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# How the Quantity of Agricultural Mechanics Training Received at the Secondary Level Impact Teacher Perceived Importance of Agricultural Mechanics Skills

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**Abstract**

*Preservice teacher candidates in agricultural education have expressed concerns with teaching agricultural mechanics content yet the number of required courses in agricultural mechanics has dwindled. To determine the root of current teachers' perceptions, it is important to look at the developmental experiences that have led to those perceptions. The theory of social development and knowing that knowledge influences beliefs provided a foundation to describe the relationship between the Iowa agricultural education teachers' perceived level of importance to teach selected agricultural mechanics skills and the quantity of agricultural mechanics training received as a secondary student. Data was collected during the Iowa agricultural education teachers' conference. Thirty-two of the 54 selected agricultural mechanics skills exhibited a significant, positive correlation between the teachers' viewed importance of teaching those skills and the amount of secondary training they received in those skill areas. Experience at the secondary level has an impact on content teachers view as important and post-secondary teacher educators and industry should continue to help beginning teachers receive additional training and support in agricultural mechanics. Additional research should be conducted to determine the factors, in addition to the quantity of secondary training received, which influence teachers' perceived importance to teach agricultural mechanics skills.*

**Keywords:** teacher education, agricultural education, teacher preparation

## Introduction

With a national push towards increased science, mathematics, engineering, and technology education in secondary schools, agricultural education programs have been manifested as a source of meaningful STEM integration (Ricketts, Duncan, & Peake, 2006). Within agricultural education, the content area of agricultural mechanics serves as an opportunity for students to engage in hands-on, meaningful experiences related to all four areas that comprise STEM education—Science, Technology, Engineering, and Mathematics (Shultz, Anderson, Shultz, & Paulsen, 2014). Secondary agricultural mechanics courses in the United States have become increasingly popular among students over the past few years (Anderson, Velez, & Anderson, 2011). Among secondary agricultural education programs, agricultural mechanics has been shown to be one of the most commonly taught areas of the curriculum (Herren, 2014). Specifically, Rudolphi and Retallick (2011) found some form of agricultural mechanics content had been taught by nearly 90% of agricultural educators in Iowa. In Missouri, agricultural education teachers dedicated an average of

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more than 11 hours per week to agricultural mechanics coursework (McKim & Saucier, 2013). With the popularity of agricultural mechanics comes the task of determining skills to teach within those courses. Secondary agricultural education programs in Iowa have local control affording teachers the ability to develop curriculum based on student and community needs (Iowa Department of Education, 2011). When considering curriculum development issues several factors influence agricultural mechanics instructor's decisions to determine the curricula to be taught in their program.

Despite the increase in popularity of agricultural mechanics at the secondary level, the teaching of agricultural mechanics courses required in preservice teacher training institutions has been on the decline, requiring additional in-service training (Burris, Robinson, & Terry, 2005). Wells, Perry, Anderson, Shultz, and Paulsen (2013) reported 54 mechanics skills agricultural education teachers deemed appropriate for secondary agricultural mechanics courses—highlighting the broad perspective of secondary agricultural mechanics. Teachers are not always adequately prepared or comfortable teaching agricultural education courses a community perceives as important (Shelley-Tolbert, Conroy, & Dailey, 2000). Agricultural mechanics is one of the content areas within agricultural education that has emerged as an area of need for additional professional development (Duncan, Ricketts, Peake & Uesseler, 2006). The range of skills related to agricultural mechanics alone adds to the complexity of choosing skills to include in the curriculum and makes it difficult for novice teachers to be adequately prepared to teach the vast array of skills. Preservice teachers have reported not being comfortable with their ability to perform welding related skills, a commonly taught agricultural mechanics skill area (Blackburn, Robinson, & Field, 2015). Byrd, Anderson and Paulsen (2015) reported that agricultural education teachers are more comfortable teaching courses other than agricultural mechanics.

