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Preservice Agriculture Teachers' Perceived Level of Readiness in an Agricultural Mechanics Course

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Abstract

This longitudinal trend study sought to compare the perceptions of preservice agricultural education teachers, enrolled in a Metals and Welding course at a land grant university, on their welding related skills at the beginning of the semester to their final course grade at the end of the semester. Preservice agriculture teachers (N = 240) who completed the course between the Fall 2006 and Spring 2012 semesters served as the population for the study. Although the course is designed, specifically, to facilitate learning in metal fabrication, not one preservice teacher in any semester perceived an excellent ability in performing the welding related skills. However, skills related to shielded metal arc welding and gas metal arc welding were rated higher than those related to gas tungsten arc welding or oxyacetylene welding. The course instructor should be made aware of this discrepancy and encourage students to seek additional experiences in metals and welding. Further, the course instructor should continue to collect these data at the beginning and end of the course to determine the impact these changes have on students' ability to perform and teach the skills as future instructors. Similar studies should be conducted in other areas of agricultural mechanics, such as small gasoline engines, plumbing, and agricultural structures.

Keywords: Preservice teachers, agricultural mechanics; agricultural education; learner readiness

Introduction and Conceptual Framework

Agricultural mechanics has been and continues to be an important component of school-based agricultural education programs (Burris, Robinson, & Terry, 2005). Among all school-based agricultural education courses in Missouri, those related to agricultural mechanics had the highest student enrollment (Burris et al., 2005). Similarly, Hubert and Leising (2000) reported that 925 Texas schools offered agricultural mechanics courses with an estimated enrollment of nearly 28,000 students. That number continues to escalate. In Oklahoma, approximately 5,000 students were enrolled in courses related to the Agricultural Power, Structures and Technology Career Pathway during the 2010–2011 and 2011–2012 academic years (Oklahoma Department of Career and Technology Education (ODCTE, 2012).

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Despite the popularity of agricultural mechanics courses at the secondary level, numerous agriculture teacher preparation programs in the United States require their preservice teachers to complete relatively few credit hours of agricultural mechanics for graduation. Burris et al. (2005) reported the majority of agricultural teacher education programs required 12 or fewer credit hours in agricultural mechanics, with 5 to 8 credit hours reported as the modal response needed for certification. Likewise, Hubert and Leising (2000) reported a mean of 6.7 credit hours of agricultural mechanics was required for agricultural education certification. Preservice teachers at Oklahoma State University are required to complete 5 credit hours of mechanized agriculture instruction for teacher certification (Leiby, Robinson, & Key, 2013).

Burris et al. (2005) recommended that teacher education programs be restructured to prepare graduates better in the area of agricultural mechanics. Increasing credit hour requirements, however, is not always an option for teacher education programs. Connors and Mundt (2001) conducted a census study of agricultural education teacher preparation programs in the United States and found the median number of credit hours required for graduation was 128. Of those 128 credit hours, 45 credit hours of technical agriculture was the median number required. Because of the pressure to decrease the total number of hours required for graduation, only a portion of the credit hours in technical agriculture can be devoted to agricultural mechanics. Dillard (1991) discussed the difficultly of preparing agricultural education instructors to teach agricultural mechanics when so few credit hours are required at the post-secondary level.

Burris et al. (2005) recommended that teacher preparation programs create innovative strategies to ensure both preservice and in-service agriculture teachers develop technical competencies. Several studies have examined the needs of both preservice and in-service teachers in agricultural mechanics laboratory management, with *safety* being the common denominator. Johnson and Shumacher (1989) conducted a Delphi study that identified 50 agricultural mechanics laboratory management competencies needed by agricultural education teachers. The competencies ranged from documenting safety instruction to making both major and minor facility repairs.

Johnson, Schumacher, and Stewart (1990) sought to identify the agricultural mechanics laboratory management needs of in-service agricultural education teachers in Missouri. The authors found that issues concerning safety were the greatest professional development need for teachers. Nearly two decades later, Saucier, Terry, and Schumacher (2009) conducted a similar study of Missouri agricultural education teachers to determine their professional development needs in agricultural mechanics laboratory management. The areas they found to have the greatest need for professional development were (a) safety, (b) managing hazardous materials, and (c) repairing equipment. Saucier and McKim (2011) assessed student teachers in Texas and reported the greatest areas of need were maintaining and repairing equipment and safety in the laboratory. In a study of Wyoming agriculture teachers, McKim and Saucier (2011) reported laboratory safety and equipment maintenance were the two areas in greatest need of professional development.

