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Assessing the Impact of a Semester-long Course in Agricultural Mechanics on Pre-service Agricultural Education Teachers' Importance, Confidence, and Knowledge of Welding

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This study sought to assess the perceptions of Oklahoma pre-service agricultural education teachers regarding the importance of identified welding skills standards and their confidence to teach them, based on a semester-long course on metals and welding. This study also sought to determine pre-service teachers' knowledge of welding prior to and at the end of instruction. It was found that pre-service teachers rated the seven constructs above average in importance; yet, they had below average confidence in their abilities to teach them at the beginning of the semester and between average and above average confidence at the end of the semester, which resulted in large practical effect sizes. Further, they increased their knowledge score from an F at the beginning of the semester to a C at the end of the semester, which was both statistically and practically significant. These pre-service teachers should be followed, longitudinally, to determine if and when they are able to fully master the skills and teach them effectively in the classroom and laboratory settings. Because agricultural mechanics is a vast field, future research should assess pre-service teachers' perceived levels of importance and confidence in areas outside of welding, such as electricity, plumbing, and small gas engines.

Keywords: pre-service agriculture teachers; agricultural mechanics; human capital; competencies

With the restricting degree plans at a maximum of 128 total credit hours, teacher preparation programs find it difficult to include enough technical competency preparation for pre-service teachers (Burris, Robinson, & Terry, Jr., 2005; Robinson, Krysher, Haynes, & Edwards, 2010). Providing secondary students with adequate opportunities to acquire necessary technical competencies in agriculture is challenging, especially when considering the subject of agricultural mechanics (Burris et al., 2005).

Dillard (1991) stated that it can be difficult to produce prepared teachers of agricultural mechanics with a minimum requirement of seven credit hours. Currently, Oklahoma State University (OSU) requires only five credit hours in agricultural mechanics coursework. As such, a need exists to determine if the current agricultural mechanics coursework at OSU is meeting the needs of its pre-service agricultural education teachers, as they will likely be expected to teach it once they enter the profession.

Agricultural mechanics is a science-based curriculum that provides teachers with opportunities to integrate concepts of physics, chemistry, and mathematics (Miller, 1991). "Agricultural mechanics traditionally has been a cornerstone in the secondary program" (Burris et al., 2005, p. 23). As noted in 2009, 59 percent of the United States' eleven thousand agricultural education instructors teach agricultural mechanics at their local school system (National FFA Organization, 2010). Therefore, ensuring that instructors are prepared to teach agricultural mechanics is critical.

Teacher preparation programs should focus on providing a high level of technical skill training in agricultural mechanics and strive to increase students' confidence to teach it effectively because producing and retaining highly qualified teachers is imperative to the success of the United States as a country (Wallis, 2008). Kennel (2009) stated, "because teachers are the single most important influence on student achievement, teacher education programs need to provide learning experiences for pre-service educators to impact their confidence to teach pertinent subject matter and their perceptions of its importance" (p. 2). Unfortunately, not all entry-level teaching graduates are ready to assume the responsibilities of professional work roles (Levine, 2005). Therefore, preparation programs should take heed and strive to ensure its graduates are ready for employment.

Agricultural education is designed to be industry-validated as it strives to equip students with the skills, education, and training necessary to be successful in industry and post-secondary education (Roberts & Ball, 2009). Therefore, teachers should be competent at teaching all agricultural subject areas (Robinson et al., 2010) and strive to "link the teaching of academic subjects to real-world applications" (Carnevale, Gainer, & Villet, 1990, p. 237). To link education to the real-world, various states take different approaches. The state of Oklahoma has implemented skills standards for various subjects to help close the gap between the classroom and the workplace.