As the world changes, the value of different agricultural mechanics skills continues to be altered, leading to the need for teachers to be prepared for what changes may occur (Laird, 1994). Laird, (1994) found that agricultural education teachers identified skills which utilized emerging technologies such as computers and Tungsten Inert Gas (TIG) welding as skills that would become more important in the future. For example, Liard (1994) noted TIG welding as a skill taught with only some importance in 1994 compared to the findings of Shultz et al. (2014) which found TIG welding to currently be perceived as important or very important by the majority of Iowa agricultural education teachers. A similar emergence has also be seen with other skills such as plasma cutting (Ramakrishnan, Gershenzon, Polivka, Kearney & Rogozinski, 1997; Finch, 2007). Industry leaders are pushing for teachers to become competent in teaching technologies critical in the workforce (B. Van Duyne, personal communication, January 21, 2015). Doerfert (2011) stated that agricultural education should continue to change in an effort to "address the new challenges and opportunities brought about by rapidly advancing technologies." (p. 8) Agricultural mechanics technologies are constantly changing (McKim & Saucier, 2013) creating a need for schools and teacher education programs to continually evaluate their curricula (Duncan et al., 2006; Shultz et al., 2014). Preservice teacher education provides vital experiences to students that will become secondary instructors in the future. In addition to the knowledge gained in teacher training programs, experiences gained as students at the secondary level influences preservice teacher values and beliefs in regards to the content learned (Fishbein, 1967; Prawat, 1992).

Recently, a reduction in agricultural mechanics course offerings has been identified in agricultural education teacher preparation programs (McKim & Saucier, 2011). In addition to knowledge gained through preservice education or in-service education programs, most agricultural mechanics teachers have experienced courses involving agricultural mechanics skills while they were secondary students (McKim & Saucier, 2011). Wells et al., (2013) found that exposure to agricultural mechanics topics as secondary students influenced topics of study chosen by postsecondary students, which may also carry into the topics secondary teachers choose to include in their curriculum. Knowing that knowledge influences beliefs (Fishbein, 1967; Prawat, 1992) it might be possible that knowledge gained during current teachers' secondary agricultural education experience may have an effect on their perceived importance of different agricultural mechanics skills. Does the amount of training teachers received while they were secondary students affect their current beliefs about the agricultural mechanics curriculum?

## Theoretical Framework

"Learning is an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience" (Shunk, 1996, p. 3). Constructivism is a paradigm in which learning is a process that builds knowledge from experiences. As a learner encounters new experiences, previous knowledge is built upon and constructed to further develop the individual's knowledge base (Belbase, 2011). Social learning theories fall under this constructivism category. Lev Vygotsky's (1978) social development theory is a prime example of this type of learning theory and provides the theoretical framework which guides this study.

Three key components make up the social development theory: social experiences which form a foundation for cognitive development, the *More Knowledgeable Other*, and the *Zone of Proximal Development* (Vygotsky, 1978). Vygotsky penned that the behaviors of adults are determined in large part by their own personal social experiences as children. The *More Knowledgeable Other* is any entity with a higher level of knowledge regarding a particular topic than the learner. The *More Knowledgeable Other* could be a teacher, another student, computer software, online media sources, or any source of knowledge (Mariage, Englert, & Garmon, 2000). By having a higher level knowledge source, a *More Knowledgeable* Other is able to expose the learner to knowledge beyond their current educational level. The impact of the *More Knowledgeable Other* is influenced by the Zone of Proximal Development (Jackson, Karp, Patrick & Thrower, 2006). The *Zone of Proximal Development* is the level at which a learner is capable of reaching on their own. In a sense, the *Zone of Proximal Development* defines the limits of learning achievable by a student's current level of development (Chaiklin, 2003). What makes the *Zone of Proximal Development* important is that when content is taught at a level beyond that of the learners' capabilities (Coffey, 2009) the learner is forced to reach out to the *More Knowledgeable Other*. If learning outcomes and strategies are not targeted within the learner's *Zone of Proximal Development*, growth becomes severely limited.

Vygostky's social development theory was conceptualized in this study as follows: the social experiences forming a foundation for cognitive development occurred when the respondent teachers were secondary students. When the respondents engaged in their course work as secondary students, they were being exposed to social experiences that continually built upon their own previous experiences. Those social experiences occurred through interaction with classmates and teachers. As those social experiences continued to occur, cognitive development followed. The *More Knowledgeable Other* was encountered by the current secondary agricultural educators while they were secondary students; during that time they build knowledge from those resources. Material taught within the learners' *Zone of Proximal Development* was influential in their cognitive development.

Vygotsky (1978) indicated that "every function in the child's cultural development appears twice; first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)" (p. 57). The agricultural mechanics skills received at the secondary level align with the students' interpsychological development on the social level due to their proximity to the instructor and other students. That is to say that when the current teacher-respondents were secondary students, the interactions with their *More Knowledgeable Others* lead to interpsychological development. The teacher's perceived level of importance of agricultural mechanics skills therefore becomes aligned to the intrapsychological development; which emerged as a result of their interpsychological foundation. To clarify, as students received continued exposure to learning outcomes and strategies within their *Zone of Proximal Development*, intrapsychological development was taking place. This led us to consider if relationships exist between the agricultural mechanics skills received at the secondary level and teachers' perceptions of what agricultural mechanics skills are important to teach.