With the number of required credit hours necessary to become an agricultural education teacher unlikely to increase, teacher education programs must determine how to prepare future teachers best without adding courses to a shrinking plan of study (Burris et al., 2005). The strategy taken by Oklahoma State University includes aligning mechanized agriculture courses with ODCTE skills standards (Leiby, 2010). The ODCTE career standards were created to serve as the:

> Foundation for competency-based instruction in Oklahoma's CareerTech system. The skills standards outline the knowledge, skills, and abilities needed to perform related jobs within an industry. Skills standards are aligned with national skills standards; therefore, a student trained to the skills standards possesses technical skills that make him/her employable in both state and national job markets (ODCTE, 2006, p. A).

Specifically, the metal fabrication course at Oklahoma State University was aligned with the Agricultural Power and Technology: Welding Technician Skills Standards, which were endorsed by the American Welding Society (AWS) (Leiby et al., 2013). The major duties described in these skills standards include employing safety while using: (a) shielded metal arc welding (SMAW), (b) gas metal arc welding (GMAW), (c) gas tungsten arc welding (GTAW), and (d) oxyacetylene welding (OAW) (ODCTE, 2006). Saucier, McKim, and Tummons (2012) conducted a Delphi study in Missouri to determine essential agricultural mechanics skills needed by early career agriculture teachers. The expert panel identified 23 skills needed by early career agriculture teachers, including (a) SMAW, (b) GMAW, (c) OAW, and (d) GTAW. These agricultural mechanics content areas represent competencies needed by agriculture teachers who teach courses with a focus on metals and welding (Leiby et al., 2013; Saucier et al., 2012).

Currently, preservice teachers at Oklahoma State University enroll in a two-credit hour metals and welding course (Oklahoma State University, 2012). Therefore, the limited number of credit hours requires that instructional time be utilized to its fullest potential. One means to attain optimal instructional efficiency is to ensure learners are ready to learn. "Readiness is a prerequisite for learning. Subject matter and learning experiences must be provided that begin where the learner is" (Newcomb, McCraken, Warmbrod, & Whittington, 2004, p. 30). Several formal and informal strategies to gauge learner readiness are available to teachers. Informally, teachers observe student reactions to subject matter or ask students questions (Newcomb et al., 2004). Readiness can also be determined more formally, as teachers may investigate prior courses students have completed or even administer pre-tests to assess prior knowledge.

Readiness also speaks to how seriously students invest in their education and build their human capital. This study was based, conceptually, on the human capital theory (HCT). HCT is the investment people make in their education, skills, and training to become more employable or well-rounded in life (Becker, 1964; Shultz, 1971). In addition to education, HCT assumes that people will develop the skills and competencies necessary for a particular job (Becker, 1964; Bernston, Sverke, & Marklund, 2006; Garavan, Morley, Bunnigle, & Collins, 2001; Little, 2003; Shultz, 1971; Smith, 2010). When people invest in "sector specific" human capital (Smith, 2010, p. 42), they become more prepared for the workforce because they can then perform the critical and important skills necessary for the job in that sector of the industry (Heckman, 2000; Iannaccone, 1990).

Agricultural education teachers who are prepared well in agricultural mechanics can "safely and effectively guide agricultural education students in the development of practical, hands-on skills" (McKim & Saucier, 2011, p. 84). Leiby et al. (2013) conducted a study to determine the impact of a course on metals and welding on preservice teachers' content knowledge and sense of confidence to teaching welding related skills. Their study revealed that at the beginning of the course the preservice teachers recognized the importance of welding skills, but lacked confidence in their ability to teach. At the end of the course, the preservice teachers still perceived the skills as important, and their confidence to teach them was higher (Leiby et al., 2013). However, the mean scores associated with their confidence to teach the skills was lower than those of their perceived level of importance of the skills (Leiby et al., 2013), indicating that teachers recognized the need to teach the skills, but lacked confidence to do so effectively.