> Skills standards provide the foundation for competency-based instruction in Oklahoma's Career Tech 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. (Oklahoma Department of Career and Technology Education (ODCTE), OD46903, 2006, p. A)

Competent, qualified teachers are the backbone of high quality instruction at any level. Highly qualified teachers are those who have gained teacher certification and licensure, know their subject area, and are competent at teaching it (Darling-Hammond & Berry, 2006). Per these requirements, Roberts, Dooley, Harlin, and Murphrey (2006) stated, "competency in subject matter and pedagogy is more subjective and thus more difficult to measure" (p. 1).

In Oklahoma, agricultural education majors must meet three minimal requirements to be qualified to teach. Students must obtain a bachelor's degree, be granted full certification, and possess proficiency in the subject matter in which they are expected to teach by passing the Oklahoma Subject Area Test (OSAT) (OSU Student Handbook for Agricultural Education & Student Teaching, 2009-2010).

To pass the OSAT examination, pre-service teachers must possess strong content knowledge in the broad field of agriculture. Specifically, prospective agricultural education teachers in Oklahoma need to possess content knowledge in "(I.) Agricultural Business, Marketing, and Communication, (II.) Animal Science, (III.) Plant and Soil Science, (IV.) Agricultural Power and Technology, (V.) Natural Resources" (Oklahoma Subject Area Tests, Study Guide-Agricultural Education, 2007, p. 2-2).

One of the key areas of Agricultural Power and Technology is welding. Oklahoma skills standards for welding were developed by the ODCTE. Welding skills standards pertain to the welding industry, specifically, and to the national welding industry, generally. Oklahoma welding skills standards are aligned with and endorsed by the American Welding Society (AWS). Skills standards provide a listing of necessary skills in which an individual should be proficient to be deemed competent and employable. To ensure that competencies are met, written assessments are used to evaluate student performance (ODCTE, OD46903, 2006). Skills standards provide educators with a roadmap of essential skills they should teach.

Specifically, welding is comprised of seven skills standards. These seven consist of manual arc welding, welding processes and procedures, welding knowledge, welding safety, oxy-fuel, brazing, and manual cutting (ODCTE, 2006). As such, pre-service teachers should be confident in and knowledgeable about these seven skills standards. Wingenbach, White, Degenhart, Pannkuk, and Kujawski (2007) stated that,

> Highly qualified teachers are defined in the No Child Left Behind Act of 2001 (NCLB) as those who not only possess state certification, but who also have content knowledge of the subjects they teach. In Career and Technical Education (CTE), teachers need to be competent in technical, employability, and academic skills. Additionally, high-quality CTE [Career Technical/Workforce Education] teachers are essential in helping the United States develop a 21st-century workforce that will be competitive in the world marketplace. (pp. 114-115)

Conceptually, this study was based on the human capital theory. Human capital (HC) is an investment in people's knowledge, skills, experiences, competencies (Becker, 1964; Bernston, Sverke, & Marklund, 2006; Garavan, Morley, Bunnigle, & Collins, 2001; Little, 2003; Mincer, 1974; Schultz, 1971; Smith, 2010; Smylie, 1996). The more developed a person's HC, the more employable that person becomes (Becker, 1975), so long as the HC is a good match, or *fit*, for the job in which he or she is seeking (Ballout, 2007; Caplan, 1987).

The Oklahoma Commission for Teacher Preparation (OCTP) documents professional examination scores in its program assessment report. In the section designated for OSAT scores, agricultural education pre-service teachers averaged the lowest or second to lowest examination scores in agricultural power and technology from 2002 to 2005 (Leiby, Robinson, Key, & Leising, 2011). Additionally, agricultural education pre-service teachers were most likely to receive failing scores in the area of agricultural power and technology on the OSAT. Below average certification scores, combined with the highest rate of failure in the OSAT area of agricultural power and technology, indicated a need to determine Oklahoma pre-service agricultural education teachers' know-ledge about and confidence to teach skills related to agricultural mechanics.

Purpose of the Study

The purpose of this study was to assess the perceptions of pre-service agricultural education teachers at Oklahoma State University regarding the importance of identified welding skills standards and their confidence to teach them, based on a semester-long course on metals and welding. Further, this study sought to determine pre-service teachers' knowledge of welding prior to and at the end of instruction. The following research objectives guided the study.

