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STUDENT PERCEPTIONS OF MALE AND FEMALE INSTRUCTORS IN  
A POST-SECONDARY WELDING COURSE

by

S. Kjersti R. Decker

A thesis submitted in partial fulfillment  
of the requirements for the degree

of

MASTER of SCIENCE

in

Agricultural Extension and Education

Approved:

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UTAH STATE UNIVERSITY  
Logan, Utah

2023

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## ABSTRACT

Student Perceptions of Male and Female Instructors in  
a Post-Secondary Welding Course

by

S. Kjersti R. Decker, Master of Science

Utah State University, 2023

Major Professors: Dr. Tyson J. Sorensen & Dr. Michael Pate  
Department: Applied Science, Technology and Education

Agricultural mechanics and welding have traditionally been perceived to be career realms reserved for males, however an increasing number of females are entering professions utilizing welding technology such as agricultural education. This research was developed due to the lack of gender research in agricultural mechanics and the increased number of females teaching welding. The purpose of this quantitative study was to examine students' perceptions of learning from a female instructor versus a male instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology.

The population for this study was undergraduate students and the sample was a convenience purposive sample of undergraduate students enrolled in beginning welding courses at Utah State University. Students' perceptions toward welding technology and learning welding technology, tinkering self-efficacy, demographic information, and preferences toward the gender of their welding

instructor were collected to determine associations and differences between the students. Survey responses were analyzed using descriptive and inferential statistics. Research findings suggest receiving instruction from a female welding instructor had a positive influence on the student's beliefs of whether they could learn from a female instructor. Several individuals displayed signs of gender bias or preference toward their own or the opposite gender. Male students also held significantly higher levels of tinkering self-efficacy, were more heavily involved in a technology-oriented degree of studies, and overall had more welding experience compared to their female counterparts.

Recommendations include an increased number of required agricultural mechanics coursework in agricultural education teacher preparation programs to increase confidence to teach agricultural mechanics for all agricultural educators, teacher preparation program addressing gender bias issues in teaching methods courses, and more research be conducted in a similar environment to verify gender bias in agricultural mechanics.

(212 pages)

## PUBLIC ABSTRACT

Student Perceptions of Male and Female Instructors in  
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S. Kjersti R. Decker

Agricultural mechanics and welding have traditionally been perceived to be careers reserved for males, yet more females have entered professions using welding such as agricultural education. This research was developed because of the lack of gender research in welding. The purpose of this study was to examine students' perceptions of learning from a male instructor versus a female instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology. The population for this study was undergraduate students and the sample was 45 undergraduate students enrolled in a beginning welding course at Utah State University.

Students' perceptions toward welding technology and learning welding technology, tinkering self-efficacy, demographics, and preferences toward the gender of their welding instructor were collected to look at differences between students. Research findings suggest receiving instruction from a female welding instructor had a positive influence on the student's beliefs of learning from a female instructor. Several individuals showed evidence of gender bias or

preference through their survey responses. Male students had higher levels of tinkering self-efficacy, were more involved in a technology-oriented degree of studies, and overall had more welding experience compared to the female students.

Recommendations include more agricultural mechanics coursework in agricultural education teacher preparation programs to increase confidence to teach agricultural mechanics for all agricultural educators, addressing gender bias issues in teaching methods courses, and more research be conducted in a similar environment to verify gender bias in agricultural mechanics.

## ACKNOWLEDGMENTS

This thesis is the result of dedicated research, time and effort which would not have been possible without many individuals who have encouraged me to pursue a graduate degree. I would like to acknowledge my advisors during my time at Utah State University, Dr. Tyson Sorensen and Dr. Michael Pate, for recognizing my ability to conduct research, give me feedback, and pushing me to pursue opportunities to teach and help me become a better agricultural educator. I would like to thank the other members of my committee, Dr. Michelle Burrows and Dr. Katie Kraus, for your friendships, advice, time commitment and example as educators and researchers.

Dr. Sarah Bush and Dr. James Connors, thank-you for seeing my potential while I was in my undergraduate degree at the University of Idaho and pushing me to pursue a graduate degree. As an undergraduate student, I did not recognize my own potential and was ready at times to switch careers, but you showed me what agricultural education is truly about and helped me find my passion for education.

To my teachers and professors who showed me examples of true teaching: Marvin Heimgartner, Dr. Tom Ptak, Mr. Jay Derting, Mr. J.R. Morrow, and Dr. Michael Colle. True teaching is hard to come by and I am grateful for each of you who have taught me life skills in different subjects which I apply in my teaching career. I would also like to thank my cooperating teachers at Jerome High School; Mr. Alan Willmore, Mrs. Nicole Lebsack and Mr. Tom Clifton. Thank-you for



taking me under your wing, giving me life advice, and teaching me how to be a great agricultural educator.

Finally, I would like to acknowledge my husband and family. Kurt, thank-you for willingness to listen to me talk about  $t$ -tests and welding non-stop. My last year of graduate school was the best year because I had you beside me and supporting me every step of the way. Thank-you for always helping me take breaks from work by playing our favorite board game Wingspan, passing the volleyball, or watching MacGyver. To my family: Mom and Dad (Penny Buckland and Chad Clawson), Clancy, Daphne, and Laurelin. Thank you for supporting me as I decided to leave my Idaho home and everything I knew to move to another state to continue my educational journey, I love you very much.

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## **Chapter I: Introduction**

### **Introduction**

Modern society in the United States and other countries has deemed certain career pathways and roles primarily reserved or more socially acceptable for one gender than the other (Eagly, 1987). The U.S. Bureau of Labor Statistics suggests the most common occupations for males in recent years are regarded as production/craft, technical, and management-oriented careers (U.S. Bureau of Labor Statistics, 2021), while the most common occupations for females are service oriented, involve clerical work, and are identified as pink-collar work (Gabriel & Schmitz, 2007; U.S. Bureau of Labor Statistics, 2021). The term pink-collar refers to careers primarily held by females (Howe, 1978) such as teachers, nurses, and secretaries.

Males are more heavily involved than their female counterparts in blue-collar work and STEM careers which have traditionally been considered predominantly male career fields (Bond, 2016; Gabriel & Schmitz, 2007; Halpern et al., 2007; Hermann, 2016; Leaper, 2015). Blue-collar work includes but is not limited to manual skilled or unskilled labor in an industrial setting. Examples of blue-collar work include welders, electricians, mechanics, painters, and construction workers (Oxford University Press, 2022). The STEM field involves careers heavily related to science, technology, engineering, and math.

England (2010) suggests for many years females avoided careers in predominately male realms, and several theories reinforce England's proposition. One can argue females are not inclined or are less willing to pursue careers in

predominately male oriented careers. Bergmann (2011) discussed the lack of training opportunities for females in blue-collar work as a cause for the lack of females in blue-collar work. Female employees in the United States also continue to be paid less compared to their male counterparts (U.S. Bureau of Labor Statistics, 2021). In 2020, female full-time and salary workers possessed a median earning of 82% of their male counterpart's salary (U.S. Bureau of Labor Statistics, 2021).

Despite gender career stereotypes, the pay gap, and potential lack of training opportunities, an increased number of females have entered male-dominated careers in recent decades. England (2010) suggests the gender divide has declined in recent decades as more females have entered male-dominated occupations, including blue-collar work, STEM, and agriculture. The trend began in the 1970's as an increasing number of females entered male dominated degree programs at colleges and universities (e.g., business, engineering, agriculture, etc.) while the number of females in pink-collar work slowly decreased (England & Li, 2006). The number of females involved in construction work expanded by 73.5% from 1985 to 2005 and in 2020 a total of 10.9% of construction workers were female (U.S. Bureau of Labor Statistics, 2021). The number of females involved in the welding industry increased during World War II as many males in the United States were serving in military positions overseas (Oliveira, 2011). The number of females in the welding industry then proceeded to decrease after World War II as many males returned to the career field. In 2020, a mere 3.5% of welders were female resulting in a heavily male oriented profession (U.S. Bureau

of Labor Statistics, 2021). The number of females pursuing careers in agricultural education has increased tremendously compared to construction work, STEM fields, and the welding industry (Bond, 2016; Smith et al., 2021; U.S. Bureau of Labor Statistics, 2021).

### **Statement of the Problem**

Agricultural education has changed dramatically in the past 103 years since the Smith-Hughes act in 1917. The Future Farmers of America (i.e., The National FFA Organization) was founded in Kansas City, MO and originally membership was reserved for Caucasian males in secondary schools (National FFA Organization, 2022). The National FFA Organization today has opened its doors to recognize membership for all ethnicities and genders (i.e., African American males were admitted in 1965 and females in 1969). FFA is an integral part of Agricultural Education. The demographics of agricultural education students and FFA members has changed, therefore agricultural educators' demographics have reflected a change. A research study conducted in 1987 reported females held an approximate 5.1% of secondary agricultural educator positions nationwide (Knight, 1987). Foster (2001) reported 15.77% agricultural educators were female and the number of females in the profession grew to 33% in the year 2014 (Shultz et al., 2014). In 2021, 76% of graduates in teacher preparation programs in agricultural education were female, a significant increase compared to previous years and a milestone for females in agricultural education (Smith et al., 2021).

Agricultural educators teach a variety of courses ranging from traditional agricultural topics such as plant science, mechanics, welding, and animal science to more contemporary topics such as aquaculture or floriculture. Agricultural educators teach, on average, four different courses per semester and one of the courses has the potential to be an agricultural mechanics course (McKim & Saucier, 2011). The National FFA Career Development Events Handbook (2006, p. 43) defines agricultural mechanics to be “comprised of strong technical content and complimented by the development of practical, hands-on skills.” Course topics include welding, fabrication, woodworking, and other applied technical content. Phipps et al. (2008) estimated 25% to 40% of an agricultural educator’s workload is spent teaching agricultural mechanics topics, yet many agricultural education teacher preparation programs require few agricultural mechanics credits in graduation requirements (Burriss et al., 2005; Byrd et al., 2015).

Despite the significant amount of agricultural mechanics coursework in the agricultural education classroom and being a career traditionally reserved for males, the number of female agricultural educators has grown and continues to rise each year. Teacher preparation programs have received an influx of female undergraduate enrollment and females represent 50% or higher of student teaching populations (Burriss et al., 2010; Saucier & McKim, 2011; Smith et al., 2021). In 2015, every FFA region in California possessed significantly more female teachers than male teachers, in some cases even double the number of male teachers (Teach Ag, n.d.). There were 808 agricultural educators in California in 2015, 58% were female and 42% were male. The increased number

of females in the profession is prominent throughout agricultural education programs in the United States (Teach Ag, n.d.). Vancouver & Ilgen (1989) suggest a profession can continue to be perceived as male dominated regardless of the increased number of females in the profession. Several female individuals in a recent case study indicated a lack of sense of belonging in agricultural education and suggested some individuals believe the profession is still a man's job (Kelsey, 2007). In another qualitative case study, a millennial female agricultural educator (and other older female educators) expressed many struggles with her male co-teachers, pressure from others to prove her teaching qualifications and abilities, and experienced sexism and resentment from students for being female (Baxter et al., 2011).

The traditional gender stereotype of an agricultural educator is a male educator. Tummons et al., (2017) argues the young, female agricultural educators today are now filling many teaching positions once held by males and are now becoming the new stereotype. Many secondary age students are finding themselves in the position of enrolling in agricultural education courses and receiving instruction from a female instructor instead of the traditional male stereotype.

The majority of female agricultural educators are potentially teaching various agricultural mechanics competencies traditionally taught by their male counterparts (Saucier & McKim, 2011). Many of these females across the U.S. are teaching welding courses representing an extremely predominate male blue-collar industry (U.S. Bureau of Labor Statistics, 2021). These female agricultural

educators are not only obtaining positions once held primarily by males but are teaching courses containing few female students. After a brief search of literature regarding the number of females enrolled in secondary welding courses, little information was found in current scholarly articles. An outdated research analysis documented a total of eight female students were enrolled in welding courses over a span of 11 years at a two-year technical college in California (Garlock, 1975). In 2020, a Texas secondary welding instructor described how few female students (i.e., only one or two females) enroll in his welding classes every year (Battis, 2020). In a Tennessee high school, it was reported only one female was enrolled in the dual enrollment welding program through a local college (William, 2021). Both articles mention the increasing number of females in welding courses, yet very few females are enrolled compared to their male counterparts according to the welding instructors. Leopold (2021) suggested welding careers are nontraditional careers for females and perhaps a reason why few females are enrolled in secondary welding courses.