A review of the literature indicated that most agriculture teacher preparation programs require relatively few credit hours in agricultural mechanics (Burris et al., 2005). Recent studies have focused on agricultural mechanics competencies needed by both preservice and in-service agriculture teachers (Burris et al., 2005; Saucier et al., 2009; McKim & Saucier, 2011; Saucier & McKim, 2011; Saucier, et al., 2012). Leiby et al. (2013) investigated how a metals and welding course impacted preservice teachers' perceptions of importance and confidence to teach welding related skills. However, little current research was found that investigated preservice teachers' perceptions, longitudinally, regarding their agricultural mechanics skills prior to a post-secondary course.

This research study relates to Research Priority Area 3: Sufficient Scientific and Professional Workforce that Addresses the Challenges of the 21st Century (Doerfert, 2011). Specifically, this research addresses key outcome number one, which states the need for "A sufficient supply of well-prepared agricultural scientists and professionals drive sustainable growth, scientific discovery, and innovation in public, private, and academic settings" (p. 18). Developing the technical competence of future teachers of agriculture is a vital component of addressing the challenge presented in this research priority area.

Purpose of the Study

The purpose of this longitudinal trend study was to determine the perceptions of preservice agricultural education teachers regarding their ability to perform welding related skills at the beginning of the semester in a mechanized agriculture course centered on metal fabrication. Further, this study sought to compare those perceptions to their final course grade at the end of the semester. The following research objectives guided this study:

1. Describe the personal characteristics of preservice agricultural education teachers that enrolled in a mechanized agriculture course between Fall 2006 and Spring 2012 semesters.
2. Describe preservice agricultural education teachers' perceptions of their ability to perform welding skills at the beginning of a mechanized agriculture course.
3. Determine trends of preservice agricultural education teachers' perceptions of their ability to perform welding skills at the beginning of a mechanized agriculture course.
4. Explain the relationship between preservice teacher's perceptions of their ability to perform welding skills and their final grade in the mechanized agriculture course.

Methods

The population for this longitudinal, trend study was all preservice agricultural education students (N = 240) enrolled in a Metals and Welding course between the Fall 2006 and Spring 2012 semesters. Longitudinal, trend studies allow researchers to examine changes in a particular population over time (Gay, Mills, & Airasian, 2009). The purpose of the Metals and Welding course was to teach welding safety, as well as principles and applications of (a) Shielded Metal Arc Welding (SMAW), (b) Gas Metal Arc Welding (GMAW), (c) Gas Tungsten Arc Welding, and (d) Oxy-acetylene Welding (OAW) (Oklahoma State University Mechanized Agriculture Course Descriptions). The instructor of the Metals and Welding course desired to know the perceived level of readiness of students at the beginning of the course each semester. As such, the course instructor created an instrument designed to assess students' perceptions of their abilities to perform the welding related skills taught in the course and administered that instrument to students on the first day of class. This allowed the instructor to have a formal measure of student readiness (Newcomb et al., 2004). The items on the instrument were aligned with the ODCTE Agricultural Power and Technology: Welding Technician Skills Standards. The instrument was comprised of two sections; the first section was student personal characteristics, including gender and academic classification. The second section was comprised of welding skills taught in the course. Since this instrument was administered as a routine component of the course, the Oklahoma State University Institutional Review Board deemed this study exempt from review.

Per section two, students were asked to rate their perceived ability to perform skills related to (a) SMAW, (b) GMAW, (c) GTAW, and (d) OAW. The categories of (a) SMAW, (b) GMAW, and (c) GTAW constructs each comprised of three individual items, while the OAW construct was comprised of two items. Each item asked the students to rate their ability to perform specific skills taught in the course. For example, one item in the SMAW construct asked the students to rate their perceived ability to perform a SMAW bead. Post hoc reliability was calculated using Cronbach's alpha, and indicated coefficients of (a) .94 (SMAW), (b) .90 (GMAW), (c) .95 (GTAW), and (d) .85 (OAW). Two agricultural education faculty members and one agricultural education doctoral student determined that the instrument exhibited both face and content validity. Content validity is achieved when an instrument measures what is intended to measure and is specifically comprised of item validity and sampling validity (Gay et al., 2009). Item validity is whether each item in an instrument is related to the intended content (Gay et al., 2009). Whether the items that comprise the instrument reflect the content as a whole is referred to as sampling validity (Gay et al., 2009).