1. Compare pre-service agricultural education teachers' perceived levels of importance to teach selected welding skill constructs prior to and at the end of instruction.
2. Compare pre-service agricultural education teachers' perceived levels of confidence to teach selected welding skill constructs prior to and at the end of instruction.
3. Determine the relationship between pre-service agricultural education teachers' perceived levels of confidence to teach selected welding skills standards and final course grade.
4. Determine the relationship between pre-service agricultural educations teachers' final course grade and level of work experience in welding.
5. Compare pre-service agricultural education teachers' levels of technical knowledge in welding prior to and at the end of instruction.

Methods

The research design employed for this study was descriptive-correlational. Descriptive statistics (i.e., modes of central tendency and variability) are helpful for summarizing trends (Ary, Jacobs, & Razavieh, 2002). Descriptive statistics assist researchers to understand better the degrees of variation in data and help define relationships among data sets (Creswell, 2008); whereas, "In correlational research designs, investigators use the correlation statistic test to describe and measure the degree of association (or relationship) between two or more variables or sets of scores" (p. 356).

The instrument used in this study consisted of three sections. Section one was utilized to capture pre-service teachers' self-perceived confidence and importance ratings on the seven welding skills constructs. Section two was designed to measure the welding knowledge proficiency of pre-service teachers. Finally, section three was employed to gather personal characteristics data from the participants. Measurements of knowledge, confidence, and importance were collected prior to and at the end of instruction via survey research.

Using participants' responses, the welding education need for pre-service agricultural education teachers was determined. The population for this study was all pre-service agricultural education teachers (*N* = 58) enrolled in a metals and welding course at Oklahoma State University in Fall 2009. Because this course has been taught for the past 25 years by the same instructor to essentially the same types of students, an assumption was made that these pre-service teachers were no different regarding their demographic makeup, age, work experiences, or knowledge than other pre-service teachers in recent, previous years. So, a time and place sample, as defined by Oliver and Hinkle (1982), was employed serving as justification for the researchers to use inferential statistics.

Descriptive statistics (i.e., means and standard deviations) were employed for objectives one and two. A Cohen's *d* statistic was used to measure the practical effect that the constructs had on students' perceived levels of importance and confidence to teach the skills as a result of the 16-week course. Practical difference is important to assess because it informs the researcher as to whether or not the treatment effect was "large enough to be useful in real world" (Kirk, 1995, p. 64) and was interpreted as .2 = small, .5 = medium, and .8 = large (Cohen, 1988).

A Pearson Product-Moment Correlation was calculated for objectives three and four. The null hypothesis for objective three stated that, in the population studied, there was no relationship between teachers' perceived level of confidence to teach selected welding skills constructs and final course grade (Ho: Þ = 0). The null hypothesis for objective four stated that, in the population studied, there was no relationship between teachers' final course grade and level of teachers' prior work experience in welding (Ho: Þ = 0).

The instrument used for section one was developed by the researchers and consisted of 26 skills which were derived from the ODCTE, OD46903 (2006). Once developed, the instrument was reviewed by a panel of agricultural education faculty for face and content validity. Then, a pilot study was performed on a group of pre-service teachers (*N* = 23) who were enrolled in the course during the summer semester of 2009. Using Nunally's (1980) minimum criteria of .70 for reliability, the pilot study results indicated that the instrument was reliable on all seven constructs, with the exception of welding safety importance. That construct had a reliability estimate of .54 (Leiby et al., 2011). However, the welding safety confidence construct had a reliability estimate of .79. Because all other constructs were above Nunally's (1980) threshold, section one of the instrument was deemed reliable. Once administered, pre-service teachers were asked to rate how important they believed the skills standards were to teaching welding. Secondly, pre-service teachers rated how confident they were at teaching those skills.

