defined self-efficacy as "…beliefs in one's capabilities to organize and execute the course of action required to produce given attainments" (p. 3). Self-doubt can hinder an individual's performance, while a sense of high self-efficacy can lead to improved performance guided by positive thoughts (Bandura, 1993). Bandura (1993) stated that some individuals "…regard ability as an acquirable skill that can be increased by gaining knowledge and competencies" (p. 120). Self-efficacy is heavily influenced by the perceived "modifiability of the environment" (Bandura, 1993, p. 125); an individual will exert effort dependent upon the amount of the environment that can be modified.

We operationalized this concept as the ability to adequately and properly teach agricultural mechanics in a secondary education environment, perhaps the most hands-on content area within SBAE (Phipps et al., 2008; Wells et al., 2013). Bandura (1997) further stated that personal influence on self-efficacy can stem from environmental factors (i.e., tools and equipment available for use in an agricultural mechanics laboratory). Without the availability of adequate tools and equipment to teach agricultural mechanics concepts, teachers may feel less efficacious in the content area. Due to this, a loss of confidence in teaching the subject matter may occur, possibly influencing teachers to reduce or ignore instruction in agricultural mechanics, thereby inhibiting students' exposure to this popular curriculum area (Wells et al., 2013). Interestingly, this potential chain of events could be the simple result of lacking the tools and equipment necessary to successfully teach in the content area.

Problem Statement & Research Objectives

Doerfert (2011) stated that, "[a]ddressing our societal and industry challenges will require a diverse workforce that includes scientists and professionals with knowledge and skill beyond today's standards" (p. 19). Agricultural education teachers must be able to supply our society with a portion of the needed professional workforce. Supplying the necessary human capital remains a difficult task without adequate tools and materials to teach agricultural mechanics courses. Doerfert (2011) posited that "highly effective educational programs will meet the academic, career, and development needs of diverse learners in all settings and at all levels" (p. 25) as a key outcome for Priority Area 5. Doerfert also points out the difficulty in maintaining up-to-date curriculum as the technological advancements within agriculture happen so quickly. With that in mind, keeping current agricultural mechanics tools and equipment up-to-date may prove challenging for agricultural education teachers. As a result of these acknowledgements, the need to understand agricultural education teachers' perceptions regarding adequate tools and equipment to teach current concepts within agricultural mechanics is paramount, grounded within the confines of Bandura's theory of self-efficacy (1997). Additionally, this study aligns with the National Research Agenda (NRA) priority area "Sufficient Scientific and Professional Workforce that Addresses the Challenges of the 21st Century" (Doerfert, 2011, p. 18). As agricultural mechanics content helps to prepare the agricultural industry workforce (Slusher et al., 2011), adequate tools and equipment are required to train a well-prepared and competent workforce that will be prepared for the problems of the future.

The purpose of this study was to determine the adequacy of tools and equipment used within high school agricultural mechanics laboratories as perceived by agricultural education teachers in Iowa. The following objectives were identified to fulfill the purpose of this study:

1. Describe the adequacy level of tools and equipment available to teach Mechanics skills.
2. Describe the adequacy level of tools and equipment available to teach Structures/ Construction skills.
3. Describe the adequacy level of tools and equipment available to teach Electrical skills.
4. Describe the adequacy level of tools and equipment available to teach Soil and Water skills.
5. Describe the adequacy level of tools and equipment available to teach Power and Machinery skills.

Methodology

This descriptive study, which was part of a larger study in agricultural mechanics education, employed survey research methods. According to Ary, Jacobs, Razavieh, and Sorensen (2006), survey research methods can be used to summarize characteristics, attitudes, and opinions, which can then be utilized to accurately describe a norm. A researcher-modified, paper-based questionnaire was used to address the objectives of the study. The instrument contained three sections. Section one included 54 agricultural mechanics skills representing five constructs: Mechanic Skills, Structures/Construction, Electrical, Power and Machinery, and Soil and Water Skills. A five-point summated rating scale was used for respondents to report their perceived level of adequacy of tools and equipment available to teach selected skills in their secondary agricultural mechanics courses. Section two consisted of 15 demographic questions relating to the teacher (e.g., number of years teaching, highest level of education, and grade levels taught), and section three included nine questions about program and school characteristics (e.g., laboratory size, consumables budget, number of teachers, and scheduling system utilized).