Data related to research objective one were analyzed via descriptive statistics, specifically, modes of central variability, such as frequencies and percentages. Research objectives two and three were analyzed using measures of central tendency (i.e., means and standard deviations). Data associated with research objective four were analyzed by calculating the Spearman rho correlation coefficient. Correlations can be employed in descriptive research to explain and existing relationship among variables (Gay et al., 2009; Miller, 1994, p. 5). Spearman rho is the appropriate correlation coefficient when investigating relationships involving ordinal data. (Gay et al., 2009). To interpret the degree of each relationship, a coefficient of determination was calculated to ascertain course grade variance explained by welding related skill perceptions (Creswell, 2012).

Findings

Research objective one sought to describe the enrollment of preservice agricultural education teachers (N = 240) in a mechanized agriculture course between the Fall 2006 and the Spring 2012 semesters. Fall 2009 consisted of the highest enrollment of preservice agricultural education teachers (n = 40) (see Figure 1). The Spring 2010 and Spring 2012 semesters consisted of the lowest enrollment (n = 10) of preservice agricultural education teachers. Regarding gender of preservice agricultural education teachers enrolled in a mechanized agriculture course between the Fall 2006 semester and the Spring 2012 semester, two-thirds (n = 160) of the students who enrolled in the course were male and one-third (n = 80) of the students were female (see Figure 1). The majority of students (n = 223) were classified as either juniors or seniors (see Table 1).

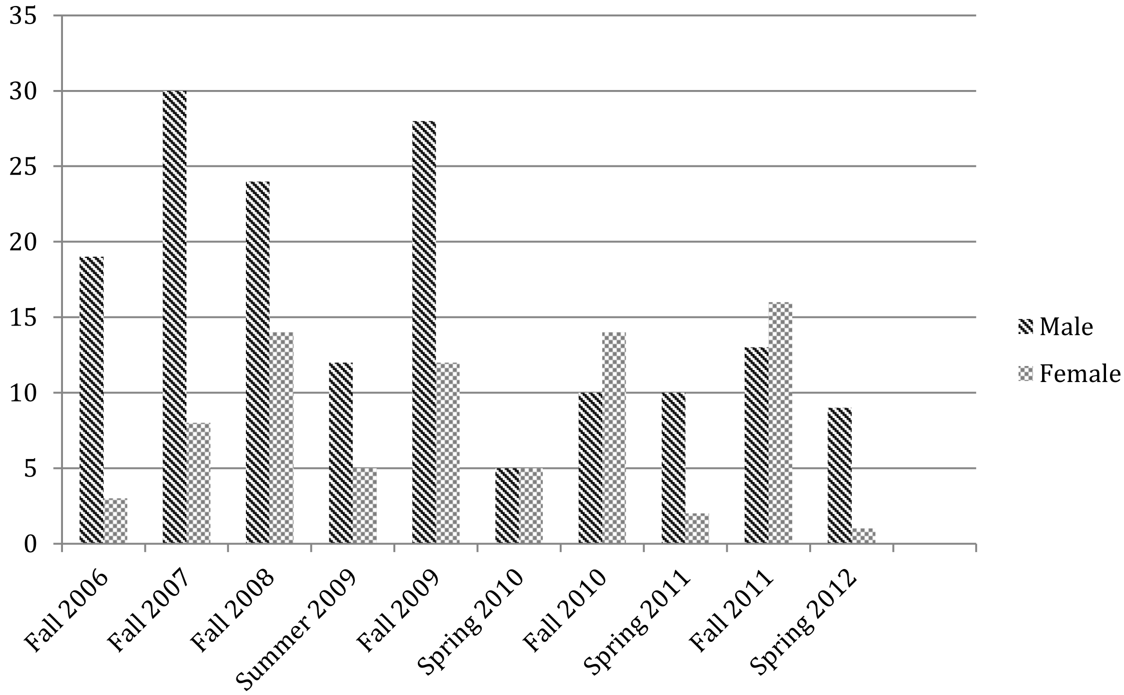

Figure1. Number of Students Enrolled in Metals and Welding Between the 2006 Fall Semester and the 2012 Spring Semester (*N* = 240).

Table 1

Academic Classification of Students Enrolled in Metals and Welding Between the 2006 Fall Semester and the 2012 Spring Semester (*N* = 240)

Classification	*f*	%
Freshman	5	2.1
Sophomore	12	5.0
Junior	116	48.3
Senior	107	44.6

Research objective two sought to determine students' perceptions of their ability to perform welding related skills at the beginning of the mechanized agriculture course, while research objective three was to determine trends associated with the preservice teachers' perceptions of their abilities to perform welding related skills. Table 2 depicts the students' perceptions of their ability to perform welding skills by semester. Those enrolled in the Spring 2011 semester held the highest (M = 2.31; SD = .86) perceptions of their ability to perform SMAW skills. Those enrolled in the Spring 2012 semester held the lowest (M = 1.80; SD = .72) perceptions of their ability to perform SMAW skills.