## Purpose and Objectives

Wells et al., (2013) found that the agricultural mechanics content in which students were exposed at the secondary level impacted the courses they pursued at the post-secondary level. Their findings led us to believe that agricultural mechanics experiences received at the secondary level may influence the content decisions that agricultural education teachers' make during the curriculum development process. The purpose of this study was to describe the relationship between the Iowa agricultural education teachers' perceived level of importance to teach selected agricultural mechanics skills and the quantity of agricultural mechanics training received when they were a secondary agricultural education student. This research purpose aligns with the National Career and Technical Education Research Agenda (Lambeth, Elliot, & Joerger, 2008) research problem area (RPA) 1: Knowledge Base for Teaching and Learning, specifically relating to the research objective (RO) 1.2 Professional Preparation. The specific research activities (RA) addressed includes RA 1.2.1: Teacher Competence and RA 1.2.2: CTE Teacher-education. This research also aligns with section 2c subsection B of the AAAE national research agenda, which specifically states that teacher candidates should be competent in agricultural and mechanical systems (Doerfert, 2011). The objective identified for this study was to describe the relationship between Iowa agricultural education teachers' perceived level of importance to teach selected agricultural mechanics skills and the quantity of agricultural mechanics training they received as secondary students.

## Methods

This descriptive study summarized respondents' characteristics, attitudes, and opinions to accurately describe a norm (Ary, Jacobs, Razavieh, & Sorensen, 2006). As part of a larger study, we used a researcher-modified questionnaire designed to address the objectives. Following the suggestions of Dillman, Smyth, and Christian (2009), an initial electronic version of the instrument was pilot tested with a group of twelve agricultural education teachers in a nearby state. Suggestions from the pilot study led researchers to adopt a paper-based, rather than electronic instrument. *Post-hoc* reliability was calculated following the suggestions of Gliem and Gliem (2003) and resulted in reliability coefficients for importance ($\alpha = 0.98$) and quantity ($\alpha = 0.97$) in section one of the instrument. The instrument contained three sections. Section one included 54 skills related to agricultural mechanics. Skills were separated into five constructs, including: *Mechanic Skills, Structures/Construction, Electrical, Power and Machinery, and Soil and Water*. Respondents were asked to use a five-point summated rated (Likert-type) scale to rate the perceived importance level of teaching each skill (5 = very important, 4 = important, 3 = moderate, 2 = little importance, and 1 = no importance) and the quantity of training received at the secondary level (5 = very strong, 4 = strong, 3 = moderate, 2 = some, and 1 = none). Section two consisted of 15 demographic questions relating to the participating teacher's educational and teaching background, and section three included nine questions specific to the teachers' school and agricultural program characteristics. Content validity was determined by five university faculty members with expertise in the fields of agricultural mechanics and agricultural education.

Data were collected using a convenience sample of attendees at the Iowa agricultural education teachers' conference. This group of secondary agricultural educators was purposely targeted because of the convenience of the respondents being gathered at the conference and because of the respondents' likelihood to be involved in annual professional development activities. Researchers distributed a questionnaire to each secondary instructor ($N$ = 130) in attendance and asked that it be completed by the end of the conference. Each participant was offered a power tool institute safety curriculum as an incentive for completing and returning the questionnaire. These efforts yielded 103 completed questionnaires for a 79.2% response rate. No further effort was made to obtain data from non-respondents. With 103 completed questionnaires, the researchers deemed that the convenience sample size was large enough to yield some stability in the results (Ferber, 1977). However, to avoid non-response bias and other sampling problems the researchers elected to address non-response error by following the suggestions of Miller and Smith (1983). Respondents' personal and program demographic data were compared with data from the Iowa Department of Education (2010). A Pearson's $\chi^2$ analysis yielded no significant differences between the sample and the population of Iowa agricultural education teachers $(p > .05)$ for gender, age, highest degrees held, years of teaching experience, or size of school community. Since this study was derived from a convenience sample limited to a specific state, it is limited from being generalizable beyond the study participants. Through employing a convenience sample, generalizability is limited to the targeted population (Ary et al., 2006).