Female welding educators offer instruction and teach skills representing an industry in which females represent only 3.5% of workers (Tummons et al., 2017; U.S. Bureau of Labor Statistics, 2021). The high increase of females in agricultural education teaching mechanics is a revolution for the profession, yet certain issues can arise in the classroom or laboratory. These challenges may include gender bias from students particularly because of the lack of females in secondary welding courses and outdated stereotypes of males as agricultural educators (Baxter et al., 2011; Kelsey, 2006; Kelsey, 2007).



Outdated agricultural education literature suggested females' only role in agricultural education was as horticulture instructors in multi-teacher programs (Bradley, 1971). Thompson (1986) found, more than a decade later, females continued to report increased amount of discrimination and struggles with job placement compared to males in agricultural education. Major changes in society have built the foundation for females in agricultural education as today females are highly represented as agricultural educators (Saucier & McKim, 2011; Tummons et. al., 2017). However, barriers continue to exist for females to enter and remain in male dominated and previously male dominated careers such as agricultural education (Baxter et al., 2011; Kelsey, 2007). Additionally, many female agricultural education graduates struggle with job placement as a result of gender bias from school administrators and male co-teachers towards a female's ability to teach mechanical and practical skills (Baxter et al., 2011; Kelsey, 2006). In a 2007 study regarding gender bias in agricultural education among females, 64% of female participants experienced gender bias throughout their teaching experience from peers, school administrators, and community members (Kelsey, 2007). Gender bias from administration during interviews was also prevalent as one superintendent asked a participant the question, "Are you sure you can weld? I've never seen a girl that can teach mechanics" (Kelsey, 2007). This is a common trend across the country regarding administration and bias towards females in agricultural education. Gender bias based on stereotypes is extremely prevalent in modern and past agricultural and technical education literature (Baxter et al., 2011; Kelsey, 2006; Kelsey, 2007, Oliveira, 2011, Leopold, 2021).

Mitchell & Martin (2018) conducted a study regarding student evaluations of faculty at the post-secondary level to determine factors students use to evaluate male and female professors and investigate differences between male and female professor evaluations. Mitchell & Martin (2018) claim males and females are evaluated based on different factors (e.g., females are evaluated primarily on appearance, personality, and student perceptions of intelligence/competence). In this study, both a male and female instructor taught identical online political science courses. A content analysis of the course evaluations and other data were collected to assess gender bias in the course evaluations. The data revealed the male instructor received higher evaluations than the female instructor (Mitchell & Martin, 2018). Student descriptions of the two professors were significantly different as students described the female instructor more often as “teacher” rather than “professor.” MacNell et al., (2015) suggested an instructor’s gender is a critical and influential component in student ratings of teacher performance because students judge teachers based on their gender. Gender bias is evident from the Mitchell & Martin (2018) study which demonstrates the potential for gender bias in agricultural mechanics courses (Boring, 2017; MacNell et al., 2015; Miller & Chamberlain, 2000). Gender bias and associated issues may increase with the influx of female agricultural educators if students perceive female educators to have lesser and/or lower teaching capabilities in agricultural mechanics courses compared to male educators.

## **Statement of the Purpose**

In recent decades, research has provided an uncertain number of female agricultural educators (Burris et al., 2010; Foster, 2001; Knight, 1987; Phipps et al., 2008; Saucier & McKim, 2011; Shultz et al, 2014). It is difficult to find the exact number of female agricultural educators who specifically teach agricultural mechanics courses, yet the average agricultural educators are most likely teaching a minimum of one agricultural mechanics course (McKim & Saucier, 2011).

Research has been conducted to gain an understanding of gender bias in educational settings (MacNell et. al., 2015; Mitchell & Martin, 2018), yet very little research has been conducted regarding student perceptions of their agricultural educators. Little to no research has been conducted specifically in agricultural education to determine students' perceptions of female agricultural mechanics instructors. This study described undergraduate students' perceptions of instructors in a post-secondary introductory welding course to examine potential gender bias and preference towards male or female welding instructors.

## **Research Questions**

The purpose of this study was to examine students' perceptions of learning from a female instructor versus male instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology. This study was designed to evaluate potential bias towards receiving instruction from a male or female welding instructor. This research was guided by the following question: Are there

differences in students' perceptions of female instructors versus male instructors of a post-secondary welding course? The following research objectives were developed to answer the research question.

1. Describe the demographic profile of students in a post-secondary welding course.
2. Describe college students' attitudes toward the gender of their welding instructor and determine any difference between male and female participants and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and their attitudes toward the gender of their welding instructor.*
3. Describe college students' perceptions towards welding technology and determine any difference between gender and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and their perceptions of welding technology.*
4. Describe college students' tinkering self-efficacy and determine any difference between gender and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and tinkering self-efficacy.*
5. Describe college students' perceptions about learning welding technology and determine any difference between gender and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and perceptions about learning welding technology.*

6. Explain the relationship between college students' demographics (i.e., gender, degree of study, and age) and their perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.
  - *H<sub>0</sub>: There is no relationship between participants' demographics and their perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.*
7. Explain the relationship between college students' choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, and perceptions about learning welding technology.
  - *H<sub>0</sub>: There is no relationship between college students' choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology.*

### **Assumptions**

Assumptions for this study were based on the instructor and participants roles. The study's assumptions were as follows:

1. All class participants were unaware of a research experiment being conducted.

2. Participants were able to independently complete both surveys (two throughout the semester).
3. Participants answered all questions honestly.
4. There was no bias from welding course instructors towards particular students or course sections.
5. Welding course instructors treated all students equally.
6. Switching instructors halfway through the semester adequately measured student's perceptions of instructor gender and kept all other variables constant.
7. The constructs (Perceptions toward Welding Technology, Tinkering Self-Efficacy, Perceptions about Learning Welding Technology, and Instructor Evaluation) were adequately measured by an instrument adapted for this study.

### **Significance of the Problem**

Gender bias is a prevalent issue in the classroom and in student evaluations (MacNell et al., 2015; Mitchell & Martin, 2018) and yet little research has been conducted regarding student evaluations in agricultural education. It is vital to understand student perceptions and bias towards their teachers, the Pygmalion effect, and the impact it may have on female educators in agricultural mechanics. Gender stereotypes and bias are rarely addressed in teacher preparation programs (in male or female dominated career pathways) and rarely provide resources for teachers to overcome gender bias issues which may arise in their future classrooms (Kollmayer et al., 2020). Research targeting the source,

the classroom, and students, will benefit researchers and teacher educators to better prepare female and male agricultural educators to provide improved agricultural mechanics instruction and remain confident in their abilities.

### **Definition of Terms**

*Agricultural Education* – In regard to this study, any high school program with a certified agricultural educator and agriculture content courses (e.g., welding, animal science, leadership, plant science, etc.).

*Agricultural Mechanics* - A sector of agriculture comprised of technical content and hands-on skills such as welding, woodworking, small engine repair, fabrication, and other applied technical content courses in a laboratory setting. (The National FFA Career Development Events Handbook, 2006).

*Gender bias* – An instance where an individual is treated differently based on their gender or perceived gender (The Cornell Law School, 2020).

*Gender stereotypes* - A preconceived perception or idea of males and females based upon social standards.

*Gender preferences* - The unconscious or conscious decision of one gender over the other.

*Self-efficacy* - An individuals' own belief of themselves regarding a topic or skill (Baker & Krause, 2007).

*Tinkering* - Disassembling, assembling, fixing, and manipulating with components or devices (Baker & Krause. 2007).

**Summary Statement**

The stereotypical average agricultural educator has altered significantly in past decades. Many positions once held by males are now held by females who are teaching agricultural mechanics, traditionally viewed as a male dominated profession. With the recent increase in female instructors, the potential for gender bias may rise if students perceive female instructors to have lower abilities to teach agricultural mechanics content versus a male instructor. This study was designed to gain a better understanding of gender bias to better prepare female educators to teach agricultural mechanics because gender bias and associated issues will not support or retain females who are currently the future of the profession (Smith et al., 2021).



## **Chapter II: Literature Review**

### **Introduction**

The purpose of this study was to examine students' perceptions of learning from a female instructor versus a male instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology. This study was designed to evaluate potential bias towards receiving instruction from a male or female welding instructor. This study seeks to answer the question, "Are there differences in students' perceptions of female instructors and male instructors of a welding course?" Chapter II will introduce the theoretical framework used to guide this study and the conceptual framework. A literature review regarding previous gender bias research in education and agricultural education will also be provided. Previous gender bias research in education has been conducted through end of course evaluations (Mitchell & Martin, 2018). A similar project regarding research design and methods was completed in 2015 which will be discussed in the literature review (MacNell et. al., 2015).

### **Theoretical Framework**

#### ***Social Role Theory & Pygmalion Leader Effect Theory***

There are several theories which attempt to expound on gender bias in the modern workplace and throughout previous years. For this particular study, we rely on social role theory developed in the 1980's (Eagly, 1987). Research and

literature regarding gender in the workplace and sex differences was emerging rapidly during this time as females' work and home roles were quickly changing and adjusting. Eagly's social role theory of sex differences suggests the behavioral differences between males and females are consequences or effects of the sex stereotypes developed and taught by societal culture (Eagly, 1987). Young boys and girls act differently from a young age due to developed social gender roles and gender norms taught by parents, teachers, and other adults to children (Eagly, 1987). For example, young children's clothing items are designed with certain colors and patterns due to societal norms for girls or boys; young girls' clothing items in a store are usually pink and purple whereas young boys' clothing items are usually blue and green.

It can be agreed upon in our modern society there are socially acceptable gender assigned roles and gender dominated occupations (e.g. blue-collar and pink-collar jobs) which have developed from social stereotypes (Leopold, 2021). Social role theory suggests repercussions in subordinate (e.g. student) perceptions when the leader's (e.g. instructor's) gender and work situation are incongruent (Eagly, 1987; Eagly & Karau, 2002). When roles are incongruent (e.g. a female in a male stereotyped position), their potential leadership ability may be devalued by subordinates (e.g. students) (Eagly & Karau, 2002; Eagly et al., 1995; Rosette & Tost, 2010). Schein et al., (1996) suggests gender stereotypes illustrate and define individual success. A female teaching an agricultural mechanics course has the potential to be deemed an incongruent role according to previous female stereotypical roles. Another example of a potential incongruent gender role may

be a male nurse which may therefore increase the odds of patients acting skeptical towards the male nurse. Karakowsky et al., (2016) suggests congruent gender and work roles have a positive influential effect on subordinates (e.g. students) perceptions of the leader (e.g. teacher), therefore the students will develop greater perceptions of trust and rapport.

The Pygmalion leader theory applied to a teacher-student relationship illustrates the effect of an individual's influence upon another individual (Karakowsky et al., 2016). When a student possesses high expectations of a teacher, the teacher will potentially result in higher performances with greater achievement. Karakowsky et al. (2016) suggests internal gender biases and stereotypes are responsible for the Pygmalion effect to trigger. The gender of the leader is not to blame but social stereotypes are to blame (Eagly, 1987). In an educational setting, gender stereotypes largely influence students' perceptions of their teachers (MacNeill et al., 2015; Mitchell & Martin, 2018; Karakowsky et al., 2016). In a previous paper Karakowsky et al., (2016) suggests it is essential for targets (e.g., students) to perceive their leader (e.g., teacher) as a credible judge with established rapport to be responsive to the leader's efforts (Karakowsky et al., 2012). McKnight et al., (1998) suggests initial trust occurs through stereotyping individuals into categories based on race or gender.

The effects of social role theory and the Pygmalion effect can be studied in education, the workplace, and even the modern home. Studying the Pygmalion effect in an educational setting can provide evidence for future research

recommendations and increase understanding of gender bias repercussions as it relates to females in agricultural mechanics education.

### ***Gender Bias & Stereotypes***

It is critical to gain an understanding of gender bias to recognize the need for this research. The Cornell Law School (2020) described gender bias as a situation where an individual is treated differently based on their gender or perceived gender. Both males and females are judged based on socially accepted gender roles or stereotypes (Mitchell & Martin, 2018). Much has changed in the equality treatment of males and females in previous decades and centuries (e.g., women given the right to vote in 1929), yet gender bias and barriers continue to be prevalent today in the workplace. Barriers continue to exist for females to enter blue collar trades and STEM (Gabriel & Schmitz, 2007; Leaper, 2015; The Center for Construction Research and Training, 2007), therefore the number of females entering those careers are slim compared to other careers which are not deemed male oriented.