A team of five university faculty members, with expertise in agricultural mechanics and/ or agricultural education, was utilized to establish content and face validity. Following the recommendations of Dillman, Smyth, and Christian (2009), the initial electronic version of the instrument was pretested through a pilot study of 12 agricultural education teachers in a neighboring state. Suggestions from this pilot study led researchers to adopt a paper-based instrument rather than an electronic instrument. Reliability coefficients for tool adequacy in each construct were calculated as follows: Mechanic Skills (α=.953), Structures/Construction (α=.956), Electrical (α=.956), Power and Machinery (α=.970), and Soil and Water Skills (α=.898). Based on George and Mallery's (2003) suggestions, the Mechanic Skills, Structures/Construction, Electrical, and Power and Machinery constructs were rated as *Excellent*. The Soil and Water Skills construct was rated as *Good*.

Data were collected during the 2011 Iowa agricultural education teachers' conference. This population was purposefully targeted because of the convenience to the researchers, and the likelihood of the participants to be involved in additional professional development activities such as technical training workshops (attendance is not mandatory at the Iowa agricultural education teachers' conference). Researchers distributed a questionnaire to each secondary instructor (N = 130) in attendance and asked that it be completed by the final day of the conference. Safety curriculum from the Power Tool Institute was offered as an incentive for completing and returning the questionnaire. These efforts yielded 103 usable instruments for a 79.2% response rate. The researchers did not track the number of participants that declined to participate in the study because they did not teach agricultural mechanics due to multiple researchers distributing and collecting questionnaires. Nor was additional effort made by the researchers to obtain data from nonrespondents. As a result, non-response error was addressed following the suggestions of Miller and Smith (1983) by comparing respondents' personal and program demographic data to school and program data from the Iowa Department of Education (2010). No significant differences *($p > .05$)* for gender, age, highest degrees held, years of teaching experience, or size of school community between respondents and the general population of agricultural education teachers in Iowa were found in the Pearson's χ^2 analysis. Data were coded and analyzed using PASW Statistics 18. Descriptive statistics (frequencies, percentages, and grand means) were calculated for each of the five constructs. Findings resulting from this study should be interpreted with care and not generalized beyond the target population due to the purposefully selected sample. However, information gleaned in this study will add to the breadth of knowledge in agricultural mechanics.

Results

The typical respondent for this study was a male teacher (*f* = 69, 67.0%), held a Bachelor's degree (*f* = 64, 62.1%), had five or less years of teaching experience (*f* = 32, 31.1%), was in a single teacher department (*f* = 91, 90.0%) and taught in a rural school district (*f* = 80, 79.2%).

Describing the adequacy of selected agricultural mechanics tools and equipment as perceived by secondary agricultural education teachers was the purpose of this study. Fifty-four skills were separated into five constructs. These constructs included Mechanic Skills, Structures/Construction, Electrical, Power and Machinery, and Soil and Water. Individual items represented specific skills within the constructs and were rated in terms of adequacy on the following five-point summated adequacy scale: as *not at all, somewhat, moderate, strong, and very strong.* Table 1 displays the grand means and standard deviations for each construct.

Table 1

Agricultural mechanics skill area adequacy grand means and standard deviations by construct

Construct	*M*	*SD*
Soil and Water	2.07	0.98
Power and Machinery	2.20	0.96
Electrical	2.33	1.16
Mechanic Skills	2.42	1.07
Structures/Construction	3.07	1.03

Note. 1 = Not at All, 2 = Somewhat, 3 = Moderate, 4 = Strong, 5 = Very Strong.