Regarding GMAW skills, students enrolled in the Summer 2009 semester held the highest (M = 2.15; SD = .52) perceptions of their ability. The lowest perceptions of ability to perform GMAW skills were held by preservice teachers enrolled in the spring 2012 semester (M =1.45; SD = .61). Preservice teachers enrolled in the Fall 2009 semester held the highest (M = 1.36; SD = .66) perceptions of their ability to perform GTAW skills. The lowest perceptions of ability to perform GTAW related skills were held by preservice teachers enrolled in the Fall 2006 semester (*M* = 1.09; *SD* = .29). Preservice teachers enrolled in the mechanized agriculture course during the summer of 2009 held the highest (*M* = 1.85; *SD* = .75) perception of their ability to perform OAW skills. The lowest (*M* = 1.05; *SD* = .16) perception of ability to perform OAW related skills were held by the preservice teachers enrolled during the Spring 2012 semester (see Table 2).

Table 2

Preservice Agriculture Teachers' Perception of their Ability to Perform Welding Skills by Semester (*n* = 240)

Variable	*n*	*μ*	*σ*
Fall 2006	22		
SMAW		2.09	.76
GMAW		1.65	.69
GTAW		1.09	.29
OAW		1.38	.56
Fall 2007	38		
SMAW		2.22	.94
GMAW		1.93	.86
GTAW		1.21	.53
OAW		1.42	.69
Fall 2008	38		
SMAW		2.00	.85
GMAW		1.81	.74
GTAW		1.17	.42
OAW		1.16	.40
Summer 2009	17		
SMAW		2.13	.51
GMAW		2.15	.52
GTAW		1.71	.71
OAW		1.85	.75
Fall 2009	40		
SMAW		2.15	.90
GMAW		2.07	.84
GTAW		1.36	.66
OAW		1.50	.73
Spring 2010	10		
SMAW		1.83	.74
GMAW		1.47	.56
GTAW		1.10	.32
OAW		1.10	.32

Table 2 Continues

Table 2 Continued

Preservice Agriculture Teachers' Perception of their Ability to Perform Welding Skills by Semester (*n* = 240)

Fall 2010	24		
SMAW		1.86	.80
GMAW		1.75	.78
GTAW		1.31	.59
OAW		1.40	.57
Spring 2011	12		
SMAW		2.31	.86
GMAW		1.98	.87
GTAW		1.25	.45
OAW		1.38	.57
Fall 2011	29		
SMAW		1.90	.88
GMAW		1.65	.68
GTAW		1.21	.43
OAW		1.22	.39
Spring 2012	10		
SMAW		1.80	.72
GMAW		1.45	.61
GTAW		1.30	.67
OAW		1.05	.16

Note: 4 = Excellent Ability; 1 = No Experience Performing Skill

Table 3 describes the perceptions of students' (*N* = 240) ability to perform welding related skills by construct. When assessing composite means, SMAW was the highest rated perceived skill in which preservice teachers could perform (*M* = 2.05; *SD* = .84). The lowest rated composite mean was GTAW skills (*M* = 1.26; *SD* = .54) (see Table 3).

Table 3

Preservice Agricultural Education Teachers' Perceptions of their Ability to Perform Welding Skills (*N* = 240)

Variable	μ	σ
SMAW Bead	2.23	.88
SMAW Joint	2.06	.89
SMAW Pipe Weld	1.88	.88
SMAW Composite Mean	2.05	.84
GMAW Bead	2.11	.94
GMAW Joint	2.02	.94
GMAW Structural Steel	1.87	.94
GMAW Aluminum	1.33	.63
GMAW Composite Mean	1.84	.77
GTAW Bead	1.28	.58
GTAW Joint	1.25	.52
GTAW Composite Mean	1.26	.54
OAW Steel	1.37	.64
OAW Braze	1.36	.64
OAW Composite Mean	1.36	.60

Note: 4 = Excellent Ability; 1 = No Experience Performing Skill

Research objective three was to determine trends related to preservice teachers' perceptions of their welding related skills. The mean scores for (a) SMAW, (b) GMAW, (c) GTAW and (d) OAW are shown in Figure 2. The figure shows that little change occurred in pre-service teacher perceptions of their welding-related skills between semesters.