Data were coded and analyzed using PSAW 18.0. The two variables in this study, secondary teachers' perceived importance of agricultural mechanics skills and the quantity of training those teachers received as secondary agricultural students, are quantitative and have and distinct, ordinal degrees of measurement. According to Lehman, O'Rourke, Hatcher, and Stepanski (2005) Spearman correlations can be used for such variables to observe possible relationships between them. The Davis Convention (1971) was used to interpret the magnitude of the correlations according to the following scale: those between .01 and .09 were defined as being negligible, those between .10 and .29 were defined as low, those between .30 and .49 were defined as moderate, those between .50 and .69 were defined as substantial, and those .70 or higher were defined as very strong.

Table 1 describes the demographics of the agricultural education instructors who participated in the study. The typical respondent was in a rural community, single teacher program and held a Bachelor's degree. A majority of teachers were male ($n$ = 69, 67%) and had less than 15 years of teaching experience ($n$ = 65, 63.2%). Table 1 contains a summary of respondent characteristics.

Table 1

*Participant Demographics*

| | *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 | | |
| 0-5 | 32 | 31.1 |
| 6-10 | 22 | 21.4 |
| 11-15 | 11 | 10.7 |
| 16-20 | 7 | 6.8 |
| 21-25 | 5 | 4.8 |
| 26-30 | 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 |
| Urban (population greater than 20,000) | 2 | 2.0 |
| Number of Agricultural Science Teachers in Department | | |
| 1 Teacher | 91 | 90.0 |
| 2 Teachers | 7 | 7.0 |
| 3 Teachers | 3 | 3.0 |

## Results

This study examined the relationship between the quantity of agricultural mechanics training agricultural education teachers received at the secondary level and those same teachers' perceived level of importance to teach the skills in their current agricultural education program. *Spearman Rho* correlations were utilized to determine significant ($p < .05$) relationships between the two variables; secondary teachers' perceived importance of teaching agricultural mechanics skills and the quantity of training those teachers received as secondary agricultural students for each of the 54 selected agricultural mechanics skills (see Table 2 through Table 6). It should be noted that correlation shown for each skill area are not representative of the construct containing the skill or any of the other skills within that same construct. For example, Small Engine Safety is an instructional area within the *Machinery Training* construct. The quantity of Small Engine Safety instruction received by current agricultural teachers while at the secondary level was correlated to the teachers' perceived level of importance to teach Small Engine Safety. This does not mean the correlation associated with Small Engine Safety instruction is meant to reflect the construct in which it lies—*Machinery Training*, or any of the other skills within the same construct.

Statistically calculated correlations of the relationship between secondary agricultural education teachers' perceived level of importance to teach mechanics skills and the quantity of mechanics training those same teachers received at the secondary level is displayed in Table 2. A significant, positive correlations was found in 13 of the 19 skills in the *Mechanics Training* construct. The skills with the strongest correlations were oxy-acetylene brazing ($r_s = .437$) and pipe cutting and threading ($r_s = .391$).

Table 2

*Spearman Rho Correlational Relationships between the Perceived Importance to Teach and the Quantity of Mechanics Training and Skills Received at the Secondary level*

| Skill Area | *n* | Importance | Quantity | Spearman Rho Correlation | Magnitude |
|---|---|---|---|---|---|
| Oxy-acetylene Brazing | 91 | 3.36 | 2.22 | .437* | moderate |
| Pipe Cut. and Threading | 83 | 3.17 | 1.79 | .391* | moderate |
| Oxy-propylene Cutting | 83 | 3.21 | 1.72 | .374* | moderate |
| Soldering | 89 | 3.37 | 1.89 | .360* | moderate |
| Plumbing | 85 | 3.41 | 1.77 | .323* | moderate |
| Oxy-acetylene Cutting | 97 | 4.15 | 2.62 | .307* | moderate |
| Oxy-acetylene Welding | 96 | 3.85 | 2.54 | .296* | negligible |
| SMAW Welding (Arc) | 96 | 4.33 | 2.85 | .277* | negligible |
| Tool Conditioning | 84 | 3.29 | 2.00 | .263* | negligible |
| Hot Metal Work | 83 | 3.02 | 1.93 | .261* | negligible |
| Computer Aided Design (CNC) | 82 | 3.37 | 1.63 | .259* | negligible |
| Cold Metal Work | 84 | 3.07 | 1.91 | .220* | negligible |
| Plasma Cutting | 91 | 4.12 | 2.00 | .215* | negligible |
| Welding Safety | 96 | 4.71 | 2.99 | .187 | - |
| GMAW Welding (MIG) | 94 | 4.31 | 2.34 | .172 | - |
| Metallurgy and Metal Work | 84 | 3.20 | 2.03 | .172 | - |
| Mechanical Safety | 88 | 4.26 | 2.48 | .143 | - |
| GTAW Welding (TIG) | 84 | 3.69 | 1.79 | .114 | - |
| Fencing | 83 | 3.32 | 1.77 | .080 | - |

*Note.* $^{*}p < .05$ (Scale: .10-.29 = negligible, .30-.49 = moderate, .50-.69 = substantial, ≥ .70 = very strong). Importance (5 = very important, 4 = important, 3 = moderate, 2 = little importance, and 1 = no importance) and quantity (5 = very strong, 4 = strong, 3 = moderate, 2 = some, and 1 = none).