Table 2 displays the perceived level of adequacy of tools and equipment available to teach soil and water skills as reported by Iowa secondary agricultural education teachers. In regards to tools in the soil and water construct, teachers reported them as only being somewhat adequate (*GM* = 2.07, *SD* = 0.98). However, when considering each individual item, the mode of each skill was rated not at all adequate.

Table 2

Agricultural Education Teachers' Perceived Adequacy of Available Tools to Teach Soil and Water Skills

		Not at All	Somewhat	Moderate	Strong	Very Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Profile Leveling	75	**40(53.3)**	18(24.0)	11(14.7)	5(6.7)	1(1.3)
Differential Leveling	76	**39(51.3)**	19(25.0)	10(13.2)	7(9.2)	1(1.3)
Use of Survey Equipment	84	**38(45.2)**	15(17.9)	14(16.7)	14(16.7)	3(3.6)
Global Positioning Systems (GPS)	85	**31(36.5)**	20(23.5)	17(20.0)	14(16.5)	3(3.5)
Legal Land Descriptions	88	**21(23.9)**	19(21.6)	19(21.6)	16(18.2)	13(14.8)

Note. Construct grand mean = 2.07. Construct SD = 0.98. Bold indicates highest mode per skill. 1 = Not at All, 2 = Somewhat, 3 = Moderate, 4 = Strong, 5 = Very Strong.

Perceived level of adequacy of tools and equipment available to teach each skill within the Power and Machinery construct is displayed in Table 3. Similar to the Soils and Water construct, teachers perceived the adequacy of tools and equipment available to teach Power and Machinery skills as *somewhat* adequate (GM = 2.19, SD = 0.95). Fourteen of the 15 individual skills were rated *not at all* adequate. Small Engine Safety was the only skill that where the mode was rated above the *not at all* adequate indicator. It was considered to have *strong* adequacy by participants (f = 21, 24.7%).

Table 3

Agricultural Education Teachers' Perceived Adequacy of Available Tools to Teach Power and Machinery Skills

		Not at All	Somewhat	Moderate	Strong	Very Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Tractor Overhaul	81	**37(45.7)**	19(23.5)	19(23.5)	5(6.2)	1(1.2)
Tractor Driving	82	**36(43.9)**	21(25.6)	15(18.3)	8(9.8)	2(2.4)
Tractor Selection	79	**35(44.3)**	21(26.6)	16(20.3)	7(8.9)	0(.0)
Tractor Operation	81	**35(43.2)**	20(24.7)	16(19.8)	10(12.3)	0(.0)
Tractor Maintenance	82	**34(41.5)**	18(22.0)	21(25.6)	7(8.5)	2(2.4)
Tractor Safety	83	**34(41.0)**	15(18.1)	20(24.1)	10(12.0)	4(4.8)
Service Machinery	82	**33(40.2)**	17(20.7)	21(25.6)	10(12.2)	1(1.2)
Machinery Selection	81	**32(39.5)**	20(24.7)	17(21.0)	12(14.8)	0(.0)
Machinery Operation	83	**32(38.6)**	21(25.3)	18(21.7)	11(13.3)	1(1.2)
Tractor Service	83	**32(38.6)**	19(22.9)	22(26.5)	7(8.4)	3(3.6)
Power and Machinery Safety	85	**30(35.3)**	14(16.5)	19(22.4)	16(18.8)	6(7.1)
Small Engine Services - 2 Cycle	86	**24(27.9)**	18(20.9)	22(25.6)	17(19.8)	5(5.8)
Small Engine Overhaul	83	**22(26.5)**	17(20.5)	19(22.9)	20(24.1)	5(6.0)
Small Engine Services - 4 Cycle	85	**21(24.7)**	18(21.2)	20(23.5)	20(23.5)	6(7.1)
Small Engine Safety	85	20(23.5)	15(17.6)	17(20.0)	**21(24.7)**	12(14.1)

Note. Construct grand mean = 2.20. Construct SD = 0.95. Bold indicates highest mode per skill. 1 = Not at All, 2 = Somewhat, 3 = Moderate, 4 = Strong, 5 = Very Strong

Teachers in Iowa also reported the overall adequacy of available tools for instruction in the Electrical construct as somewhat adequate (*GM* = 2.33, *SD* = 1.16). When considering items individually, the adequacy of tools available to teach each of the skills was rated as *not at all adequate*. Reported ratings by teachers concerning the adequacy of tools available to teach Electrical skills are displayed in Table 4.