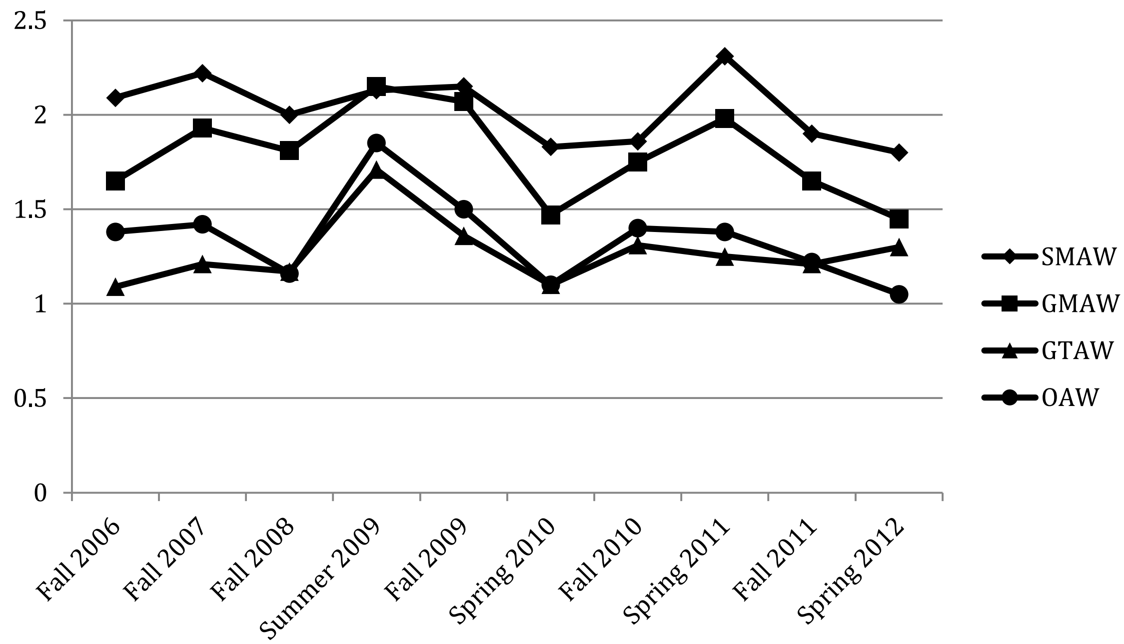

Figure 2. Preservice agriculture teachers' perceptions of their ability to perform welding related skills by semester.

Research objective four sought to explain the relationship between preservice teachers' perceptions of their ability to perform welding related skills and their final course grade in a mechanized agriculture course focused on welding. Table 4 lists the frequencies and percentages of final course grade. Roughly three-fourths (n = 184) of students earned either a *C* or *B* grade in the course. In addition, approximately 12% earned either a *D* or *F* and 11% earned an *A* (see Table 4).

Table 4

Final Grade Frequencies for Preservice Agricultural Education Teachers Completing the Metals and Welding Course Between the Fall 2006 and Spring 2012 Semesters (N = 240*)*

Grade	*f*	%
F	8	3.3
D	21	8.8
C	75	31.3
B	109	45.4
A	27	11.3

When comparing perceived skills with final grades, statistically significant ($p < .05$) relationships were found between (a) SMAW, (b) GMAW, and (c) OAW skills and end-of-instruction scores (see Table 5). Approximately four percent of the course grade variance could be explained by the perceptions of SMAW and OAW welding skills, while approximately three percent of the course grade variance was explained by the perceptions of GMAW skills. A statistically significant relationship between course grade and GTAW skills did not exist (see Table 5).