Statistically calculated correlations of the relationship between the perceived importance to teach and quantity of *Structure and Construction* training received at the secondary level is shown in Table 3. The results indicated significant positive correlations in eight of the nine skills. The skills with the strongest correlations were woodworking power tools ($r_s$ = .473) and construction skills (carpentry) ($r_s$ = .414) which placed both skills in the tier of "moderate" correlation (Davis, 1971).

Table 3

*Spearman Rho Correlational Relationships between the Perceived Importance to Teach and the Quantity of Structure and Construction Training and Skills Received at the Secondary Level*

| Skill Area | *n* | Importance | Quantity | Spearman Rho Correlation | Magnitude |
|---|---|---|---|---|---|
| Wood Working Power Tools | 91 | 4.24 | 2.88 | .473* | moderate |
| Construction Skills | 90 | 3.98 | 2.69 | .414* | moderate |
| Wood Working Hand Tools | 92 | 4.03 | 2.92 | .342* | moderate |
| Concrete | 85 | 3.67 | 2.34 | .328* | moderate |
| Drawing and Sketching | 83 | 3.83 | 2.56 | .266* | negligible |
| Selection of Materials | 87 | 4.05 | 2.52 | .260* | negligible |
| Construction and Shop Safety | 91 | 4.46 | 2.91 | .216* | negligible |
| Fasteners | 86 | 3.73 | 2.34 | .216* | negligible |
| Bill of Materials | 88 | 4.20 | 2.71 | .311 | - |

*Note.* $^{*}p < .05$ (Scale: .10-.29 = negligible, .30-.49 = moderate, .50-.69 = substantial, ≥ .70 = very strong). Importance (5 = very important, 4 = important, 3 = moderate, 2 = little importance, and 1 = no importance) and quantity (5 = very strong, 4 = strong, 3 = moderate, 2 = some, and 1 = none).

Table 4 reports statistically calculated correlations of the relationship between the perceived importance to teach and quantity of *Electrical Training* received at the secondary level. The results indicated significant, positive correlations in three of the six skills in the electrical construct. The skills with the strongest correlations were wiring skills (switches & outlets) ($r_s$ = .320) and electrical controls ($r_s$ = .274) which have moderate and low correlations respectively according to the Davis Convention (1971).

Table 4

*Spearman Rho Correlational Relationships between Perceived Importance to Teach and the Quantity of Electrical Training and Skills Received at the Secondary Level*

| Skill Area | *n* | Importance | Quantity | Spearman Rho Correlation | Magnitude |
|---|---|---|---|---|---|
| Wiring Skills (Switches & Outlets) | 89 | 3.87 | 2.29 | .320* | moderate |
| Electricity Controls | 87 | 3.58 | 1.91 | .274* | negligible |
| Electrician Tools | 89 | 3.74 | 2.14 | .272* | negligible |
| Electrical Safety | 86 | 4.19 | 2.28 | .189 | - |
| Types of Electrical Motors | 84 | 3.37 | 1.82 | .186 | - |
| Cleaning Motors | 80 | 3.33 | 1.80 | .135 | - |

*Note.* $^{*}p < .05$ (Scale: .10-.29 = negligible, .30-.49 = moderate, .50-.69 = substantial, ≥ .70 = very strong). Importance (5 = very important, 4 = important, 3 = moderate, 2 = little importance, and 1 = no importance) and quantity (5 = very strong, 4 = strong, 3 = moderate, 2 = some, and 1 = none).

Statistically calculated correlations of the relationship between the perceived importance to teach and quantity of power and machinery training received at the secondary level are presented in Table 5. Significantly positive correlations were found in seven of the 15 skills in the *Power and Machinery* construct. The skills with the strongest correlations were small engine services - 2 Cycle ($r_s = .340$) and small engine safety ($r_s = .309$) and are both defined as moderately correlated (Davis, 1971).