Table 4

Agricultural Education Teachers' Perceived Adequacy of Available Tools to Teach Electrical Skills

		Not at All	Somewhat	Moderate	Strong	Very Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Cleaning Motors	78	**37(47.4)**	18(23.1)	15(19.2)	7(9.0)	1(1.3)
Types of Electrical Motors	82	**35(42.7)**	19(23.2)	18(22.0)	9(11.0)	1(1.2)
Electricity Controls	85	**29(34.1)**	18(21.2)	22(25.9)	13(15.3)	3(3.5)
Electrician Tools	87	**27(31.0)**	16(18.4)	20(23.0)	15(17.2)	9(10.3)
Electrical Safety	84	**26(31.0)**	14(16.7)	15(17.9)	16(19.0)	13(15.5)
Wiring Skills (Switches & Outlets)	87	**25(28.7)**	16(18.4)	20(23.0)	17(19.5)	9(10.3)

Note. Construct grand mean = 2.41. Construct SD = 1.06. Bold indicates highest mode per skill. 1 = Not at All, 2 = Somewhat, 3 = Moderate, 4 = Strong, 5 = Very Strong

The tools available to teach skills identified in the Mechanics construct were rated as *somewhat adequate* (*GM* = 2.42, *SD=1.07)*. Teachers reported having *strongly adequate* tools to aid them in teaching oxy-acetylene cutting (*f* = 28, 29.8%), welding safety (*f* = 29, 31.2%), and arc welding (*f* = 25, 26.6%); while tools for 11 of the 19 skills were reported as *not at all adequate*. Computer aided design (*f* = 42, 53.8%) and fencing (*f* = 42, 52.5%) had the highest reported inadequacy of tools available. Frequencies and percentages for each skill within the Mechanic skills construct are displayed in Table 5.

Table 5

Agricultural Education Teachers' Perceived Adequacy of Available Tools to Teach Mechanic Skills

		Not at All	Somewhat	Moderate	Strong	Very Strong
	n	*f*(%)	*f*(%)	*f*(%)	*f*(%)	*f*(%)
Computer Aided Design	78	**42(53.8)**	10(12.8)	16(20.5)	5(6.4)	5(6.4)
Fencing	80	**42(52.5)**	16(20.0)	15(18.8)	6(7.5)	1(1.3)
Oxy-propylene Cutting	80	**40(50.0)**	12(15.0)	15(18.8)	1215.0	1(1.3)
Pipe Cut. And Threading	79	**36(45.6)**	17(21.5)	15(19.0)	9(11.4)	2(2.5)
Plumbing	82	**34(41.5)**	20(24.4)	20(24.4)	6(7.3)	2(2.4)
GTAW Welding (TIG)	83	**34(41.0)**	14(16.9)	15(18.1)	8(9.6)	12(14.5)
Hot Metal Work	82	**30(36.6)**	26(31.7)	16(19.5)	8(9.8)	2(2.4)
Cold Metal Work	82	**30(36.6)**	21(25.6)	20(24.4)	10(12.2)	1(1.2)
Metallurgy & Metal Work	82	**27(32.9)**	22(26.8)	21(25.6)	8(9.8)	4(4.9)
Tool Conditioning	82	**25(30.5)**	22(26.8)	23(28.0)	10(12.2)	2 (2.4)
Mechanical Safety	85	**23(27.1)**	14(16.5)	20(23.5)	18(21.2)	10(11.8)
Soldering	86	25(29.1)	**26(30.2)**	19(22.1)	12(14.0)	4(4.7)
Plasma Cutting	88	21(23.9)	9(10.2)	**25(28.4)**	17(19.3)	16(18.2)
GMAW Welding (MIG)	91	12(13.2)	17(18.7)	**22(24.2)**	20(22.0)	20(22.0)
Oxy-acetylene Welding	93	12(12.9)	17(18.3)	**28(30.1)**	23(24.7)	13(14.0)
Oxy-acetylene Cutting	94	8(8.5)	16(17.0)	26(27.7)	**28(29.8)**	16(17.0)
Welding Safety	93	7(7.5)	8(8.6)	22(23.7)	**29(31.2)**	27(29.0)
Oxy-acetylene Brazing	89	21(23.6)	14(15.7)	20(22.5)	**25(28.1)**	9(10.1)
SMAW Welding (ARC)	94	7(7.4)	16(17.0)	23(24.5)	**25(26.6)**	23(24.5)