Section two was designed to assess welding knowledge via pre-service teachers' final course grade. As such, a criterion-referenced test was developed by the researchers. In all, 25 questions were developed for the welding knowledge test. These questions were taken directly from notes and a test bank from the instructor of record. Reliability coefficients such as a Cronbach's alpha are not necessary for establishing reliability of criterion-referenced tests. Instead, Wiersma and Jurs (1990) listed eight factors that researchers should address to improve measurement reliability of criterion-referenced tests.

The following accommodations were made to address the suggestions of Wiersma and Jurs (1990): 1) *Homogeneous items:* The questions utilized in the design of the test were taken directly from course content or from an established course question bank. All material used for developing the test was cross-referenced with Oklahoma Agricultural Power and Technology and Welding Skills Standards; 2) *Dis-*

criminating items: Test questions were analyzed utilizing question difficulty and discrimination scores provided and computed by the Oklahoma State University Testing Center; 3) *Enough items:* The test consisted of 25 questions on pre-service teachers' knowledge of welding. In its entirety, the instrument contained 87 questions and was administered twice during the semester (prior to instruction and at the end of instruction). Therefore, the instrument was deemed acceptable in length; 4) *High quality copying and format:* The test was custom printed professionally by the OSU Testing Center. Sections two and three were printed using laser jet ink mass copying systems. All laser jet ink copies were reviewed, sorted, culled, and reprinted when necessary to provide clean, sharp, and readable copies. All responses were provided on commercially available scantron forms; 5) *Clear directions for the students:* Oral instructions were developed by the researcher and read aloud to participants before all survey administrations. With the assistance of whiteboard illustrations, the researcher attempted to provide examples of how to complete the test properly. The instructions were provided with the intention of minimizing the rate of student errors and any potential sources of confusion; 6) *A controlled setting:* Students were allowed time to take the test in the same location in which their laboratory experiences occurred; 7) *Motivating instructions:* In addition to receiving the oral instructions, pre-service teachers were provided with the intentions of the test and the importance of answering questions accurately and honestly; 8) *Clear directions to the scorer:* All Scranton® forms were scored and tabulated by the OSU Testing Center. For objective five, an independent samples *t*-test was run. The null hypothesis stated that, in the population studied, no statistically significant ($p > .05$) difference existed between teachers' level of technical knowledge of welding before and after instruction (Ho: $\mu_1 = \mu_2$). This study was part of a larger body of work (Leiby et al., 2011), which revealed that those who participated in the study were predominately male (74%) and 22 years of age or older (47%). Greater than one-half (59%) of these pre-service teachers had no formal welding experience prior to enrolling in the course.

Findings

Objective one was to compare pre-service agricultural education teachers' perceived levels of importance to teach selected welding skills standards prior to and at the end of instruction. Pre-service teachers experienced positive gains on all seven constructs throughout the semester (see Table 1), as detected by the low, practical effect sizes.

Table 1
Comparison of Pre-service Teachers' Perceptions of Importance to Teach Selected Welding Skill Constructs Prior to and at the End of Instruction (N = 58)

Construct	Prior to Instruction[a]		End of Instruction[b]		Mean Differences[c]
	M	*SD*	*M*	*SD*	
Manual Arc Welding	4.21	.89	4.39	.69	+.18*
Welding Processes and Procedures	4.38	.72	4.53	.68	+.15*
Welding Knowledge	4.37	.73	4.48	.67	+.11*
Brazing	4.21	.88	4.32	.76	+.11*
Welding Safety	4.69	.61	4.77	.46	+.08*
Oxy-fuel	4.62	.63	4.69	.54	+.07*
Manual Cutting	4.27	.88	4.34	.71	+.07*
Overall Composite Score	4.39	.76	4.50	.64	+.11*

Note. [a]Prior to Instruction = August; [b]End of Instruction = December; Scale: 1 = No Importance, 2 = Below Average Importance, 3 = Average Importance, 4 = Above Average Importance, 5 = High Importance; [c]Practical effect per Cohen's *d*; * = small effect; ** = medium effect; *** = large effect