Table 5

*Spearman Rho Correlational Relationships between Perceived Importance to Teach and the Quantity of Power and Machinery Training and Skills Received at the Secondary Level*

| Skill Area | *n* | Importance | Quantity | Spearman Rho | Magnitude |
|---|---|---|---|---|---|
| Small Engine Services - 2 Cycle | 83 | 3.88 | 2.24 | .340* | moderate |
| Small Engine Safety | 85 | 4.31 | 2.45 | .309* | moderate |
| Service Machinery | 79 | 3.54 | 1.90 | .304* | moderate |
| Small Engine Overhaul | 85 | 3.92 | 2.32 | .273* | negligible |
| Small Engine Services - 4 Cycle | 85 | 4.01 | 2.41 | .260* | negligible |
| Tractor Service | 81 | 3.61 | 1.83 | .256* | negligible |
| Tractor Maintenance | 80 | 3.74 | 1.81 | .230* | negligible |
| Machinery Selection | 80 | 3.45 | 1.91 | .190 | - |
| Tractor Driving | 80 | 3.51 | 1.88 | .182 | - |
| Tractor Overhaul | 79 | 3.25 | 1.64 | .170 | - |
| Power and Machinery Safety | 83 | 3.99 | 2.08 | .156 | - |
| Machinery Operation | 81 | 3.58 | 1.89 | .143 | - |
| Tractor Safety | 82 | 3.95 | 1.98 | .132 | - |
| Tractor Operation | 79 | 3.43 | 1.85 | .128 | - |
| Tractor Selection | 78 | 3.32 | 1.67 | .052 | - |

*Note.* $^{*}p < .05$ (Scale: .10-.29 = negligible, .30-.49 = moderate, .50-.69 = substantial, ≥ .70 = very strong). Importance (5 = very important, 4 = important, 3 = moderate, 2 = little importance, and 1 = no importance) and quantity (5 = very strong, 4 = strong, 3 = moderate, 2 = some, and 1 = none).

Statistically calculated correlations of the relationship between the perceived importance to teach and the quantity of soil and water training received at the secondary level is displayed in Table 6. Results indicated significantly positive correlations in one of the five skills in the *Soil and Water* construct. Legal and land descriptions garnered a moderate correlation ($r_s = .429$) (Davis, 1971).

Table 6

*Spearman Rho Correlational Relationships between Perceived Importance to Teach and the Quantity of Soil and Water Training and Skills Received at the Secondary Level*

| Skill Area | *n* | Importance | Quantity | Spearman Rho | Magnitude |
|---|---|---|---|---|---|
| Legal Land Descriptions | 83 | 3.97 | 2.44 | .429* | moderate |
| Differential Leveling | 75 | 3.25 | 1.47 | .215 | - |
| Profile Leveling | 75 | 3.13 | 1.50 | .190 | - |
| Use of Survey Equipment | 82 | 3.67 | 1.77 | .116 | - |
| Global Positioning Systems (GPS) | 82 | 4.23 | 1.80 | .074 | - |

*Note.* $^{*}p < .05$ (Scale: .10-.29 = negligible, .30-.49 = moderate, .50-.69 = substantial, ≥ .70 = very strong). Importance (5 = very important, 4 = important, 3 = moderate, 2 = little importance, and 1 = no importance) and quantity (5 = very strong, 4 = strong, 3 = moderate, 2 = some, and 1 = none).

## Conclusions and Discussions

The purpose of this study was to describe the relationship between the Iowa agricultural education teachers' perceived level of importance to teach selected agricultural mechanics skills and the quantity of agricultural mechanics training those teachers received as secondary agricultural education students. The results of this study indicated that moderate or low correlations between the variables of this study were observed in the majority of the selected skills. Similar to the findings of Wells et al. (2013) which stated that exposure to specific agricultural mechanics topics as secondary students impacted topics postsecondary students pursued, we conclude that a relationship also exists between agricultural education teachers' perceived importance to teach agricultural mechanics skills and the amount of training they received in those skills while secondary students. Additionally, our findings lead us to believe that the agricultural mechanics content currently being taught to secondary students will impact the content that those students may deem important to teach in the future.

Our findings further suggest that some skills which teachers have deemed as important (Shultz et al., 2014) have shown little to no correlation with the quantity of secondary training those teachers received in those skills. Shultz et al. (2014) reported safety-related skills such as Welding Safety, Construction and Shop Safety, and Mechanical Safety as being among the most important agricultural mechanics skills, yet our findings show the importance of these skills has a negligible or non-existent relationship with the amount of secondary training teachers have received in these skill areas. It is possible that although these skills are deemed as important by teachers, it does not require extensive training for teachers to perceive those skills as important. Rather it is simply known and accepted by teachers that safety related skills are important to teach, regardless of those teachers' prior educational experiences.