Acker (1990) suggests females occupy lower positions in the workplace with less confidence and are less logical compared to their male counterparts. Females have been stereotypically described as possessing “warmer” personalities whereas males have been described to have “legitimate authority,” therefore females are required to prove themselves to earn the same respect in certain work settings (Acker, 1990; Baxter et al., 2011; Bennett, 1982). The differences between male and female behavior may seem easily explained by biology factors (Ellemers, 2014) yet many studies regarding cognitive performance, social

behaviors, and psychological performance surprisingly revealed more biological similarities exist than differences between the two genders (Hyde, 2014). Biology does not cause differences between males and females according to literature; socially accepted harmful gender stereotypes create theoretical and stereotypical boundaries and roles for males and females which influences differences between the two genders (Ellemers, 2017).

### ***Lack of Sense of Belonging***

It is a human necessity for males and females to obtain a sense of belonging to be truly satisfied and engaged in a particular environment (Lave & Wenger, 1991). It is also a basic human need according to Maslow's hierarchy of needs (Maslow, 1962). A sense of belonging occurs in environments where an individual senses connection, acceptance, support, and respect from others (Baumeister & Leary, 1995; Hagerty et al., 1992). Brainard & Carlin (1998) suggest developing a sense of belonging is critical among females in STEM careers and for the future of females in STEM. Females tend to avoid careers in male oriented realms (England, 2010) perhaps because of the lack of sense of belonging in a male dominated profession (Brainard & Carlin, 1998). There is a lack of females in welding courses and in the welding profession (Battis, 2020; U.S. Bureau of Labor Statistics, 2021; William, 2021) and a lack of sense of belonging may be a potential factor in regard to females entering the welding profession.

### ***Gender Bias in Education***

Evidence of gender bias in education and academia is highly prevalent in research literature. There are several theories which support gender bias issues in the classroom, but most important is the basic fundamental theory regarding expectations. Students expect their instructors (e.g. in post-secondary educational settings) to follow or behave in established stereotypical “masculine” or “feminine” manners which comply with the instructor’s gender (MacNell et. al., 2015). Students, subconsciously or consciously, uphold their teachers to these stereotypes. When sex and gender stereotypical roles are socially incongruent, social consequences may occur (Karakowsky et al., 2016). Therefore, a female instructor in a course identified as blue-collar work or STEM may receive judgement from students. Previous research suggests instructors who follow gender assigned expectations are highly favored among students (Andersen & Miller, 1997; Bennett, 1982).

Two recent studies in particular emphasize gender bias toward professors in undergraduate courses at public universities in the United States. MacNell et al., (2015) conducted a research experiment regarding student ratings of teachers in an online course. The independent variable (i.e., gender) was manipulated as the instructors identified as the opposite gender in one section of an online course and their authentic gender in another section (e.g. the female instructor posed as female for section one and as a male for another course section) for a total of four course sections. A 2-by-2 experimental design was used to compare evaluations of perceived gender with authentic gender (MacNell et al., 2015). Each course

was an identical, online course designed to contain duplicate information. The only difference was email communication between the instructor and students. A significant difference was found between student ratings/perceptions of the male instructors (e.g., authentic and posed male instructor) and female instructors (e.g., authentic and posed female instructor). The female instructors possessed much lower ratings compared to the male instructor and the posed male instructor (MacNell et al., 2015). Student ratings at the university or post-secondary level are often utilized to gain tenure and often signify higher quality of teaching, yet Mitchell & Martin, (2018) suggest students evaluate male and female instructors on different factors.

Mitchell & Martin (2018) conducted a similar study to better understand the relationship between an instructors' gender and the student evaluations of the instructor with similar motives regarding professors' tenure and ratings. This research project consisted of a male and female instructor who each taught an identical online course. A content analysis was conducted of open-ended course evaluations and online "Rate My Professor" website evaluations. Mitchell & Martin, (2018) produced similar results to MacNell et al., (2015). The female instructor received overall lower ratings than the male instructor. Mitchell & Martin (2018) suggest based on their study findings that males and females are judged based on different criteria in an educational setting; females are evaluated primarily on appearance, personality, and perceptions of intelligence/competence.

Females were rated poorly compared to the male counterparts in the identical online courses when personality and appearance were not variables

(Mitchell & Martin, 2018). The female professor was also referred to as “teacher” more often than “professor” contrary to the male professor which contributes to the argument that female instructors are perceived to be more unqualified compared to males in certain educational settings (Mitchell & Martin, 2018).

### ***Gender in Agricultural Education***

Many occupations traditionally perceived to be reserved for males continue to remain heavily male dominated regardless of the increased number of females entering those professions (Vancouver & Ilgen, 1989). Recently it has become more socially acceptable for males and females to hold socially incongruent gender and work roles. Agricultural education was arguably a male oriented career for many years since the origin of the Future Farmers of America in 1928 as membership in the organization was reserved for male students (National FFA Organization, 2022). Almost 40 years ago, in 1987, 5.1% of secondary agricultural educators identified as female (Knight, 1987). The number of female educators has slowly increased over time; in 2014 approximately 33% of agricultural educators were female. Foster (2001) suggests agricultural education was not traditionally viewed as a career available to females, yet the gender gap in agricultural education has decreased and currently females are the majority of professionals. Females represent approximately 76% of individuals entering the agricultural education profession (Smith et al., 2021).

Many challenges consistently exist for agricultural educators to be successful (e.g., work family balance, Supervised Agricultural Experiences (SAE), teaching a variety of topics, FFA duties, etc.). Gender bias in the



agricultural education workplace is unamiable and does not support the demand for teacher retention, a critical issue in agricultural education. Foster (2003) presented three main acceptance barriers (i.e., acceptance by student parents/community, peers, and administration) to females when entering the agricultural education profession, yet all barriers involved emotions of lack of acceptance (lack of sense of belonging) from parents/community, peers (e.g., male teachers), and school administration.

Gender is a consistent topic prevalent in agricultural education literature, yet the majority of research consists of self-efficacy, case studies, theoretical based research, and non-experimental studies. Little research exists regarding students' perceptions of their agricultural educators and even less in agricultural mechanics. Yet previous research demonstrates evidence of bias female agricultural educators have experienced, for the past few decades, in the profession from their male counterparts, administration, and students.

Cano (1990) conducted a study investigating male agricultural educators' perceptions toward female agricultural educators and claimed discrimination against female educators was highly evident from the male educators, students, community, employers, and parents (Cano, 1990). Although Cano (1990) was conducted 33 years ago, these findings continue to be relevant today as similar findings occur in the 2000's agricultural education literature (Baxter et al., 2011; Kelsey, 2006; Kelsey, 2007).

Many participants in several agricultural education case studies reported gender bias from peers, school administrators, and community members (Baxter

et al., 2011; Kelsey, 2006; Kelsey, 2007). Kelsey (2006) conducted a mixed-method study investigating teacher attrition among females in secondary agricultural education positions in Oklahoma. Kelsey (2006) found “subtle sexism” as a hurdle for many of her study participants throughout their agricultural education careers. Several individuals experienced sexism or gender bias in the job interview process such as inappropriate questions. Many of Kelsey’s (2006) study participants indicated being a female impacted their job search. Similar results were found a year later in Kelsey’s (2007) case study targeting gender bias among female agricultural educators. Gender bias from administration during interviews was also prevalent as one superintendent asked a participant if she was “sure she could weld” (Kelsey, 2007). Over half of study participants experienced gender bias or discrimination throughout their career (Kelsey, 2007).

Baxter et al., (2011) conducted a study utilizing interviews and open-ended questions to determine barriers for females in agricultural education throughout the past few decades. Several themes arose from the female study participants such as the pressure to prove to they were qualified to be agricultural educators and perform assigned duties, and sexism from students, co-teachers, and community members.

### ***Gender in Agricultural Mechanics***

The agricultural mechanics competency of agricultural education has traditionally been perceived to be taught and reserved for male educators (Bradley, 1971) and has been a substantial barrier for female agricultural

educators to overcome. Females' roles in previous outdated agricultural education literature were strictly to teach horticulture in multi-teacher programs and under no circumstance teach mechanics (Bradley, 1971). The majority of agricultural educators today teach a variety of courses; one in four courses fall into the agricultural mechanics category (McKim and Saucier, 2001). Agricultural mechanics course subjects may include but are not limited to welding, fabrication, woodworking, and other applied technical content courses.

Female educators face unique challenges as agricultural mechanics instructors (Tummons et al., 2017) inflicted by the accumulation of gender bias from the majority of individuals they interact with (e.g., students, peers, administration, etc.). Many female agricultural educators are teaching various agricultural mechanics competencies traditionally taught by their male counterparts (Saucier & McKim, 2011). Female pre-service and early career agricultural educators have presented concerns of teaching agricultural mechanics content (Kelsey 2006; Kelsey, 2007; Tummons et al., 2017). Many agricultural education teacher preparation programs require few credits in agricultural mechanics (Burriss et al., 2005; Byrd et al., 2015) which does not reinforce female agricultural educators concerns of teaching agricultural mechanics. Female agricultural mechanics educators teaching welding courses are teaching skills from an industry in which females represent only 3.5% of workers (Tummons et al., 2017, U.S. Bureau of Labor Statistics, 2021).

The increased number of females teaching mechanics is a revolution for the agricultural education profession, yet certain issues can arise in the classroom

or laboratory such as gender bias particularly because of the lack of female students enrolled in secondary welding courses and outdated stereotypes of males as agricultural educators (Baxter et al., 2011; Kelsey, 2006; Kelsey 2007). There is little to no experimental research examining gender bias and preference in agricultural education specifically in the realm of agricultural mechanics and even less research from the students' perspective. As the number of female teachers who teach agricultural mechanics increases, the potential bias and discrimination also increases. Research is critical to understand the potential bias students present towards their teachers and the challenges present in our profession.

### ***Perceptions of Welding Technology***

It is well documented less females are involved in STEM (Bond, 2016) and in welding (U.S. Bureau of Labor Statistics, 2021) compared to their male counterparts. It is paramount for an individual to take an active role in their education to find meaning in a subject (Sallee et al., 2013). Therefore, if a student possesses little to no value in welding technology, their perception of their instructor or the welding course may potentially be different.

### ***Tinkering Self-Efficacy***

Tinkering self-efficacy is an individuals' own belief in themselves regarding competence, comfort, and experience in manual activities (Baker & Krause, 2007). Baker & Krause (2007) have described females as lacking experience with machinery and regard females to have a lower tinkering self-efficacy than their male counterparts. Females are also regarded as more

apprehensive of mechanical devices compared to males, therefore decreasing their comfortability, and tinkering self-efficacy (Beckwitk et al., 2006; Crismond, 2001). If this is accurate, students may have lower expectations (e.g. Pygmalion effect theory) of a female instructor, negative perceptions, or even be surprised to be receiving instruction from a female in a welding course. Tinkering self-efficacy is crucial to understand the differences among female and male participants in agricultural mechanics courses and the potential correlation between tinkering self-efficacy and their attitudes toward the gender of their welding instructor. If a participant has high levels of tinkering self-efficacy, they might have different perceptions of the instructors compared to an individual with low levels of tinkering self-efficacy. Female students who have a lower tinkering self-efficacy might perceive a higher value for instruction from a female instructor in order to reduce feelings of inadequacy in the technical domain, feel a stronger connection or be more comfortable working with a female instructor. Parsons (1995) suggests three factors contribute to tinkering: experimental, social, and personal (e.g., referring to an individuals' like or dislike towards a topic). If an individual has high tinkering self-efficacy, we can infer they have higher confidence and competency regarding their tinkering abilities compared to an individual with low self-efficacy (Baker & Krause, 2006).

### ***Perceptions about Learning Welding Technology***

Motivation and experience are essential in student learning (Kolb, 1984; Phipps et al., 2008) as motivation to learn a subject can be difficult without enjoyment of the subject. Lack of experience is a potential trial in the learning

process as experience gives individuals the information needed to give them ownership in the learning process (Kolb, 1984). It is essential for a learner to examine the course teachings and then make a conscious decision about the information (Sallee et al., 2013) therefore perceptions about learning a particular subject (e.g., welding technology) may be critical information to collect from individuals. Perhaps males and females have significantly different perceptions towards learning welding technology which would provide crucial findings for the future of females in agricultural education, welding careers, and STEM.