Note. Construct grand mean = 2.41. Construct SD = 1.06. Bold indicates highest mode per skill. 1 = Not at All, 2 = Somewhat, 3 = Moderate, 4 = Strong, 5 = Very Strong

Table 6 displays Iowa secondary agricultural education teachers' perceived level of adequacy of available tools in the Structure and Construction skills construct area as *moderately adequate* (GM = 3.07, SD = 1.03). This is the only construct area in which respondents identified tools as having a *moderate* level of adequacy as measured by the overall tools available to teach the skills identified. Of the nine specific skills within the Structure and Construction construct area, the highest mode for three skills occurred in the *moderate adequacy* category and the remaining six skills were nestled in the *strongly adequate* category.

Table 6

Agricultural Education Teachers' Perceived Adequacy of Available Tools to Teach Structure and Construction Skills

		Not at All	Somewhat	Moderate	Strong	Very Strong
	N	*f*(%)	*f*(%)	*f* (%)	*f*(%)	*f*(%)
Fasteners	84	16(18.8)	13(15.3)	**29(34.1)**	22(25.9)	4(4.7)
Concrete	84	17(20.2)	19(22.6)	**23(27.4)**	21(25)	4(4.8)
Drawing and Sketching	83	15(18.1)	19(22.9)	**24(28.9)**	19(22.9)	6(7.2)
Construction Skills (Carpentry)	87	14(16.1)	11(12.6)	20(23.0)	**33(37.9)**	9(10.3)
Selection of Materials	86	12(14)	13(15.1)	26(30.2)	**32(37.2)**	3(3.5)
Bill of Materials	88	12(13.6)	10(11.4)	21(23.9)	**33(37.5)**	12(13.6)
Construction & Shop Safety	89	11(12.4)	7(7.9)	18(20.2)	**34(38.2)**	19(21.3)
Wood Working Hand Tools	90	8(8.9)	13(14.4)	23(25.6)	**30(33.3)**	16(17.8)
Wood Working Power Tools	89	8(8.9)	11(12.4)	22(24.7)	**31(34.8)**	17(19.1)

Note. Construct grand mean = 3.06. Construct SD = 1.03. Bold indicates highest mode per skill.
1 = Not at All, 2 = Somewhat, 3 = Moderate, 4 = Strong, 5 = Very Strong.

Conclusions, Implications, & Recommendations

Based on the findings of this study, it can be concluded that agricultural mechanics laboratories in Iowa are poorly equipped to teach many skill areas within agricultural mechanics. Respondents indicated four of the five construct areas had only *somewhat adequate* tools available to teach skills. In terms of having the tools and equipment with which to teach a specific skill, the findings of the present study indicate that agricultural education teachers in Iowa were most equipped to teach welding safety compared to all other skills within agricultural mechanics. It is reassuring that safety has been addressed, but this finding is of great concern to teacher educators in Iowa, as many agricultural education teachers may not, due to a reported lack of adequate tools, be equipped to teach the breadth of topics within the broad content area of agricultural mechanics. Inadequate resources in the classroom can severely hinder learning for students (Darling-Hammond, 2007). As basic agricultural mechanics competence is important to prospective agricultural industry employers (Slusher et al. 2011), it is important that agricultural education teachers be adequately equipped to teach a wide range of mechanics-related topics.