The findings from this study support Vygotsky's (1978) social development theory. The agricultural mechanics skills to which our respondents were exposed in the social setting (as secondary students), has reemerged intrapsychologically today in what they consider important to teach. In other words, the agricultural educators in our study used the learning achieved through social interactions and observations to develop a personal base of knowledge and beliefs system regarding the important of agricultural mechanics skills. This means that current teachers have developed current perceptions on what is important to teach in part due to what they were taught on the social level as secondary students. For example, in 1994 teachers identified oxy-acetylene brazing as having some importance for inclusion in secondary agricultural mechanics curriculum (Laird, 1994). Current teachers were learning oxy-acetylene brazing skills as secondary students, resulting in their interpsychological development. That interpsychological foundation can then be seen today in their intrapsychological beliefs and may have led to oxy-acetylene brazing having a moderate correlation ($r_s$ = .437) in our study.

Additionally, skills with the highest correlation between teachers' perceived importance of teaching skills and the quantity of training received in those skills at the secondary level tended to be skills that were both common to industry previously and are still in significant use today. Under the *Mechanics Training* construct, for example, the oxy-acetylene brazing and pipe cutting and threading skills were the two skills with the highest correlations. These are two skills that are currently used and have been common in industry for a long time (Miller, Pawloski, & Standridge, 2010). The same relationship can be seen in the *Structure and Construction* skills construct. The two skills with the highest correlation in this construct were woodworking power tools and construction skills. Both of these skills are still important to industry today. This implies that when current teachers were secondary students, the relevant material of the time was being taught to them, impacting their perceived level of importance to the agricultural mechanics curriculum.

Conversely, the relationship between a particular skill's relevance to industry and teachers' perceived importance of those skills can be seen with the lowest correlating skills. One of the lowest statistically significant correlating skills in the *Mechanics Training* construct is plasma cutting ($r_s$ = .215). While plasma cutting was introduced in the 1950's (Ramakrishnan, Gershenzon, Polivka, Kearney & Rogozinski, 1997), it was not common in industry until the late 1980's (Finch, 2007). Yet even still in 2015 industry leaders were finding teachers to be lacking in preparedness to teach plasma cutting (B. Van Duyne, personal communication, January 21, 2015). It is likely that many current teachers were not exposed to plasma cutting as secondary students. Yet there is an increasing push from industry leaders who were creating curriculum for teachers to help address the lack of plasma cutting exposure current teachers received as secondary students (B. Van Duyne, personal communication, January 21, 2015). This could be a cause of the low correlation between the amount of training teachers received as secondary students and their level of perceived importance to teach those skills today.

One of the two constructs that had fewer than half of the skills with significant correlation between the two variables was the *Soil and Water* training construct. Within this construct, four of the five skills did not show a statistically significant correlation. Situations that would result in a negative correlation between the two variables could be: the skills were not perceived as important while in secondary school but are perceived as important today, or the skills were perceived as important while in secondary school but are no longer perceived as important today. Some of the emerging skills may not have existed or had not been integrated into secondary curriculum during the time when current teachers were secondary students. One of the skills in the *Soil and Water* training construct is global positioning systems (GPS). It was not until the late 1990's that GPS started to become readily available for public use (Yunck, Chao-Han & Ware, 2000). With a technology so new to the public, it can be easily assumed that GPS systems were not popularly taught while our current teachers were students in secondary schools. Looking at the demographics from this study, we see that 47.5% ($f$ = 49) of respondents have been teaching for more than 11years. That amount of experience places them in secondary schools no later than approximately 2000, which makes their access to GPS technology as a secondary student unlikely.

A similar case may be seen with TIG welding. In Laird's 1994 study, TIG welding was identified as being taught in "little depth" (Laird, 1994, p. 44) at the time, yet teachers expected that importance to rise substantially. Perhaps the resulting fact that TIG welding had no correlation between the two variables of our study is because TIG welding was not popular during the time when the current teachers were secondary students, but has become a more popularly taught skill today.