Specifically, it was found that the construct in which pre-service teachers experienced the greatest amount of growth from the beginning of the semester to the end was manual arc welding (*Mean Difference* = +.18). Welding safety was the construct with the highest mean importance score at the beginning (*M* = 4.69; *SD* = .61) and end (*M* = 4.77; *SD* = .46) of the semester. Brazing (*M* = 4.21; *SD* = .88) and manual arc welding (*M* = 4.21; *SD* = .89) were the constructs with the lowest mean importance score prior to instruction. Brazing (*M* = 4.32; *SD* = .76) was the lowest mean importance score at the end of instruction for pre-service teachers (see Table 1).

Objective two was to compare pre-service agricultural education teachers' perceived levels of confidence to teach selected welding skill constructs prior to and at the end of instruction. The construct regarding teachers' confidence to teach with the greatest amount of growth prior to and at the end of instruction was brazing (*Mean Difference* = +1.86). Welding safety was the construct with the highest mean confidence score prior to (*M* = 3.86; *SD* = 1.11) and at the end of instruction (*M* = 4.53; *SD* = .68). Brazing (*M* = 2.26; *SD* = 1.17) was the construct with the lowest score for confidence prior to the semester. Welding knowledge (*M* = 3.90; *SD* = .91) was the construct with the lowest score for confidence at the end of the semester for pre-service teachers.

Table 2
Comparison of Pre-service Teachers' Perceptions of Confidence to Teach Selected Welding Skill Constructs Prior to and at the End of Instruction (N = 58)

	Prior to Instruction[a]		End of Instruction[b]		
Construct	*M*	*SD*	*M*	*SD*	Mean Differences[c]
Brazing	2.26	1.17	4.12	.92	+1.86***
Manual Arc Welding	2.55	1.29	4.03	.91	+1.48***
Oxy-fuel	2.84	1.39	4.28	.86	+1.44***
Manual Cutting	2.60	1.35	3.96	.96	+1.36***
Welding Knowledge	2.63	1.26	3.90	.91	+1.27***
Welding Processes and Procedures	2.98	1.31	4.05	.87	+1.07***
Welding Safety	3.86	1.11	4.53	.68	+.67**
Overall Composite Score	2.82	1.26	4.12	.87	+1.30***

Note. [a]Prior to Instruction = August; [b]End of Instruction = December; Scale: 1 = No Importance, 2 = Below Average Importance, 3 = Average Importance, 4 = Above Average Importance, 5 = High Importance; [c]Practical effect per Cohen's *d*; * = small effect; ** = medium effect; *** = large effect

A large, practical effect was noticed for six of the seven constructs measured regarding confidence (brazing, manual arc welding, oxy-fuel cutting, manual cutting, welding knowledge, and welding processes procedures). Welding safety had a medium, practical effect on students' confidence as a result of the course (see Table 2). Overall, a large effect (+1.30) was detected regarding students' perceptions of their confidence to teach these welding constructs as a result of the 16-week course.

Objective three was to determine the relationship between pre-service agricultural education teachers' perceived levels of confidence to teach selected welding skill constructs and final course grade. All pre-service teachers' end-of-instruction responses regarding confidence were averaged to create an individual mean confidence measurement for each teacher in the study. Individual confidence means were then averaged to create a confidence grand mean score for pre-service teachers in the study. Also pre-service teachers' end-of-instruction course scores were recorded, transposed, and averaged to create a final course grade mean score (see Table 3).