Another interesting takeaway is the reported lack of adequate tools to teach skills relating to technology (i.e., GPS, surveying, computer aided design, electrical motors, etc.). For example, the researchers noted that 60% of teachers reported available tools needed for instruction in GPS technologies were *somewhat* (f = 20, 23.5%) or *not at all* (f = 31, 36.5%) adequate. Yet at the same time, agricultural education teachers in Iowa found these same skills very important for inclusion in the agricultural mechanics curriculum (Shultz et al., 2014). Several other technology-related skills included tools that were rated at a low level of adequacy (i.e., *somewhat* or *not at all adequate*). This seems counterintuitive and undermines the philosophy that secondary agricultural education must be preparing students to work with a wide variety of technologies used in industry (Doerfert, 2011). Is more in-service training regarding technology usage in agriculture still desired or warranted, particularly as it applies to instruction in the area of agricultural mechanics, or is obtaining teaching materials and equipment still a concern for teachers (Connors, 1998; Connors & Mundt, 1999)? Doerfert (2011) noted that agricultural technology is in a constant state of change, and teachers must be adequately equipped to properly educate students in this dynamic, ever-changing field. Furthermore, the demand for high-skill, high-wage workers drives the need to fill positions with knowledgeable and skilled candidates (Slusher, Robinson, & Edwards, 2011). Agricultural education teachers not teaching specific skills or subjects with the construct areas considered in this study could also explain the lack of adequate tools. In turn, the lack of adequate teaching materials as well as the absence of selected content areas can fundamentally undercut high-quality agricultural education. Teacher-perceived self-efficacy to teach specific skills may also be a factor in the respondents' reported adequacy of available tools.

From the perspective of Bandura's theory of self-efficacy (1997), it was interesting to view the areas of agricultural mechanics in which low levels of adequate tools and equipment were reported (e.g., profile leveling, computer aided design, etc.), as this may also be the areas wherein teachers may have the least self-efficacy. Free CAD software is readily available, which led the researchers to conclude that it may be difficult for teachers to gain access to computers. It could also revolve around teacher's lack of training in CAD, and other technology-rich skill areas, that may lead to avoidance of teaching a skill area. It may have also been easier for respondents to report not having adequate tools if no effort is exerted to acquire proper tools and equipment. In turn, there exists the possibility that these tools and equipment have not been procured or maintained by teachers due to a lack of self-efficacy, interest, desire, or ability to instruct in the relevant content areas. This would support Bandura's (1993) explanation on the development of self-efficacy via perceived level of environmental modifiability. It stands to reason that if a teacher has limited or nonexistent self-efficacy in a selected area of instruction, then he or she may decline to offer instruction in that particular area. Predictably, the pursuit of tools and equipment necessary to teach that content will be minimized when compared to content in which a teacher's self-efficacy, interest, desire, or ability to teach are high. However, as Wells et al. (2013) illustrated, instructional choices can hold implications for future teachers as well, especially when considering the possibility that the forthcoming generation of teachers may draw their content choices upon personal and professional interests and past experiences in SBAE.

Regarding these conclusions, could the reported tool inadequacies identified by the respondents in this study reflect upon their beliefs regarding the importance of these topics for inclusion in the agricultural mechanics curriculum? Shultz et al. (2014) compiled a listing of selected agricultural mechanics topics that detailed agricultural education teachers' perceptions of importance to teach within SBAE programs. It is interesting to note that many of the topics within the present study that held lower levels of tool adequacy also held lower levels of importance within Shultz et al.'s (2014) study. Alternatively; items reported as having high importance were reported in the present study as having higher levels of adequate tools. This finding seems to suggest the possibility that secondary agricultural education teachers may have ensured tools were available for topics that they perceived to be important. A full comparative analysis would be beneficial, but is beyond the scope of the present study. Lamentably, the findings from this study led to more questions than answers, yet provide a foundation for future research in agricultural mechanics instruction.