## Implications and Recommendations

Experience at the secondary level has an impact on content teachers view as important and post-secondary teacher educators and industry should continue to help beginning teachers receive additional training and support in agricultural mechanics. Something to which these results may allude is the tendency for curriculum to become stuck in a cyclical pattern. Some of the significantly correlating skills may be the result of an educator teaching a skill simply because it is what they were taught and with which they have become comfortable. If they are teaching skills based more on a level of comfort than on an industry need for employable skills, are they wasting the time of their students; further, are they wasting the resources of the school? The education system as a whole should be in constant state of evolution to ensure students are receiving the skills needed not only for today, but the skills they will need in the future.

The broadness of agricultural mechanics has shown little likelihood of narrowing. There will always be a great need for the skills of agricultural mechanics to be taught, but teachers will need to be focused on teaching what they think is the most important to their students' while meeting the needs of the global community. Due to the respondent teacher participants in this study being in a local curriculum control state, the flexibility to choose what they teach becomes a critical responsibility. We recommend that teacher educators consider industry trends and determine important skills needed by agricultural education graduates. Students leaving secondary schools need skills that make them employable or skills that will help them with their advanced education; and it is up to the teachers to give them the necessary education. Researchers should continue to investigate individual agricultural mechanic skills which teachers perceive as important and how important they think those same skills will be in the future to help determine what skills are truly important to teach in agricultural education programs.

How can teachers become better prepared to achieve the previously stated expectations? Almost all of that weight is currently placed squarely on the shoulders of preservice institutions. However, the disconcerting trend being seen is the teaching of agricultural mechanics courses in preservice teacher training institutions has been on the decline (Burris, Robinson, & Terry, 2005). It cannot be expected that teachers graduating from these institutions will be adequately prepared to teach agricultural mechanics if their access to appropriate training is dwindling. Graduating students will leave teacher preparation programs underprepared and underqualified to teach skills deemed necessary by society. These institutions will need to continue to evolve their curricula to meet the demands of industry leaders. They will need to focus on giving teachers the skills they need to determine what is the most important to teach. Preservice teacher training institutions should work closely with industry leaders and continue to research employment trends demanded by the 21$^{st}$ century skills workforce. By working together in a collective action, industry leaders and preservice teacher training institutions can provide an education more efficient than either entity could by operating independently (Romer & Griliches, 1993).

Industry leaders themselves will also need to play an important role in helping secondary agricultural educators determine what skills are important. They can offer workshops and other forms of professional development to assist preservice and in-service teachers develop industry-expected skills. Many companies have been developing educational curriculum that is aligned with the equipment they produce. This curriculum is designed for teachers to use in the classroom to teach their students as if they had an industry expert in the school with them.

There should not be any generalization of these results beyond the population of this study. It is possible that the agricultural mechanics skills perceived to be important in Iowa are different than the skills perceived to be important in other regions of the United States. It should also be noted that additional limitations within this study may exist including a teacher’s ability to remember the content they learned in high school, if in fact they were actually exposed to agricultural mechanics in the secondary level. A limitation also exist in regards to if technology related to individual skills existed when the participants were enrolled in an agricultural mechanics course. Similar technology discrepancies will cause low or no correlations where there might not have been if the technology existed in the time when current teachers were secondary students. In this study we looked specifically at the impact the quantity of secondary training teachers received had on teachers’ perceived importance of agricultural mechanics skills. It cannot be ignored that additional outside factors can play a role in influencing a person’s level of perceived importance. It is quite possible that the respondents’ levels of perceived importance have been influenced by previous experiences including those in post-secondary education. Youth programs may have an effect on current teachers’ perceptions of the importance of teaching agricultural mechanics skills similar to that of the secondary education courses they have taken.

Additional research should be implemented to determine the factors, in addition to the quantity of secondary training received, which influence teachers’ perceived importance to teach agricultural mechanics skills. Research gaps to be addressed include the availability of technology at the time of current teachers’ secondary training. Also the influence of work done on farms or in other exposure in the agricultural industry, influences of post-secondary education, and 4-H or other youth programs could play influential roles in determining what skills are important to teach. Through analysis of the aforementioned variables and teachers’ perceived level of importance for teaching agricultural mechanics skills would help to identify important content for the teachers’ curriculum design process. Research which considers secondary agricultural teachers’ perceived future importance of agricultural mechanics skills could be beneficial in setting pre-service training goals.

If agricultural education teachers are teaching skills based on their experiences as secondary students, they need to be sure to constantly evaluate their reasoning for teaching those skills. The educational community should continue to develop an understanding of what factors influence the perceived importance to teach. By better understanding what deems a skill as important and giving teachers the opportunity to make educated decisions about what to teach in their classrooms, students in agricultural education will continue to receive an efficient and effective education.

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