### ***Potential Demographic Bias Factors***

Demographics can provide information regarding individuals to identify common trends among groups. Every individual is different and unique, yet groups of individuals have certain similarities as each are shaped by certain environmental factors (Vanderstel, 2014). Three potential pieces of demographic information (e.g., gender, degree of study and age) are common pieces of evidence to collect from individuals in a study. Research suggests college students are in two different categories: traditional and non-traditional students. Kasworm (1982) suggests non-traditional and traditional aged college students have different behaviors. Collegiate students 18-23 typically began their college education promptly after high school commencement (Johnson, 2013; Stringer, 2022). Collegiate students over the age of 24 typically did not attend college directly after high school commencement (Johnson, 2013; Stringer, 2022). Stage of life (e.g., student category or age) may be a major influence on an individual's perceptions of their instructor or of a subject. Older individuals have more "life

experience” therefore may potentially have more experiences working with individuals or females in position of authority.

Previous research regarding college students’ degree of study suggests personality and political views are major influences on students’ choice of college major (Balsamo et al., 2012; Porter & Umbach, 2006). Students who have chosen a college major have specific personality traits similar to others in their majors and fields of study (Balsamo et al., 2012). Therefore, students studying in technology-oriented degrees may have differing perceptions of male and female welding instructors or of welding technology compared to other studying in non-technology oriented degree programs.

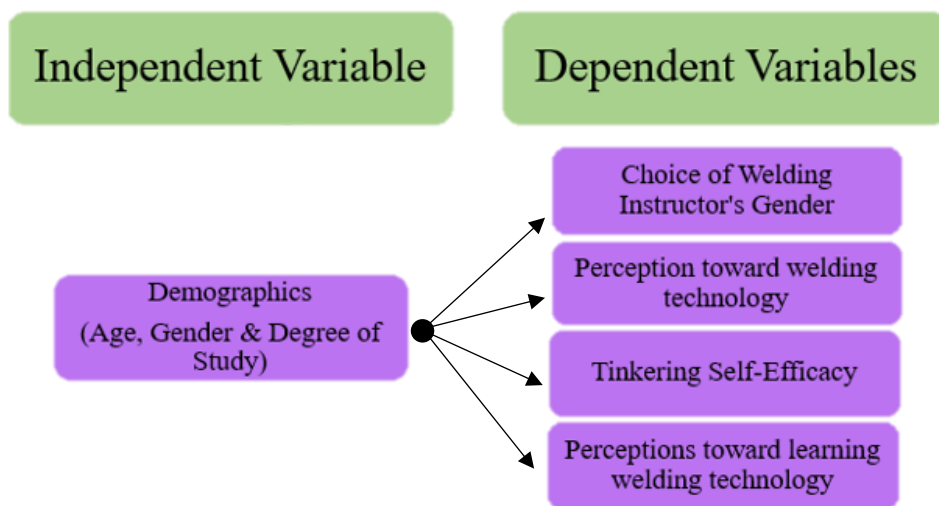
### **Conceptual Framework**

The conceptual framework (figure 1 and 2) was developed based on the theoretical framework, literature review and potential differentiating factors between students in agricultural mechanics courses. The framework served as a guide throughout this research study. The conceptual framework model consists of different relationships of the three constructs (e.g., perceptions toward welding technology, tinkering self-efficacy, perceptions about learning welding technology), demographic information, and student choice of their welding instructor’s gender. Figure one suggests students’ demographic information (e.g., age, gender, and degree of study) has potential influence on their choice of their welding instructor’s gender, their perceptions of welding technology, tinkering self-efficacy and perceptions about learning welding technology. Figure two suggests students’ perceptions of welding technology, tinkering self-efficacy,

perceptions of learning welding technology and demographic information (e.g., age, gender, and degree of study) may influence an individual's choice of their welding instructor's gender.

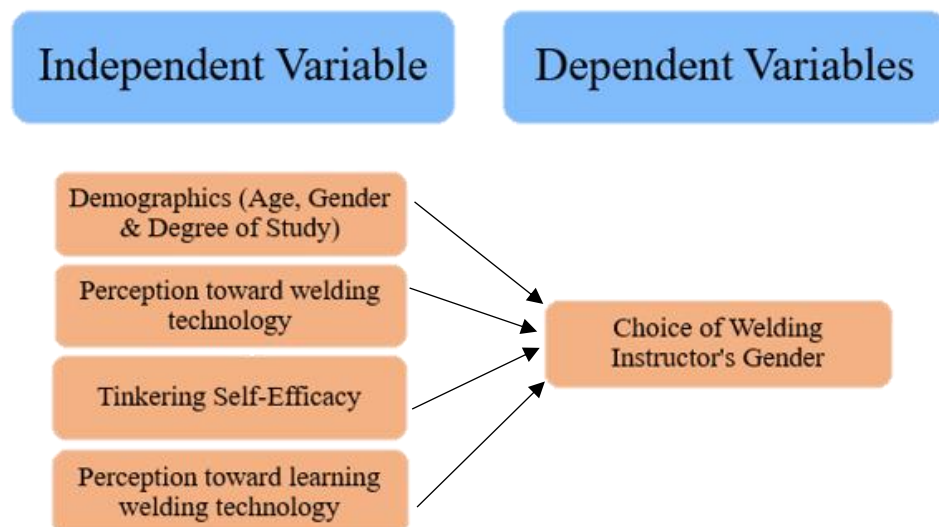
**Figure 1**

*Objective 6*



**Figure 2**

*Objective 7*





## **Chapter III: Methodology**

### **Introduction**

The purpose of this study was to examine students' perceptions of learning from a female instructor versus male instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology. This study was designed to evaluate potential bias towards receiving instruction from a male or female welding instructor. The research was guided by the following question: Are there differences in students' perceptions of female instructors versus male instructors of a post-secondary welding course?

### **Research Design & Rationale**

The research project was a two-group repeated measures counterbalance quasi-experimental design (Johnson, 2020; Sullivan, 2008). This design was chosen to ensure we were able to manipulate certain independent variables to collect the necessary data to investigate the research questions. The research design tested perceptions from two independent groups (i.e., Tuesday and Thursday course sections) simultaneously to evaluate changes from the beginning to the end of the semester after the treatment. The treatment was the switching of welding course instructors at week eight. Agricultural education literature possesses a significant amount of similar survey designs which provided the confidence to move forward with the two-group repeated measures

counterbalance quasi-experimental design (Bird et al., 2019, Murphy & McKibben, 2021). Pre-survey and post-survey experimental design is often used in education action research and experimental designs to evaluate participants' attitudes or perceptions based on a treatment (Stratton, 2019).

We collected data through a pre-survey (week 4) and post-survey (week 12) to collect student perceptions toward three constructs: (1) welding technology, (2) learning welding technology, and (3) tinkering self-efficacy. Individual questions and statements were measured on a seven point Likert-scale to observe participant's attitudes toward the gender of their welding instructor. Demographic information included age, gender, and degree of study to provide means for grouping students, describing our sample/population, and viewing differences between student demographics, the constructs, and other survey questions. The experiments were conducted in the spring of 2022 and fall of 2022 in the Utah State University ASTE 3030 metal welding processes and technology in agriculture (i.e., beginning welding) course.

The experimental treatment variable was the gender of the course instructor. Each section was randomly assigned to begin the course with a female or male instructor. Each instructor taught and associated only with their assigned section (e.g., the female instructor taught lecture and lab for the Thursday section). Course instructors collaborated together to ensure all curriculum and teaching strategies were identical in design. Online course pages were identical. The instructors switched course sections at week eight in order to gain information about students' perceptions of both the male and female instructors.

We did not inform students of the experiment until the conclusion of the semester (i.e., after both surveys). Students were notified via an online course announcement that the welding course instructors were required to switch course sections due to scheduling conflicts in the university department. Students were informed by an independent observer during survey administration that the surveys were used to improve the course quality. We utilized deception to maintain validity and limit possibility of the Hawthorne effect which occurs when study participants recognize they are being studied and adjust their behaviors (Fox et al., 2008). For example, if study participants knew the instructors were going to switch sections (i.e., the treatment) or the survey was not designed to necessarily “improve the course,” their survey responses would potentially be quite different. Validity is essential to advance research. If results were influenced by subjects' awareness of a research experiment, it may have been difficult to acquire valid results and test the hypothesis. There are three main methods to reduce the Hawthorne effect; 1) discard initial observations 2) use control groups and 3) secrecy (Simply Psychology, 2021). Secrecy or deception was most appropriate for this study. We recognized students may have speculated an experiment was conducted and might have conversed with friends and/or potential future study participants regarding the experiment. We were anticipated these factors did not affect our study during spring and fall 2022 as there was a summer session between the two semesters.

The pre-survey was administered by an independent observer in each course section at week four to collect data. Half-way through the semester, at week

eight, the instructors switched sections (i.e., students assigned to the female instructor for the first eight weeks then received instruction from the male instructor for the last eight weeks). At week 12, the post-survey (identical to the pre-test) was administered to study participants by the independent observer. At week 14 of the semester, students were informed of the experiment by the independent observer. Participants were requested to provide informed consent to allow the use of the survey results. The male and female course instructors did not have access to either survey to prevent favoritism or bias towards students. Table 1 contains a semester timeline describing timing of the surveys and the switching of instructors.

**Table 1**

*Experiment Semester Timeline*

Lab Section	Instructor Weeks 1-7	Pre-Survey	Instructor Weeks 8-15	Post – Survey	Informed Consents
Tuesday	Male	Week 4	Female	Week 12	Week 14
Thursday	Female	Week 4	Male	Week 12	Week 14

\*Same timeline used for spring and fall 2022 semesters.

**Limitations**

A limitation of this study was the lack of a random sample which we considered in statistical analysis, conclusions, and recommendations. While the findings of this study are not generalizable to the entire study population due to the lack of randomization, our findings do provide data to suggest future

recommendations and a foundation for future research in gender bias research in an agricultural mechanics setting (Stratton, 2019).

A second limitation or concern with the experimental design was ensuring the two welding courses were as identical as possible. Instructors collaborated to ensure curriculum, demonstrations, and online course pages were as identical as humanly possible. Instructors' welding and teaching skills were not measured and/or compared yet both instructors were deemed qualified to for the role of beginning welding instructors by a senior faculty member (i.e., a previous beginning welding course instructor). The instructors' both had previous experience teaching welding yet different backgrounds. The male instructor held a bachelor degree in welding technology, farmed a variety of crops, previously taught collegiate welding courses, and was working towards a master degree in agricultural systems technology education. The female instructor held a bachelor degree in agricultural education with an emphasis in agricultural mechanics, previously taught welding at the high school and collegiate level, previously worked as a part-time GTAW welder, and was working towards a master degree in agricultural systems technology education. Study participants were not explicitly informed of their instructor's gender. Potential extraneous variables included maturation, experiment effect (e.g., deception) and participants displaying socially acceptable answers (e.g., not their true beliefs) on the survey.

**Table 2***External & Internal Validity and Strengths & Weaknesses*

Validity Type	Explanation	Strength	Weakness
Internal Validity	Credible Findings	Pilot study conducted to allow for experiment and survey adjustments.	The experiment effect. Deception was utilized to limit the experiment effect.
		Experiment conducted twice (spring and fall 2022) to ensure larger sample size.	Students might not have been truthful during survey administration (e.g., wrote socially acceptable answers).
External Validity	Generalizable Findings to Study Population	Research was applicable and similar in design to previous gender bias experiment research (MacNell, 2015; Mitchell & Martin, 2018).  Research can be replicated.	Sample is a convenience purpose sample and cannot be generalizable to study the population.

**Research Objectives**

Are there differences in students' perceptions of female instructors versus male instructors of a welding course? The following research objectives were developed to answer the research question.

1. Describe the demographic profile of students in a post-secondary welding course.
2. Describe college students' attitudes toward the gender of their welding instructor and determine any difference between participant gender and the course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and their attitudes toward the gender of their welding instructor.*
3. Describe college students' perceptions towards welding technology and determine any difference between participant gender and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and their perceptions of welding technology.*
4. Describe college students' tinkering self-efficacy and determine any difference between participant gender and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and tinkering self-efficacy.*
5. Describe college students' perceptions about learning welding technology and determine any difference between participant gender and course section.
  - *H<sub>0</sub>: There is no difference between students' gender or course section and perceptions about learning welding technology.*
6. Explain the relationship between college students' demographics (i.e., gender, degree of study, and age) and their perceptions towards welding

technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.

- *H<sub>0</sub>: There is no relationship between participants' demographics and their perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.*

7. Explain the relationship between college students' choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, and perceptions about learning welding technology.