Table 3
The Relationship between Teachers' Confidence to Teach Welding at the End of the Semester and their Final Course Grade

Pre-service Teachers' Confidence Grand Mean Score	Final Course Grade Mean Score	*r*	*p*-value
4.11	78.07	.29	.03*

**Note*. $p = < .05$; df = 56, Scale: 1 = No Confidence, 2 = Below Average Confidence, 3 = Average Confidence, 4 = Above Average Confidence, 5 = High Confidence

When correlating teacher confidence and final course grade, the *r*-value was .29, indicating a positive, low relationship (Davis, 1971). The *p*-value was .03, indicating that there was a statistically significant relationship between the confidence measurement and final course grade of pre-service teachers (see Table 3). Therefore, the null hypothesis was rejected.

Objective four sought to determine the relationship between pre-service agricultural education teachers' final course grade and level of previous work experience in welding. It was found that there was no statistically significant relationship (Þ = 0) between previous work experience in welding and pre-service teachers' final course grade (see Table 4). Thus, the null hypothesis was accepted.

Table 4
Relationship among Pre-service Teachers' Final Course Grade and Previous Work Experience

Variable	Previous Work Experience in Welding
Final Course Grade	0.19

Objective five was to compare pre-service agricultural education teachers' levels of technical knowledge in welding prior to and at the end of instruction. On the 100-point, criterion-referenced examination, students averaged a score of 58.41 (SD = 13.42) prior to instruction (see Table 5). On the same examination, students averaged a score of 70.21 (SD = 13.43) at the end of instruction.

Students' mean knowledge scores increased nearly 12 percent (11.8%) throughout the semester. Standard deviations remained nearly constant ($SD = 13.42_{\text{prior to instruction}}$; $SD = 13.43_{\text{end of instruction}}$). However, students' minimum and maximum scores increased by 12 percent on measures taken prior to and at the end of instruction, respectively. Pre-service teachers demonstrated a statistically significant increase in welding technical knowledge ($p = .00$) at the end of instruction when compared to their scores prior to instruction. This change resulted in a large effect size (Cohen, 1988). Therefore, the null hypothesis was rejected in favor of the alternative hypothesis, indicating that there was a statistically significant difference in mean scores prior to and at the end of instruction ($p = < .05$).

Table 5
Pre-service Teachers' Level of Technical Knowledge in Welding Prior to and at the End of Instruction

			Range			
Variable	*M*	*SD*	Min. %	Max. %	*p*-value	Cohen's *d*
Prior to Instruction[a]	58.41	13.42	28	84	.00*	.89
End of Instruction[b]	70.21	13.43	40	96		

Note. Range = [a]0 to 100%; [b]0 to 100%; $p = < .05$

Conclusions

Pre-service teachers perceived positive levels in the importance of and their confidence to teach all seven welding constructs as a result of the 16-week course. Ratings showed small, practical differences regarding the importance of the welding constructs as a result of the semester-long course, with mean differences ranging from +.07 to +.18. However, confidence scores showed large practical effects, with ratings ranging from +.67 to +1.86. As a result, the course had a small, practical effect on students' perceptions of the importance of the welding constructs and a large practical effect on their confidence to teach the constructs.

Regarding confidence, pre-service teachers began the semester ranging between below and average confidence on the seven welding constructs. However, by the end of the semester, teachers were above average in their confidence levels to teach the constructs. What is more, the course had a large practical effect on students' confidence to teach them. In a teacher preparation program, this finding is encouraging because confidence can lead to mastery (Bandura, 1997)—in this case, teaching agricultural mechanics effectively.

Pre-service teachers placed a high amount of importance on welding safety both prior to and at the end of instruction. Safety precautions should always be considered, regardless of the sector of the agricultural industry in which an individual works (Slusher, Robinson, & Edwards, 2011). As such, it was encouraging to see that these individuals recognized the importance of safety, especially in a laboratory setting where danger is present constantly. The need to be attentive to safety specific to agricultural mechanics laboratories has been documented well in the literature (McKim & Saucier, 2011; Saucier, McKim, & Tummons, 2012; Saucier, McKim, Murphy, & Terry, Jr., 2010; Saucier, Terry, Jr., & Schumacher, 2009).