An additional question should be considered: Does tool adequacy reflect upon teachers' course content selections? Attention should be drawn to the content areas of electrical skills, power and machinery skills, and soil and water skills. As described in the present study, it appeared that the agricultural education teachers often expressed that the available tools to teach the skills within the aforementioned content areas were *not at all adequate*. Could this be an indication of a perception by teachers that instruction in these specific areas is not needed or warranted? The possibility does exist that the tools receiving a lower adequacy rating (i.e., *not at all* or *somewhat adequate*) correlate to skill areas that may be taught in industrial technology programs. Thus, this could be a limitation of the present study. It is conceivable, and should be noted, that the lack of inclusion of these topics within secondary agricultural education programs may lead to a diminishing role of agricultural mechanics instruction in Iowa, ultimately costing valuable industry-based instruction and exposure.

Future research in agricultural mechanics instruction should seek to build upon the current body of research in regard to agricultural education teachers' curriculum choices, tool selection and availability, and tool and equipment adequacy based on industry standards. In considering the observations listed previously, it is recommended that research should also examine the perceptions of teacher's tool selection criteria. Research shows that secondary agriculture teachers feel obtaining and inventorying teaching materials, shop tools, and equipment is of paramount importance (Connors & Mundt, 1999) but no relevant research has explored tool selection criteria. This could provide further insight on why specific tools are selected over others, or not selected at all. Could the tool selection choice be based upon offerings in other areas of the school (i.e., industrial technology)?

Examining the quality of agricultural mechanics instruction received at the post-secondary level as it relates to tool adequacy is also recommended. More specifically, the possibility does exist that a lack of quality post-secondary agricultural mechanics instruction could compromise the quality of agricultural mechanics instruction offered at the secondary level. This could potentially influence the type, quality, and quantity of tools selected for inclusion in secondary agriculture programs. Secondary agricultural education teachers should strive to provide quality instruction with the use of quality teaching resources (Darling-Hammond, 2007) in the overall program, and specifically in the agricultural mechanics laboratory.

It may be of interest for researchers to explore purchasing decisions within school-based agricultural education programs. Where are they purchasing the tools? Are they coming from the local hardware store, the big box stores, direct from industry or through the tool catalog companies? Do agricultural education teachers purchase high-quality tools (i.e., commercial/industrial grade) or lower quality tools (i.e., residential grade)? With the lack of agricultural mechanics coursework completed at the university level do they even know that there is a difference in the quality of tools available? Do the teachers know where to purchase industrial grade equipment and tools that will hold up to the wear and tear of frequent usage? Essentially, are the agricultural education teachers getting the most tool for their dollar? The decision (intentionally or unknowingly) to save money by purchasing residential grade tools and equipment could cost a SBAE programs more money in the long run and lead to a decrease in tools available to use.

Additional research concerning the age and condition of available tools may also provide insight on the disparity of tool adequacy among the agricultural mechanics domains. It is further recommended that secondary agricultural education teachers work to ensure that agricultural mechanics facilities are adequately stocked with tools appropriate for both curricular and industry demands. Do agricultural education teachers seek out industry donations for equipment and consumables to stretch their already diminished budget (McKim & Saucier, 2013)? Are the teachers asking for educational discounts for the tools and equipment that they purchase? An examination on the use of the agricultural mechanics laboratory is recommended, specifically looking if the program is self-sustaining or money generation operation. If programs lack many of the tools of the trade, how can optimum education occur in the wide range of mechanics-based career areas (i.e., agriculture)? Further, what effects could the lack of adequate tool supplies have on the quality of the overall agricultural education program? Research that addresses whether specific topics (i.e., welding) are taught within the agricultural education curricula or in another department within the school (i.e., industrial technology) would also greatly benefit the agricultural mechanics research body.

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