- *H<sub>0</sub>: There is no relationship between college students' choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology.*

### **Population & Sample**

The population of this study was undergraduate students. The sample was a convenience purpose sample of male and female undergraduate students enrolled in the ASTE 3030 (metal welding processes and technology in agriculture) at Utah State University in the following semesters: spring 2022 and fall 2022. Several individuals elected not to participate in the research study. A total of 45 individuals elected for their survey information to be utilized in the research analysis. The chosen sample was representative of the study population, yet the statistical data inferences did not represent the entire population due to the



sample lacking randomization (Stratton, 2019). The large sample size of 45 participants aided in research validity and statistical analysis. A convenience sample was the most logical option as the ASTE 3030 welding course was a convenient group of undergraduate students for us to work with. A weakness with convenience sample in quantitative research is the majority of statistical functions rely on and assume data is random (Robinson, 2014). The majority of research experiments do not contain random samples but instead convenience samples due to the difficulty of administering research with random samples (Johnson, 2020). The project consisted of two convenience samples to support the statistical analysis and research reliability. A random sample would have required recruiting undergraduates to be enrolled in the course which would have resulted in inaccurate data.

It was estimated the sample would contain more male students based on previous undergraduate enrollment in the ASTE 3030 course. A brief analysis of the previous two years of ASTE 3030 course enrollments through the Utah State University's record system revealed approximately 20-30% of each course section was female while the rest was male. Students were studying a variety of degree programs and were a variety of ages (e.g., degree program and age trends were also revealed in the brief search). All students in the course were eligible to be study participants regardless of gender, age, or degree of study.

## **Instrumentation**

The pre-survey and post-survey instruments were identical in nature and gauged student preferences and bias towards the welding instructors. The survey consisted of three constructs on a seven-point Likert-Scale: Perceptions toward Welding Technology (7 items), Tinkering Self-Efficacy (7 items) and Perceptions about Learning Welding Technology (14 items) (see appendix A). Questions regarding attitude toward the gender of the welding instructor were also measured on the Likert-Scale and in true or false questions. Demographic information (e.g., age, degree, gender, etc.) was collected through open-ended questions.

The constructs and questions were selected based on previous literature regarding research in gender bias research, technical education, and potential correlations to gender bias (Baker & Krause, 2007; Bond, 2016; Sallee et al., 2013; Satori 2012). Content validity for the instrument was evaluated by a panel of agricultural education faculty knowledgeable in survey research methods, design, and analysis.

The majority of the survey instrument consisted of independent statements on a seven-point Likert-scale (1 = *strongly disagree*, 4 = *neutral*, 7 = *strongly agree*) and the last section collected data through other questions. Table 3 provides more information regarding each variable and statistical data type. The majority of constructs and survey items were developed by the research team. The tinkering self-efficacy construct was adapted from Baker & Krause (2006).

**Table 3***Statistical Data Type*

Variable	Instrument	Data Type
Construct 1 - Perceptions of Welding Technology	7 – Pt. Likert Scale	Scale
Construct 2 - Tinkering Self-Efficacy	7 – Pt. Likert Scale	Scale
Construct 3 - Perceptions about Learning Welding Technology	7 – Pt. Likert Scale	Scale
Demographics - Age	Open-ended question	Continuous
Demographics – Gender	Open-ended question	Dichotomous*
Demographics – Degree of Study	Open-ended question	Continuous
Attitude towards welding instructor	7 – Pt. Likert Scale & True/False Questions	Categorical & Scale Data

\*Gender was a dichotomous variable. Students who did not identify as male or female were excluded from certain data analysis due lack of numbers.

*Perceptions toward Welding Technology*

The first construct in the survey instrument was, “Perceptions toward Welding Technology” measured through a seven-point Likert-scale and consisted of seven construct items. We reported means scores of the pre-survey and post-survey perception toward welding constructs and if a significant difference was present between the course sections (i.e., Tuesday and Thursday course sections) and between the male and female participants between the pre-survey and post-survey. Data regarding student perception of welding technology was crucial to investigate the male and female participants and review correlations between this

construct and their attitudes towards the male and female instructors. Sample construct items included: “Welding technology is important to learn” and “For my future career, I will utilize welding.”

### ***Tinkering Self-Efficacy***

The second construct in the survey instrument was, “Tinkering Self-Efficacy” measure through the seven-point Likert-scale and consisted of seven construct items. In our research study, tinkering was in regard to an agricultural shop or welding environment. In previous literature, males and females have displayed significantly different levels of tinkering self-efficacy (Baker & Krause, 2006). This construct was measured with a seven-point Likert-scale, each statement was brief and based upon tinkering theory; “I enjoy taking apart items and seeing how they work”, “I enjoy learning how machines operate”, and “I enjoy repairing equipment.” We reported means of the pre-survey and post-survey tinkering self-efficacy scores and if a significant difference was found between the course sections (e.g., Tuesday and Thursday course sections) and male and female student participants between the pre-survey and post-surveys.

### ***Perceptions about Learning Welding Technology***

The third construct was, “Perceptions about learning welding technology.” This construct was measured on the seven-point Likert scale and consisted of 14 items. Statements in this construct included, “I am not interested in learning welding,” “Oxy-Fuel cutting is a good skill to have,” and “Welding can be used in real life.” We reported means of the pre-survey and post-survey perceptions

towards learning welding technology scores and if a significant difference was found between the course sections (e.g., Tuesday and Thursday course sections) and between the males and females between the pre-survey and post-surveys.

### ***Instructor Evaluation***

The instructor evaluation portion is arguably the most crucial section of the survey. All questions directly correlated to student perceptions of their welding instructors and gender bias. Careful consideration was given to ensure all questions were essential to the overall purpose of the study and data/conclusions were expressed in an uncomplicated manner. Data were collected through six statements on a Likert-scale and two multiple choice questions.

1. The person who teaches welding does not impact my ability to learn the content.
2. If I believe the instructor is knowledgeable, I learn more.
3. I would learn more from a female instructor in this welding course.
4. I would learn more from a male instructor in this welding course.
5. I believe my gender is why I will be successful in welding.
6. An instructor who has welding experience is more beneficial to my learning than is their gender.
7. Given an option of instructors with similar background and knowledge of welding, which instructor would you choose?
8. I have no preference towards gender of the instructor if they can teach welding well.

The answer options for the question, “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose?” were a male or female instructor. No “either” or “neutral” option was provided to ensure study participants formed a conscious decision regarding the question. The question, “I have no preference towards gender of the instructor if they can teach welding well” was true or false. There was open space on the paper survey for students to write opinions or other answers to these questions. Descriptive statistics (e.g., means, standard deviations, valid percentages, etc.) were provided regarding the collected data.

### ***Demographics & Other Participant Information***

Sample demographics provided grouping variables to ensure accurate recommendations and conclusions were provided regarding the study sample. Demographics provided information regarding study participants to identify common trends among individuals with certain demographics. The demographic data collected were participant’s age, gender, degree program (i.e., the current undergraduate degree program participant was enrolled in at Utah State University). All demographic questions were open-ended ensuring participants possessed the ability to be as accurate as possible. Descriptive statistics (e.g., means, standard deviation, valid percentages, etc.) were reported regarding demographic information. Participant gender was vital data to collect to interpret different genders’ perceptions of the male and female welding instructors and differences between males and females in regard to the other constructs (i.e.,

perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology).

Two other questions were included to obtain information regarding if participant's had previous high school welding experience and if they enjoyed agricultural mechanization courses. This information was critical to provide accuracy regarding the number of males and females enrolled in secondary welding courses and if whether both genders enjoy agricultural mechanization courses.

### **Pilot Study, Validity & Reliability**

We conducted a pilot study in the beginning welding ASTE 3030 course at Utah State University in the fall of 2021 semester. The results from the pilot study were used to determine reliability and complete minor adjustments to the final instrument. In the pilot study, the study participants were enrolled in a lecture and laboratory course, and which consisted of the same lecture instructor, but different lab instructors. One major adjustment took place after the pilot study; students' only received instruction from one individual (i.e., study participants received instruction from the same lecture and lab instructor) to maintain reliability and consistency. Cronbach's alpha was determined to test for internal instrument reliability of the fall 2021 pilot study to ensure the instrument was dependable before spring of 2022.

**Table 4***Pilot Study Reliability Estimates of Instrument*

Construct	Pre- Cronbach's Alpha	Post – Cronbach's Alpha
Perceptions toward Welding Technology (7 items)	.804	0.791
Tinkering Self-Efficacy (7 items)	0.896	0.936
Perceptions about Learning Welding Technology (14 items)	0.814	0.774
Instructor Evaluation (2 items)	0.551	0.942

*Note.* Pilot sample size was (n = 30)

A paired-samples *t*-test was used to assess the impact of changing instructor gender on students' rating of learning from different instructor genders in the pilot study. Results were nonsignificant. Assumptions of paired-samples *t*-tests include normally distributed data, independent observations, and no outliers (Johnson, 2022).

**Data Collection**

Data were collected twice each semester. The pre-survey was administered by an independent observer during week four. The identical post-survey was administered during week 12 of the semester. All students received instruction from each instructor (e.g., a male and a female instructor) for three weeks before completing each survey. All surveys were paper copy and stored in the independent observer's office. Brief instructions were given to all participants before each survey. Students were not informed of the extent of the research project until week 14 when the course was almost completed.



## **Human Subject Approval**

The research experiment was reviewed and approved by Utah State University Institutional Review Board under protocol #12108 (see appendix B). Prior to the pilot study and collecting data, an IRB proposal was submitted consisting of the survey instrument and research summary. IRB regulations and ethical research procedures ensured no physical, emotional, or psychological harm would be inflicted upon the participants. All IRB protocols were followed to ensure confidentiality of participant information and responses.

## **Data Analysis**

At the completion of the study, all paper surveys were carefully coded and entered into Statistical Analysis Software (i.e., SPSS). Data was coded based on the Likert-Scale (1 = *strongly disagree*, 4 = *neutral*, 7 = *strongly agree*) and other questions such as demographic information (1 = male, 2 = female) were coded appropriately. Data were analyzed systematically to allow for descriptive and inferential statistical analysis for all seven research objectives. Cronbach's Alpha was determined to test for internal consistency in each construct. Statistical researchers recommend 0.6-0.7 is acceptable whereas 0.8-0.9 is very good (Ursachi, 2013) A level higher than 0.9 (e.g., or 0.95 depending on researcher) would regard the construct as redundant (Hulin et al., 2001). Between 0.6 and 0.9 was our aim for each construct to be considered valid. Information regarding Cronbach's Alpha in the pilot study can be found in table 4.

The analysis consisted of the spring and fall 2022 datasets aggregated together. The researchers considered implications of combining the two datasets and found no evidence to support analyzing the data by semester for this particular analysis. Independent samples *t*-tests were used to determine if differences were present between the spring 2022 and fall 2022 semesters in each construct and no statistically significant differences were present.

### ***Research Objective One Analysis***

Objective one utilized descriptive statistics such as means, standard deviations and valid percentages to describe participant age, gender, degree of study, the number of participants with prior secondary welding experience, and the number of participants who enjoy agricultural mechanization courses. Objective one was analyzed by course section (i.e., Tuesday or Thursday section) and by participant gender.

### ***Research Objective Two Analysis***

Objective two utilized descriptive statistics such as means, standard deviations, valid percentages, and inferential statistics such as independent samples *t*-tests and paired samples *t*-tests to describe attitudes about the gender of their welding instructors and compare differences between the course sections (i.e., Tuesday and Thursday) and participant gender. We hypothesized students' perceptions of their ability to learn welding content from a male and female would adjust after experiencing receiving instruction from a qualified female welding instructor. We also hypothesized the majority of male students would

prefer a male instructor at the beginning of the course and after receiving instruction from a female their perception would alter with more willingness to learn from a female.

Twelve individuals were mentioned in the analysis of objective and assigned pseudonyms to protect their identity. These individuals either indicated increased signs of gender bias compared to their classmates in survey questions, provided quotes on the survey instruments, or did not follow the same patterns as other members of their gender. A non-binary student was also given a pseudonym to protect their identity. Table 5 contains a list of all the individuals' assigned pseudonyms, their gender, and the course section they were enrolled in.