Table 5

Relationships[a] of Preservice Agricultural Education Teachers' (N = 240) Perceptions of Abilities to Perform Welding Related Skills and Final Course Grade

Construct	Course Grade	
	ρ_s	ρ_s^2
Shielded Metal Arc Welding (SMAW) skills	.20*	.04
Gas Metal Arc Welding (GMAW) skills	.16*	.03
Gas Tungsten Arc Welding (GTAW) skills	.04	NA
Oxy-Acetylene Welding (OAW) skills	.21*	.04

*Note: [a]Spearman's rho (ρ_s) correlation coefficient, *p < .05*

Conclusions

The majority of the preservice teachers who completed the metals and welding course between the Fall 2006 semester and the Spring 2012 semester have been male. Since Fall 2009, however, the number and percentage of male students has decreased. The number of female students has remained relatively stable. This is consistent with recent enrollment patterns in the agricultural education department at Oklahoma State University. The majority of students who enroll in this course are classified as juniors or seniors. This finding aligns with enrollment in Oklahoma State University College of Agricultural Sciences and Natural Resources.

Overall, no semester of preservice teachers indicated an excellent ability to perform welding related skills at the beginning of the course. Why is that? Enrollment patterns at the secondary level indicate that agricultural mechanics courses are being taught. Are the students who complete high school level agricultural mechanics courses not receiving adequate instruction or are they simply not enrolling at Oklahoma State University in agricultural education? A lack of perceived ability in the welding related skills was true across constructs for all the semesters, although skills related to SMAW and GMAW were rated higher than skills related to GTAW and OAW. These findings are congruent with Leiby et al. (2013) who reported that preservice teachers had below average confidence in their abilities to teach welding skills at the beginning of a metals and welding course at Oklahoma State University. When analyzing the preservice teachers' perceptions of their abilities to perform welding related skills, the data revealed that no clear trends seem to exist. It appears that preservice teacher's have had low perceptions of their abilities to perform welding related skills every semester.

Regarding final grades, it can be implied that the bell curve exists for this course, as grades were distributed across the curve evenly. Therefore, it can be implied that the majority of students have an average understanding of metals and welding content. Unfortunately, this knowledge does little to convince students of their abilities. Although, statistically significant relationships were found between students' perceptions to perform (a) SMAW, (b) GMAW, and (c) OAW related skills and their final course grade, the relationships were small and explain very little variance of course grade as indicated by the coefficient of determination calculated for each item. These findings resonate with similar research by Leiby et al. (2013) who reported a low, positive relationship between student confidence to teach welding skills and final course grade.

Recommendations for Practice

The findings of this study should be shared with the instructor of record. Specifically, the instructor should be pleased that, although students enter the course with rather low levels of experience related to performing various welding skills, they have been able to improve their competency by way of their final grade in the course. However, with approximately 43% receiving a grade of *C* or worse, there is room for improvement.

Data should continue to be collected each semester to determine the impact the course has on students' levels of readiness to learn, apply, and later teach the concepts to secondary students. This readiness measure allows the instructor to begin course instruction at the level of the students (Newcomb et al., 2004) and teach the agricultural mechanics skills necessary for their future employment (Becker, 1964; Shultz, 1971). The instructor should recognize that the majority of students indicated little to no experience in performing these welding related skills prior to enrolling in the course. Thus, efforts should be made by the instructor to ensure that students learn the fundamental competencies related to the course in an attempt to increase their overall ability in using the equipment and machinery appropriately. Because the course is introductory in nature, the instructor should strive for mastery of the course content by way of making special accommodations for additional practice.

To obtain mastery in any area requires additional practice (Bandura, 1982). Newcomb et al. (2004) highlighted the importance of *student readiness*. The authors stressed that teachers should begin where the students are in relation to their level of readiness to receive the content. As such, teacher educators at Oklahoma State University should consider additional opportunities for students to practice their skills in an applied fashion. One such way is to offer a series of one-credit hour weekend, outreach courses. The purpose of these courses could be two-fold: a) to allow students who have taken the course to experience additional, hands-on experiences related to welding and cutting with a focus on the pedagogical delivery of teaching these concepts to future students, and b) to serve as a leveling course for those students who do not have former experiences in agricultural mechanics. The latter option would allow students who are truly novices to begin building their self-efficacy prior to enrolling in a full-blown, semester-long course. Thus, when students enter the metals and welding course, less time could be spent getting students ready to learn the basics, which would allow for students to experience more advanced level concepts and skills specific to the job of teaching agricultural mechanics, which is important for developing *sector-specific* human capital (Smith, 2010).

Another option for those who have limited previous experiences related to agricultural mechanics is the creation of a series of online modules designed to introduce students to the terminology and competencies needed for welding. With the expansion of digital game-based learning (DGBL), students could be exposed to simulated welding as a means for developing competence and confidence prior to enrolling in the metals and welding course (Oblinger, 2006).