Pre-service teachers rated the importance of all constructs higher than their confidence to teach them. Further, when comparing overall composite means, the importance composite score was higher than the confidence composite score. This finding supports previous research by Radhakrishna and Bruening (1994) and Robinson et al. (2007) who concluded that graduates tended to rate items higher on importance than their self-perceived competence to perform them.

No statistically significant relationship existed between pre-service teachers' prior work experiences in welding and their grade in the course. This finding contradicts Bandura's (1997) assertion that experiences lead to mastery and competency.

The course resulted in pre-service teachers obtaining above average confidence in teaching the seven welding constructs. Further, the course had a statistically significant effect on students' knowledge of welding. This resulted in a large effect size, and enabled pre-service teachers to advance their knowledge in welding from a failing grade at the beginning of the semester, to a grade of *C* at the end of the semester—a 12% increase. This finding supports Bandura's (1997) notions that confidence improves with performance. In addition, it implies that these pre-service teachers were beginning to master their knowledge in welding toward the end of the semester, which is another important source of developing self-efficacy (Bandura, 1997).

Recommendations for Future Research

This study focused on pre-service teachers' abilities to teach constructs devoted to welding, with a particular focus in hot metal work. However, agricultural mechanics is much more diverse than being solely about welding. Therefore, future studies should be conducted on additional areas of agricultural mechanics curriculum, such as concrete, plumbing, electricity, and small gas engines, to determine pre-service teachers' regard for their importance in the secondary classroom as well as their level of confidence to teach them effectively.

Further research also should assess the impact this course will have on these pre-service teachers long term. For instance, are students who took the course prepared better in agricultural mechanics versus than those who did not? Does this preparation lead to more effective teaching in the agricultural mechanics laboratory and, in turn, affect these future teachers' students positively? Specifically, are secondary students whose teachers participated in this course more proficient at performing agricultural mechanics competencies on end-of-instruction examinations than those who did not? Follow-up studies should be conducted.

This study revealed that these pre-service teachers' confidence and knowledge in welding increased as a result of the course. However, it is not certain that these teachers have mastered the art of teaching welding. Therefore, a longitudinal study should be conducted to determine if and when these teachers develop the human capital necessary to *fully* master the welding skills needed to be an effective teacher in the classroom and laboratory settings (Bandura, 1997; Knobloch & Whittington, 2002). Because mastery experience is the most effective way of creating self-efficacy (Bandura, 1997), it would be important to determine if the pre-service teachers who had higher confidence and knowledge scores in this study are able to assist their students in achieving higher end-of-the-year, state-mandated examination scores, as opposed to the students of teachers who had lower confidence and knowledge scores.

Regarding safety, it was found to be the highest rated construct prior to instruction. Because of its high initial rating by pre-service teachers at the beginning of the semester, it was the construct that experienced the least amount of growth when comparing teachers' confidence to teach the constructs at the end of the semester. However, indicating an appreciation for safety and actually practicing safety are two different perspectives. Therefore, follow-up studies should include attempts to determine if teachers are able to teach and practice safety effectively with secondary agriculture students once they enter the teaching profession.

Recommendations for Practice

Pre-service teachers rated welding knowledge and manual cutting as the lowest mean score constructs. Because developing human capital is largely contingent on knowledge acquisition (Schultz, 1961), additional emphasis on these areas should be offered to pre-service teachers. Specifically, at Oklahoma State University, opportunities exist for faculty to offer one-credit hour weekend courses throughout the fall and spring semesters. To that end, teacher educators at OSU should consider offering additional coursework to pre-service teachers regarding welding knowledge and manual cutting. Additionally, the findings of this study should be applied to in-service teachers as well. Because this study employed a time and place sample (Oliver & Hinkle, 1982), it can be assumed that former pre-service teachers who are now in-service teachers received the same training and preparation and likely have the same needs regarding agricultural mechanics. As such, professional development should exist in the way of welding knowledge and manual cutting.