**Table 5**

*Participant Pseudonyms*

Participant Pseudonym	Gender	Course Section
Michael	Male	Tuesday
James	Male	Tuesday
Jack	Male	Tuesday
Joe	Male	Tuesday
Bill	Male	Tuesday
Ron	Male	Tuesday
Cameron	Non-Binary	Tuesday
George	Male	Thursday
Jane	Female	Thursday
Rose	Female	Thursday
Dave	Male	Thursday
Sally	Female	Thursday
Katie	Female	Thursday

### ***Research Objective Three, Four, and Five Analysis***

Objectives three, four and five utilized descriptive statistics such as means, standard deviations, and valid percentages and inferential statistics such as independent samples *t*-tests and paired samples *t*-tests. Objective three sought to describe student perceptions toward welding technology, objective four sought to describe students' tinkering self-efficacy and objective five sought to describe student perceptions about learning welding technology. Results were differentiated by course sections (i.e., Tuesday and Thursday) and participant gender.

Assumptions of independent sample *t*-tests include homogeneity of variance, normality, and independent observations (Johnson, 2020). We tested for homogeneity of variance through Leven's Test for Equality of Variance in the pilot study and found an insignificant result. A histogram or QQ-Plot was used and interpreted to test for normality. Our sample contained independent observations therefore all assumptions for our Independent Samples *t*-test were in place. Paired samples *t*-tests were used to determine if differences were present between the pre-survey and post-survey in the same group (i.e., course section or participant gender group) and are commonly utilized in repeated measure experimental designs (Field, 2017).

**Table 6***Objectives One through Five Values to Report*

Research Objective	Instrumentation	Results to Report	Statistics
Objective 1	Demographic Information	Participant gender, age, degree of study, prior welding experience.  Participants enjoyment of ag. Mech. courses	Descriptive Statistics
Objective 2	Instructor Evaluation Questions 1-6 on Likert-Scale and Demographic Questions 5 & 6	Course section (Tuesday & Thursday) results*  Participant gender group (male or female) results*  Changes over time between pre-survey and post-survey	Independent Samples <i>t</i> -tests  Paired Samples <i>t</i> -tests
Objectives 3-5	Summated scores of constructs: Perceptions of Welding Technology, Tinkering Self-Efficacy, & Perceptions about Learning Welding Technology	Course section (Tuesday & Thursday) results*  Participant gender group (male or female) results*  Changes over time between pre-survey and post-survey	Independent Samples <i>t</i> -tests  Paired Samples <i>t</i> -tests

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\*Indicates data had a pre-survey and post-survey score

***Research Objective Six Analysis***

Objective six described the relationship between college students' demographics and their perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology, and their attitudes about

the gender of the male and female welding instructors. In simpler terms, this objective sought to describe how participants' demographics (e.g., age, gender, and degree of study) affected the following: perceptions toward welding technology, tinkering self-efficacy, perceptions about learning welding technology, and their attitudes about the gender of the male and female welding instructors. Demographics (age, gender, and degree of study) were the independent variable and each of the other constructs were dependent variables.

The statistical analysis for objective six consisted of comparing certain demographic variables (i.e., age, gender, and degree of study) to interpret associations present in regard to certain dependent variables. The analysis consisted of 12 individual inferential statistical tests to compare the independent variables and dependent variables. Statistical tests were chosen based on the statistical data type in table three. The dependent variable, "Attitude toward gender of the welding instructor," is based on the categorical data question, "Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option." There were two possible answers to this question: male or female instructor. Many students wrote in their own answer which was coded as neutral. Table seven contains the 12 statistical tests used to determine associations between demographics and the dependent variables.

**Table 7***Objective Six Statistical Analysis*

Independent Variable	Dependent Variable	Statistical Test
Demographics (Gender)	Perceptions of Welding Technology	Independent Samples <i>t</i> -test
Demographics (Gender)	Tinkering Self-Efficacy	Independent Samples <i>t</i> -test
Demographics (Gender)	Perceptions about Learning Welding Technology	Independent Samples <i>t</i> -test
Demographics (Gender)	Attitude towards the gender welding instructor	Chi-Square
Demographics (Degree)	Perceptions of Welding Technology	Independent Samples <i>t</i> -test
Demographics (Degree)	Tinkering Self-Efficacy	Independent Samples <i>t</i> -test
Demographics (Degree)	Perceptions about Learning Welding Technology	Independent Samples <i>t</i> -test
Demographics (Degree)	Attitude towards the gender welding instructor	Chi-Square
Demographics (Age)	Perceptions of Welding Technology	Independent Samples <i>t</i> -test
Demographics (Age)	Tinkering Self-Efficacy	Independent Samples <i>t</i> -test
Demographics (Age)	Perceptions about Learning Welding Technology	Independent Samples <i>t</i> -test
Demographics (Age)	Attitude towards the gender welding instructor	Chi-Square

Participants who neither identified as male or female were excluded from several statistical tests due to limited sample size to perform an analysis. All assumptions of independent sample *t*-tests (i.e., homogeneity of variance, normality, and independent observations) were assumed. The chi-square test assumptions include independent observations and a certain number of expected frequencies for each cell in the data analysis (Field, 2017). In one instance when measuring the association between participant gender and participants' choice of their welding instructor's gender, we violated this assumption as over 20% of our cells had an expected count of less than five. We then utilized Field's (2017) suggestion to use a likelihood ratio due to the assumption being violated and the small sample size (Field, 2017).

**Objective Six Coding.** Objective six determined associations between participant demographic information of the different constructs and their attitudes toward the gender of their welding instructor. Study participants were coded into groups based on the statistical test. When the demographic variable of gender was being utilized, students were differentiated into two groups, male and female.

When age was the variable being utilized, the study participants were differentiated into two groups regarding their age: traditional students and non-traditional students. The traditional student group consisted of participants ages 18-23. The non-traditional student group consisted of participants over 24 years of age. Previous research has suggested collegiate students fall into two categories; traditional students aged 18-23 and non-traditional over 24 years of age (Johnson, 2013; Stringer, 2022). Collegiate students 18-23 typically began their college



education promptly after high school commencement (Johnson, 2013; Stringer, 2022). Collegiate students over the age of 24 typically did not attend college directly after high school commencement (Johnson, 2013; Stringer, 2022). We took careful consideration when grouping students by age. Students were coded into two groups to ensure statistical analysis assumptions were met.

When the demographic variable of degree of study was being utilized, students were differentiated into two groups, a "technology-oriented degree" and a "non-technology-oriented degree" group. Previous research regarding college students' major has suggested personality and political views are major influences on students' choice of major (Balsamo et al., 2012; Porter & Umbach, 2006). Students who have chosen a college major have specific personality traits similar to others in their majors and fields of study (Balsamo et al., 2012). Astin (1993) argues students personality characteristics are an indicator of a student's major. Students who are studying "technology-oriented degrees" or more heavily STEM related careers may have higher tinkering self-efficacy levels and different attitudes towards a female instructor in the welding course. We carefully determined which category would be most appropriate for each major. Students were coded into two groups to ensure statistical analysis assumptions were met (see Table 8).

**Table 8***Technology-Oriented vs. Non-Technology Oriented Degree of Study*

Technology-Oriented Degrees <i>n</i> = 28	Non-Technology-Oriented Degrees <i>n</i> = 18
Outdoor product design & development	Agricultural education
Aviation maintenance management	Animal science
Agricultural systems technology	Agribusiness
Technology & engineering education	General science
Technology systems	Integrated science
Engineering	Degree outside College of Agriculture or Engineering*

\*Majors outside of the college of agriculture were concluded to not be a technology oriented degree. Six participants fell into this category.

***Research Objective Seven Analysis***

Objective seven described the relationship between college students' attitudes of the gender of their male and female welding instructor and demographics, perceptions towards welding technology, tinkering self-efficacy, and perceptions about learning welding technology. In simpler terms, this objective sought to describe how participants' demographics, perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology affect their attitudes towards the gender of their welding instructor. The dependent variable was the attitudes about the instructor and the other constructs were the independent variables. Objectives six and seven were fundamental to explaining and determining why students have the perceptions they possess in objectives two through five.

The statistical analysis for objective seven consisted of comparing four independent variables to a dependent variable (e.g., attitude toward gender of the

welding instructor) to interpret if correlations were present. The analysis consisted of six individual statistical tests to compare the independent variables and dependent variables. Statistical tests were chosen based on the statistical data type in Table 3. The dependent variable, “Attitude toward gender of the welding instructor,” is based on the categorial data question “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option.” There were three possible answers to this question. Table 9 contains the six statistical tests used to determine associations between demographics and the dependent variables.

**Table 9**

*Objective Seven Statistical Analysis*

Independent Variable	Dependent Variable	Statistical Test
Demographics (Gender)	Attitude towards welding instructor	Chi-Square
Demographics (Degree)	Attitude towards welding instructor	Chi-Square
Demographics (Age)	Attitude towards welding instructor	Chi-Square
Perceptions of Welding Technology	Attitude towards welding instructor	Multinomial Logistic Regression
Tinkering Self-Efficacy	Attitude towards welding instructor	Multinomial Logistic Regression
Perceptions about Learning Welding Technology	Attitude towards welding instructor	Multinomial Logistic Regression

Participants who neither identified as male or female were excluded from several statistical tests due low sample size to perform an analysis. All assumptions of the chi-square test were met (e.g., assumptions include independent observations and a certain number of expected frequencies for each cell in the data analysis) (Field, 2017). In one instance when measuring the association between participant gender and participants' choice of their welding instructor's gender, we violated this assumption as over 20% of our cells had an expected count of less than five. We then utilized Field's (2017) suggestion to use a likelihood ratio due to the assumption being violated and the small sample size (Field, 2017). All assumptions were met for the multinomial regression model.

**Objective Seven Coding.** Objective seven determined associations between participant demographic information and the different constructs (i.e., perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology) and their attitudes toward the gender of their welding instructor. Study participants were coded into the identical groups utilized in objective six for several tests. See objective six section of chapter 3 and table 7 for more information.

### **Summary**

This study examined students' perceptions of female and male instructors and investigated many different variables including demographic information (i.e., gender, age, and degree of study), perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology to provide recommendations and rationale regarding gender in agricultural

mechanics instruction. Careful consideration took place in developing the survey instrument and experiment to acquire conclusions and recommendations for agricultural education, welding education and other professions.

## Chapter IV: Results

### Introduction

The purpose of this study was to examine students' perceptions of learning from a female instructor versus male instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology. This study was designed to evaluate potential bias towards receiving instruction from a male or female welding instructor.

This project consisted of a convenience purpose sample of post-secondary welding students at Utah State University in the spring and fall of 2022 semesters. Several individuals elected not to participate in the research study. A total of 45 individuals elected for their survey information to be utilized in the research. Results presented are primarily differentiated by course section (i.e., Tuesday or Thursday section) or participant gender. The research was guided by the following question: Are there differences in students' perceptions of female instructors versus male instructors of a welding course? The following research objectives were developed to answer the research question.

1. Describe the demographic profile of students in a post-secondary welding course.
2. Describe college students' attitudes toward the gender of their welding instructor and determine any difference between participant gender and course section.

- *H<sub>0</sub>: There is no difference between students' gender or course section and their attitudes toward the gender of their welding instructor.*
3. Describe college students' perceptions towards welding technology and determine any difference between participant gender and course section.
    - *H<sub>0</sub>: There is no difference between students' gender or course section and their perceptions of welding technology.*
  4. Describe college students' tinkering self-efficacy and determine any difference between participant gender and course section.
    - *H<sub>0</sub>: There is no difference between students' gender or course section and tinkering self-efficacy.*
  5. Describe college students' perceptions about learning welding technology and determine any difference between participant gender and course section.
    - *H<sub>0</sub>: There is no difference between students' gender or course section and perceptions about learning welding technology.*
  6. Explain the relationship between college students' demographics (i.e., gender, degree of study, and age) and their perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.
    - *H<sub>0</sub>: There is no relationship between participants' demographics and their perceptions towards welding*

*technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.*

7. Explain the relationship between college students' choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, and perceptions about learning welding technology.

- *H<sub>0</sub>: There is no relationship between college choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, and perceptions about learning welding technology.*

To determine if the spring 2022 and fall 2022 data were statistically similar regarding constructs, we used independent samples *t*-tests to check for significant differences between the semesters. No statistically significant differences were present between the spring 2022 and fall 2022 data therefore, we found no consequences to combining the datasets. The Tuesday sections of the course (i.e., spring and fall semesters) began the semester with receiving instruction from a male welding instructor for weeks one through seven. The Thursday sections of the course (i.e., spring and fall semesters) began the semester with receiving instruction from a female instructor for weeks one through seven. The instructors switched course sections at week eight. In Appendix D, there are eight tables which summarize all the statistical results found in objectives 2-5.



## Research Objective 1

The first research objective sought to describe the demographic profile of collegiate students in a post-secondary welding course by gathering information regarding gender, degree of study and age in a pre-survey and post-survey.