Finally, professional development should exist for in-service teachers. Perhaps current teachers suffer from a lack of understanding and efficacy related to teaching welding. With science, technology, engineering, and mathematics (STEM) competencies in high demand, agricultural education teachers stand poised to deliver key concepts needed in the 21st century. However, for that to happen, agricultural education teachers must be knowledgeable about and competent in teaching the basic skills related to agricultural mechanics (Leiby et al., 2013). Therefore, efforts should be devoted to re-introduce basic competencies to teachers through in-service workshops.

Teacher educators should realize that many of the students entering agriculture teacher preparation programs do not possess technical knowledge in many areas, including agricultural mechanics. Even at the post-secondary level, there should be emphasis in basic knowledge and skill development before mastery can be assumed (Bandura, 1982). Teacher educators in agriculture should also strive to build a culture of lifelong learning among preservice teachers.

Due to the broad nature of agricultural education and the standards imposed by states and universities, it is "impossible to give adequate training in a four-year college program" (Phipps, Osborne, Dyer, & Ball, p. 371). Seeking professional improvement and possessing excellent subject matter knowledge have been identified as indicators of effective agriculture teachers (Roberts & Dyer, 2004).

Recommendations for Future Research

This longitudinal study focused on preservice teachers' perceptions of their abilities to perform welding related skills at the beginning of the course. Future data collection should also include student perceptions of their abilities to perform the welding skills at the end of the course. Doing so would allow researchers to determine how teacher self-efficacy (Tschannen-Moran, Wolfolk-Hoy, & Hoy, 1998) is impacted as a result of the semester-long course. Additional personal characteristics data are needed as well. The instrument should be expanded to include students' cumulative grade point average, previous secondary agricultural mechanics experience, and job related agricultural mechanics experience. In addition, the welding perceptions scale should be expanded to include additional anchors that align with Bandura's (1982) social cognitive and Tschannen-Moran et al.'s (1998) teacher self-efficacy scales.

This study found that the numbers of male students enrolling in this course has steadily decreased since 2009. Since this course is a requirement for all preservice teachers at Oklahoma State University, it stands to reason that fewer males are choosing agricultural education as a career. Future research should investigate career choice of students to determine why fewer male students are choosing agricultural education as a profession.

This study focused on skills related to various welding related processes only. Agricultural mechanics is a diverse curriculum with more instructional topics than just welding (Leiby et al., 2013). In Oklahoma, students take additional courses in small gasoline engines, structures, and electricity. Therefore, similar studies should be conducted in these areas of agricultural mechanics to determine students' competence and perceptions of their skills.

Implications

For the past 10 semesters, preservice teachers have indicated they have little to no experience performing welding related skills. There were, however, approximately 5,000 secondary agriculture students enrolled in the APT pathway the past two academic years (ODCTE, 2012). Further, most preservice agricultural education teachers at Oklahoma State University completed courses in school-based agricultural education (Jon Ramsey, personal communication, September 28, 2012). Wells, Perry, Anderson, Shultz, and Paulsen (2013) reported strong relationships between quantity of high school agricultural mechanics courses completed and preservice teachers' intentions to enroll in post-secondary agricultural mechanics courses. It can be implied that a large majority of students are entering their teacher education program without even the most basic human capital in agricultural mechanics. Why is that? First, perhaps teachers at the secondary level are not teaching agricultural mechanics thoroughly and comprehensively. It is possible that students with interest and ability in agricultural mechanics are choosing not to pursue a major in agricultural education. Perhaps teachers are lacking in confidence and competence in the area of agricultural mechanics and need to invest in their own human capital regarding this subject area. Finally, perhaps students are being misguided in their education and are learning bad habits regarding their performance in the area of agricultural mechanics. Perhaps quality of agricultural mechanics instructional experiences at the secondary level impacts students' perceived ability to perform essential skills at the post-secondary level.

Many of the preservice teachers in this population completed the course with a "C" grade or lower. How does average (or worse) course performance translate into teaching ability? Having an excellent knowledge of technical subject matter has been identified as a characteristic of effective agriculture teachers (Roberts & Dyer, 2004). It is safe to assume that some of the preservice teachers in this study are now in the teaching profession and some may be in charge of the agricultural mechanics curriculum in their respective schools. Have these teachers sought professional improvement in metals and welding?

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