Because agricultural education exists to prepare students for college and careers, simultaneously (Roberts & Ball, 2009), further discussions need to exist with in-service teachers regarding employment possibilities for high school graduates in the welding sector of the agricultural mechanics industry. Understanding the opportunities that exist could encourage teachers to develop expertise in the areas identified in this study. Helping teachers realize the numerous career opportunities available in welding and agricultural mechanics has implications for building a sufficient workforce in the 21st Century, which corresponds with priority number five of the National Research Agenda (Doerfert, 2011).

Because there was a statistically significant relationship between pre-service teachers' confidence to teach welding skills and their final course grade, it is recommended that the course continue allowing student experiences that increase their human capital in welding. Perhaps these students could work in groups or teams to receive additional observation and modeling regarding effective welding practices. Bandura (1997) noted the impact vicarious learning can have on an individual's level of self-efficacy. So, perhaps students' levels of self-efficacy would elevate higher if they worked in teams to achieve these tasks. Specifically, because all seven welding constructs were rated above average on importance by pre-service teachers both prior to and at the end of instruction, the instructor of record for this course should continue to teach each one of them.

Finally, performing welding skills as a student and teaching them as an instructor are two separate issues. In other words, just because human capital was acquired as a result of this course does not mean that it will be sustained and practiced in the field when these pre-service teachers enter the profession. Because these pre-service teachers were not full-time teachers, caution is issued with making wholesale changes to the curriculum or generalizing the results of this study to the larger profession. To determine if these participants can teach these skills, microlessons should be developed and microteachings should be conducted and scored by university supervisors in pre-service teaching methods courses.

Implications

At the end of the semester, pre-service teachers had above average confidence in teaching the seven welding constructs measured in this study. Yet, their final grade in the class was barely passing (*C*) and a low, positive relationship existed. What does this finding mean? Could it be that these pre-service teachers overestimated their abilities to master these constructs? Knobloch and Whittington (2003) stated that student teachers tend to be overly confident in their abilities to teach in the classroom. Further, it is also possible that the reason students' course grade and mean confidence score experienced a low, positive relationship was due to the fact that students might see their educational courses as a mere checklist of criteria that has to be completed to earn a degree instead of realizing the value these courses will have on their career readiness long term. Said another way, perhaps some students see education as a series of hurdles to clear prior to entering the workforce and not as an opportunity to invest in their human capital, which will lead to employability. Therefore, it is possible that the reason students have elevated confidence but lower test scores is due to not taking their coursework seriously. These students should be reminded that, according to principals, the most important factor of human capital when employing an entry-level agriculture teacher in Oklahoma is academic rigor (Robinson & Baker, 2012).

It is concerning that the lowest rated construct score for confidence at the end of the semester was welding knowledge. How can students be more confident in teaching all other constructs related to welding knowledge, yet score the actual welding knowledge construct lowest by comparison? What does this mean about the pedagogy offered in the course? Perhaps students understand the skills needed to perform certain skills, like brazing; however, they fail to recognize how to synthesize these skills into a format conducive to teaching and learning. An example of skills listed under the welding knowledge construct are: selecting and using shielded gas, identifying major parts of gas metal arc (MIG) welding, and identifying welding errors. Implications exist for teacher educators to help pre-service teachers understand the basics of agricultural mechanics curriculum from a teaching and learning standpoint. These students need assistance in critiquing their own work and making decisions for why they choose one piece of equipment over another.

This study revealed that prior work experience did not affect teachers' confidence in welding. This finding is concerning considering the fact that experience is a core tenant of human capital (Becker, 1964; Schultz, 1971). It would seem that students with experience in welding would be more confident in their ability than those who had no experience. Perhaps the type of experience students received was not positive or was *miseducational* in nature. Unlearning bad habits can be time consuming and difficult. As such, current agricultural education teachers should monitor the instruction being offered in secondary agricultural mechanics courses to ensure that students receive positive experiences in welding.

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