Demographic information was collected through open-ended questions.

Information regarding participant's previous welding experience and enjoyment of agricultural mechanization courses was also collected.

### *Participant Gender*

**Sample Size.** The total sample consisted of 45 participants; 31 males, 13 females and one participant who identified as non-binary. See table 10 for more information regarding the number of sample participants, the number of male, and female participants.

**Table 10**

*Distribution of Participant Gender by Section & Semester Term*

	Spring 2022 Semester		Fall 2022 Semester		
	Male Participants	Female Participants	Male Participants	Female Participants	Non-Binary
Section	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>
Tuesday	9	1	10	3	1
Thursday	5	5	7	4	0

**Tuesday Sections.** A total of 24 students were enrolled in a Tuesday section of the course either in the spring or fall semester. The Tuesday section

consisted of a total of 19 males, four females and one student who identified as non-binary.

**Thursday Sections.** A total of 21 students were enrolled in a Thursday section of the course either in the spring or fall semester and consisted of 12 male and nine female participants.

### *Study Participant Ages*

**Sample Age.** The average age of all study participants (i.e., spring and fall 2022 semester samples) was 22.5 and ranged between 18 and 39. The average age of the male participants was 23.06 ( $SD = 4.20$ ). The average age of all the female participants was 21.46 ( $SD = 2.02$ ), lower than the age of their male counterparts.

### *Participants' Degree of Study*

**Tuesday Section.** Participants' degrees of study in the Tuesday course sections included nine students studying outdoor product design and development, four students studying technology and engineering education, three students studying technology systems, three students studying agricultural education, two students studying agricultural systems technology, one student studying aviation maintenance management, and two students studying a degree outside of the college of agriculture in a non-technology oriented degree program. Table 11 conveys participants' degree of study in the Tuesday course section.

**Table 11***Distribution of Participant's Degree of Study for Tuesday Section*

Participant Degree of Study	<i>f</i>
Outdoor Product Design and Development	9
Technology and Engineering Education	4
Technology Systems	3
Agricultural Education	3
Agricultural Systems Technology	2
Aviation Maintenance Management	1
Major outside the college of Agriculture	2

*Note.* Tuesday section sample size was ( $n = 24$ )

**Thursday Section.** Participants' degrees of study in the Thursday course sections included six students studying agricultural education, three students studying agricultural systems technology, two students studying technology and engineering education, two students studying agribusiness, one student studying animal science, one student studying engineering, one student studying technology systems, and five students studying a degree outside the college of agriculture in a non-technology oriented degree (see Table 12).

**Table 12***Distribution of Participants' Degree of Study for Thursday Section*

Participant Degree of Study	<i>f</i>
Agricultural Education	6
Agricultural Systems Technology	3
Technology and Engineering Education	2
Agribusiness	2
Animal Science	1
Engineering	1
Technology Systems	1
Major outside of the college of agriculture	5

*Note.* Sample size for Thursday section was ( $n = 21$ )

**Male and Female Participant Degrees of Study.** Study participants were enrolled in a variety of majors, the majority in the College of Agriculture and Applied Sciences. Several students were studying degrees outside the College of Agriculture and Applied Sciences in non-technology oriented degrees and one student was studying a degree in the College of Engineering. One of the outdoor product design and development majors switched his major to an engineering degree after the pre-survey (see Table 13).

**Table 13**

*Distribution of Participants' Degree of Study by Gender*

Participant Degree of Study	Males <i>f</i>	Females <i>f</i>
Outdoor Product Design & Development	10*	0
Agricultural Education	3	6
Agricultural Systems Technology	4	1
Technology and Engineering Education	4	2
Technology Systems	4	0
Agribusiness	1	1
Engineering	1*	0
Aviation Maintenance Management	1	0
Animal Science	1	0
Major outside of the college of agriculture	4	3

\*Note. In the pre-survey there were 10 students studying outdoor product design & development. In the post-survey there were nine students studying outdoor product design and two studying engineering. Total of 45 participants.

### ***High School Welding Experience***

Study participants were asked to select whether they had previous welding experience from a high school course. Approximately 26% of the sample ( $n = 12$ ) had enrolled in a high school welding course; 11 male participants and one female participant. Seventy-one percent of the sample ( $n = 32$ ) claimed they did not

possess prior welding experience from a high school welding course. Four percent of the sample ( $n = 2$ ) did not provide a response to the question.

Approximately 7% of the female participants ( $n = 1$ ) reported previous welding experience from a high school welding course and the majority of the female participants, 92% ( $n = 12$  females), claimed they did not obtain prior welding experience from a high school welding course. Approximately 35% of the male participants ( $n = 11$  males) reported previous welding experience from a high school welding course and 65% of the male participants ( $n = 20$  males) claimed they did not obtain prior welding experience from a high school welding course.

### ***Enjoyment of Agricultural Mechanization Courses***

Study participants were asked to select whether they enjoyed agricultural mechanization courses. Approximately 88% of the entire sample (i.e., spring and fall course sections) selected “yes” in the pre-survey indicating they enjoyed agricultural mechanization courses. Approximately 9% of the sample ( $n = 4$ ) selected “no” in the pre-survey indicating they did not enjoy agricultural mechanization courses. Of those four participants, two were male, one was female, and one identified as non-binary. One participant did not answer the question.

Similar results were found in the post-survey, yet the number of participants who enjoyed agricultural mechanization courses decreased from 89% in the pre-survey to 86% in the post-survey indicating participants overall enjoyed agricultural mechanization courses. Eleven percent of the sample ( $n = 5$ ) selected

“no” in the post-survey indicating they did not enjoy agricultural mechanization courses. Of those five participants, 40% were male ( $n = 2$ ), 40% were female, and 20% identified as non-binary ( $n = 1$ ).

## **Research Objective 2**

The second research objective sought to describe collegiate students' attitudes regarding the gender of their welding instructor and determine any differences between males and females and the Tuesday and Thursday course sections. We collected data through a pre-survey at week four and a post-survey at week 12 to determine if participants preferences changed after experiencing both a female and male instructor in the welding course. Data were collected through six statements on a Likert-scale and two multiple choice questions.

1. “The person who teaches welding does not impact my ability to learn the content.”
2. “If I believe the instructor is knowledgeable, I learn more.”
3. “I would learn more from a female instructor in this welding course.”
4. “I would learn more from a male instructor in this welding course.”
5. “I believe my gender is why I will be successful in welding.”
6. “An instructor who has welding experience is more beneficial to my learning than is their gender.”
7. “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose?” Options were male or female.

8. “I have no preference towards gender of the instructor if they can teach welding well.” Options were true or false.

### ***Question 1***

Study participants were asked to respond to the statement, “The person who teaches welding does not impact my ability to learn the content,” measured on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). We conducted independent samples *t*-tests to determine if significant differences were present between the Tuesday and Thursday course sections and between the male and female participants. We also conducted paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

**Tuesday vs. Thursday Results.** At the beginning of the semester, the Tuesday sections began with receiving instruction from a male instructor and averaged a pre-survey mean of 2.83 ( $SD = 2.07$ ) in regard to the statement, “The person who teaches welding does not impact my ability to learn the content.” The Tuesday section indicated a post-survey mean of 3.42 ( $SD = 1.90$ ). A paired samples *t*-test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding the statement, “the person who teaches welding does not impact my ability to learn the content.” There was no significant difference between the

Tuesday section's pre-survey ( $M = 2.83$ ,  $SD = 2.07$ ) and post-survey ( $M = 3.42$ ,  $SD = 1.90$ ) scores;  $t(22) = -1.83$ ,  $p = 0.08$ ,  $d = 1.82$ .

The Thursday sections began with receiving instruction from a female instructor and averaged a pre-survey mean of 3.70 ( $SD = 1.80$ ) and a post-survey mean of 3.58 ( $SD = 2.24$ ). No significant difference was found in the Thursday section's pre-survey ( $M = 3.70$ ,  $SD = 1.80$ ) and post-survey ( $M = 3.58$ ,  $SD = 2.24$ ) scores;  $t(19) = 0.19$ ,  $p = 0.85$ ,  $d = 2.47$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the Tuesday and Thursday course sections or between the sections' pre-survey and post-survey.

No significant difference ( $t = -1.46(42)$ ,  $p = 0.15$ ,  $d = 1.96$ ) was found between the Tuesday and Thursday course sections in the pre-survey. No significant difference ( $t = -0.25(41)$ ,  $p = 0.79$ ,  $d = 2.06$ ) was found between the Tuesday and Thursday course sections in the post-survey (see Table 14).

**Table 14**

Tuesday vs. Thursday Course Sections: "The Person Who Teaches Welding does not Impact my Ability to Learn Content"

	Tuesday	Thursday				
	<i>M/SD</i>	<i>M/SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
Pre-Survey Score	2.83/2.07	3.70/1.80	-1.46	42	0.15	1.96
Post-Survey Score	3.42/1.90	3.58/2.24	-0.25	41	0.79	2.06

*Note.* Construct items scaled from 1 "Strong disagree" to 7 "Strongly agree"



**Male vs. Female Participant's Results.** The male participants averaged a pre-survey mean of 3.07 ( $SD = 1.94$ ) in regard to the statement, "The person who teaches welding does not impact my ability to learn the content." In the post-survey, the males' mean score was 3.33 ( $SD = 1.84$ ). A paired samples  $t$ -test was conducted to determine if a significant difference was found between the male participant's pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant's pre-survey and post-survey regarding the statement, "the person who teaches welding does not impact my ability to learn the content." There was no significant difference in the male participant's pre-survey ( $M = 3.07$ ,  $SD = 1.94$ ) and post-survey ( $M = 3.33$ ,  $SD = 1.84$ ) scores;  $t(27) = -0.86$ ,  $p = 0.39$ ,  $d = 2.40$ .

The female participants averaged a pre-survey mean of 3.58 ( $SD = 2.27$ ) indicating they were more neutral in regard to the statement compared to their male counterparts (see Table 15). The female participants indicated a mean of 3.75 ( $SD = 2.56$ ) in the post-survey. No significant difference was found in the female participant's pre-survey ( $M = 3.58$ ,  $SD = 2.27$ ) and post-survey ( $M = 3.75$ ,  $SD = 2.56$ ) scores;  $t(11) = -0.37$ ,  $p = 0.71$ ,  $d = 1.52$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male and female participants or between their pre-survey and post-survey.

All means were in the disagree or somewhat disagree range indicating the majority of participants disagreed with the statement and believe that the person who teaches welding does impact their ability to learn content. No significant difference was found between the male and female participants in the pre-survey

( $t = -0.70(41)$ ,  $p = .48$ ,  $d = 2.01$ ). Equal variances could not be assumed in the post-survey and no significant difference was found between the two genders in the post-survey ( $t = -0.59(15.77)$ ,  $p = 0.61$ ,  $d = 2.06$ ).

**Table 15**

Male vs. Female Participants: "The Person Who Teaches Welding does not Impact my Ability to Learn the Content."

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	3.07/1.94	3.58/2.27	-0.70	41	0.48	2.01
Post-Survey Score	3.33/1.84	3.75/2.56	-0.59	15.77	0.61	2.06

*Note.* Construct items scaled from 1 "Strong disagree" to 7 "Strongly agree"

### **Question 2**

Study participants were asked to respond to the statement, "If I believe the instructor is knowledgeable, I learn more," measured on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). We conducted independent samples *t*-tests to determine if significant differences were present between the Tuesday and Thursday course sections and between the male and female participants. We also conducted paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

**Tuesday vs. Thursday Results.** At the beginning of the semester, the Tuesday section began with receiving instruction from a male instructor and

averaged a pre-survey mean of 6.29 ( $SD = 0.99$ ) in regard to the statement, “If I believe the instructor is knowledgeable, I learn more.” The Thursday section began with receiving instruction from a female instructor and averaged a pre-survey mean of 5.95 ( $SD = 0.94$ ) (see Table 16).

The Tuesday sections’ post-survey mean was identical to the pre-survey 6.29 ( $SD = 0.85$ ) and the Thursday sections’ mean in the post-survey was 6.26 ( $SD = 0.87$ ). All means were in the agree or somewhat agree range indicating the majority of participants agreed with the statement, “if I believe the instructor is knowledgeable, I learn more.” No significant difference ( $t = 1.15(52)$ ,  $p = 0.25$ ,  $d = 0.97$ ) was found between the Tuesday and Thursday course sections in the pre-survey. No significant difference ( $t = 0.10(41)$ ,  $p = 0.91$ ,  $d = 0.86$ ) was found between the Tuesday and Thursday course sections in the post-survey.

**Table 16**

*Tuesday vs. Thursday Course Sections: "If I Believe the Instructor is Knowledgeable, I Learn More."*

	Tuesday	Thursday				
	<i>M/SD</i>	<i>M/SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
Pre-Survey Score	6.29/0.99	5.95/0.94	1.15	42	0.25	0.97
Post-Survey Score	6.29/0.85	6.26/0.87	0.10	41	0.91	0.86

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples  $t$ -test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after

receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding the statement, “if I believe the instructor is knowledgeable, I learn more.” There was no significant difference in the Tuesday section’s pre-survey ( $M = 6.29, SD = 0.99$ ) and post-survey ( $M = 6.35, SD = 0.85$ ) scores;  $t(22) = -0.34, p = 0.73, d = 1.20$ . No significant difference was found in the Thursday section’s pre-survey ( $M = 5.95, SD = 0.94$ ) and post-survey ( $M = 6.26, SD = 0.87$ ) scores;  $t(17) = -0.15, p = 0.26, d = 1.01$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the Tuesday and Thursday course sections or between the sections’ pre-survey and post-survey.

**Male vs. Female Participant’s Results.** The male participants averaged a pre-survey mean score of 6.20 ( $SD = 0.92$ ) in regard to the statement, “If I believe the instructor is knowledgeable, I learn more.” The female participants averaged a pre-survey mean of 6.15 ( $SD = 0.98$ ). Both the male and female participants agreed with the statement indicating if they believed their instructor is knowledgeable, they learn more (see Table 17).

In the post-survey, the males’ mean score was 6.37 ( $SD = 0.76$ ) and the females’ mean score was 6.25 ( $SD = 0.86$ ). All means were in the agree or somewhat agree range indicating the majority of participants agreed with the statement, “if I believe the instructor is knowledgeable, I learn more.” No significant difference was found between the male and female participants in the pre-survey ( $t = 0.14(41), p = .88, d = 0.94$ ) and in the post-survey ( $t = 0.42(40), p = 0.66, d = 0.79$ ).

**Table 17**

*Male vs. Female Participants: "If I Believe the Instructor is Knowledgeable, I Learn More."*

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.20/0.92	6.15/0.98	0.14	41	0.88	0.94
Post-Survey Score	6.37/0.76	6.25/0.86	0.43	40	0.66	0.79

*Note.* Construct items scaled from 1 "Strong disagree" to 7 "Strongly agree"

A paired samples *t*-test was conducted to determine if a significant difference was found between the male participant's pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant's pre-survey and post-survey regarding the statement, "if I believe the instructor is knowledgeable, I learn more." There was no significant difference in the male participant's pre-survey ( $M = 6.20$ ,  $SD = 0.92$ ) and post-survey ( $M = 6.37$ ,  $SD = 0.76$ ) scores;  $t(27) = -1.00$ ,  $p = 0.32$ ,  $d = 1.13$ . No significant difference was found in the female participant's pre-survey ( $M = 6.15$ ,  $SD = 0.98$ ) and post-survey ( $M = 6.25$ ,  $SD = 0.86$ ) scores;  $t(11) = -0.24$ ,  $p = 0.80$ ,  $d = 1.16$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male and female participants or between their pre-survey and post-survey.

### ***Questions 3 & 4***

Participants were asked to respond to two statements on a 7-point Likert Scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree) regarding their beliefs of learning from a male or female instructor. The first statement was, “I would learn more from a female instructor in this welding course.” The second statement was “I would learn more from a male instructor in this welding course.” We conducted independent samples *t*-tests to determine if significant differences were present between the Tuesday and Thursday course sections and between the male and female participants. We also conducted paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

**Sample Results.** The majority of students (88% of participants in the pre-survey and 84% in the post-survey) selected the same answer for question three and four (e.g., selected 4 for “I would learn more from a female instructor in this welding course and selected 4 for “I would learn more from a male instructor in this welding course) in both the pre-survey and post-survey indicating zero bias toward receiving instruction from a male or a female welding instructor. The majority of students (82% of participants) chose the neutral or disagree options on the 7-point Likert Scale.

**Tuesday vs. Thursday Results.** In the pre-survey, the Tuesday section ranked statement three (i.e., I would learn more from a female instructor) lower than statement four (i.e., I would learn more from a male instructor). The Tuesday

section resulted in a mean of 3.31 ( $SD = 1.25$ ) for statement three (i.e., I would learn more from a female instructor) and a 3.58 ( $SD = 1.47$ ) for statement four (i.e., I would learn more from a male instructor) (see Table 18).

The result was the same in the post-survey (i.e., the Tuesday section indicated a mean of 3.71 ( $SD = 1.51$ ) for statement three (i.e., I would learn more from a female instructor) and indicated a mean of 3.88 ( $SD = 1.59$ ) for question four (i.e., I would learn more from a male instructor).

In the pre-survey, the Tuesday section ranked statement three (i.e., I would learn more from a female instructor) higher than statement four (i.e., I would learn more from a male instructor). In the pre-survey, the Thursday section indicated a mean of 3.40 ( $SD = 1.69$ ) for question three (i.e., I would learn more from a female instructor) and a 3.34 ( $SD = 1.59$ ) for question four (i.e., I would learn more from a male instructor).

Similar results for the Thursday section were found in the post-survey. The Thursday section indicated a post-survey mean of 3.79 ( $SD = 1.51$ ) for statement three (i.e., I would learn more from a female instructor) and a mean of 3.74 ( $SD = 1.36$ ) for question four (i.e., I would learn more from a male instructor). The Thursday section overall ranked statement three (i.e., I would learn more from female instructor in the welding course) higher than statement four (i.e., I would learn more from a male in the welding course) in both the pre-survey and post-survey.

No significant difference was found between the Tuesday and Thursday sections in the pre-survey regarding question three (i.e., I would learn more from

a female instructor) ( $t = -0.41(42)$ ,  $p = 0.66$ ,  $d = 1.47$ ) and four (i.e., I would learn more from a male instructor) ( $t = .50(42)$ ,  $p = 0.61$ ,  $d = 1.53$ ).

No significant difference was found between the Tuesday and Thursday sections in the post-survey regarding question three ( $t = -0.17(41)$ ,  $p = 0.86$ ,  $d = 1.54$ ) and question four ( $t = .30(41)$ ,  $p = 0.76$ ,  $d = 1.50$ ). Therefore, we failed to reject null hypothesis; there was no difference between the Tuesday or Thursday sections in regard to their attitudes toward the gender of their welding instructor.

A paired samples  $t$ -test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding the statements, “I would learn more from a female instructor” and “I would learn more from a male instructor.”

A significant difference was present between the Tuesday section’s pre-survey ( $M = 3.21$ ,  $SD = 1.25$ ) and post-survey ( $M = 3.71$ ,  $SD = 1.51$ ) in regard to the statement, “I would learn more from a female instructor”;  $t = (22) = -2.40$ ,  $p = 0.02$ ,  $d = 1.03$ . Therefore, receiving instruction from a female instructor had a positive influence on the Tuesday sections’ beliefs of whether they could learn from a female instructor. No significant difference was found in the Tuesday section’s pre-survey ( $M = 3.58$ ,  $SD = 1.47$ ) and post-survey ( $M = 3.88$ ,  $SD = 1.59$ ) in regard to the statement, “I would learn more from a male instructor”;  $t(22) = -1.32$ ,  $p = 0.20$ ,  $d = 1.10$ . Therefore, we reject the null hypothesis; a significant difference was present between the Tuesday course sections’ perceptions of



learning from a female instructor after receiving instruction from a female instructor for the last eight weeks of the semester.

No significant difference was found between the Thursday section's pre-survey ( $M = 3.40$ ,  $SD = 1.69$ ) and post-survey ( $M = 3.79$ ,  $SD = 1.51$ ) in regard to the statement, "I would learn more from a female instructor";  $t(17) = -0.44$ ,  $p = 0.66$ ,  $d = 1.58$ . No significant difference was found in the Thursday section's pre-survey ( $M = 3.35$ ,  $SD = 1.59$ ) and post-survey ( $M = 3.74$ ,  $SD = 1.36$ ) in regard to the statement, "I would learn more from a male instructor";  $t(17) = -0.90$ ,  $p = 0.38$ ,  $d = 1.57$ .

**Table 18**

*Tuesday vs. Thursday Sections' Average Ratings of Learning Based on Instructor Gender*

Course Section	Item	Week 4 Survey			Week 12 Survey		
		<i>f</i>	<i>M</i>	<i>SD</i>	<i>f</i>	<i>M</i>	<i>SD</i>
Tuesday Section	I would learn more from a female instructor	24	3.21	1.25	24	3.71	1.51
	I would learn more from a male instructor	24	3.58	1.47	10	3.88	1.59
Thursday Section	I would learn more from a female instructor	20	3.40	1.69	19	3.79	1.51
	I would learn more from a male instructor	19	3.35	1.59	10	3.74	1.36

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

**Male vs. Female Results.** In the pre-survey, the male participants ranked statement three (i.e., I would learn more from a female instructor) lower than statement four (i.e., I would learn more from a male instructor). The male participants indicated a mean of 2.90 ( $SD = 1.37$ ) for statement three (i.e., I would learn more from a female instructor) and a 3.20 ( $SD = 1.60$ ) for statement four (i.e., I would learn more from a male instructor). Similar results were found in the

post-survey. The male participants indicated a mean for statement three (i.e., I would learn more from a female instructor) of 3.67 ( $SD = 1.64$ ) and a mean of 3.77 ( $SD = 1.65$ ) for statement four (i.e., I would learn more from a male instructor).

In the pre-survey, the male participants ranked statement three (i.e., I would learn more from a female instructor) higher than statement four (i.e., I would learn more from a male instructor). The female participants indicated a mean of 4.15 ( $SD = 1.34$ ) for statement three (i.e., I would learn more from a female instructor) and a 4.08 for statement four (i.e., I would learn more from a male instructor). In the post-survey, the female participants indicated identical means of 3.92 ( $SD = 1.08$ ) for question three and four indicating they were neutral regarding whether they could learn more from a male or a female instructor.

Unequal variances could not be assumed, yet a significant difference was present between the male and female participants in the pre-survey regarding statement three ( $t = -2.79(23.33)$ ,  $p = 0.01$ ,  $d = 1.36$ ). Unequal variances could not be assumed comparing the male and female participants in the pre-survey regarding statement four, yet no significant difference was present ( $t = -1.98(30.06)$ ,  $p = 0.05$ ,  $d = 1.49$ ). Therefore, we reject the null hypothesis; there was a difference between the male and female participants in regard to their attitudes toward the gender of their welding instructor.

No significant difference was found between the male and female participants in the post-survey regarding statement three (i.e., I would learn more from a female instructor) ( $t = -0.46(40)$ ,  $p = 0.64$ ,  $d = 1.56$ ) and statement four

(i.e., I would learn more from a male instructor) ( $t = -0.28(40)$ ,  $p = 0.77$ ,  $d = 1.51$ ).

**Table 19**

*Male vs. Female Participants' Average Ratings of Learning Based on Instructor Gender*

Participants	Item	Week 4 Survey			Week 12 Survey		
		<i>f</i>	<i>M</i>	<i>SD</i>	<i>f</i>	<i>M</i>	<i>SD</i>
Male Participants	I would learn more from a female instructor	30	2.90	1.37	30	3.67	1.64
	I would learn more from a male instructor	30	3.20	1.60	30	3.77	1.65
Female Participants	I would learn more from a female instructor	13	4.15	1.34	12	3.92	1.08
	I would learn more from a male instructor	13	4.08	1.18	12	3.92	1.08

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

Michael, a male participant in the Tuesday section, ranked learning from a female instructor with a “3” (i.e., somewhat disagree) and learning from a male instructor with a “5” (i.e., somewhat agree) in the pre-survey. This individual

adjusted his answer after receiving instruction from a female instructor to indicate zero bias toward learning more from a male or a female in the welding course.

Sally, a female participant in the Thursday section, ranked learning from a female instructor with a "4" (i.e., neutral) and learning from a male instructor with a "6" (i.e., agree) in the pre-survey. She did not complete a post-survey. George, a male participant in the Thursday section, ranked learning from a female with a "7" (i.e., strongly agree) and learning from a male instructor with a "6" (i.e., agree) in the post-survey. He did not complete a pre-survey. Rose, a female participant in the Thursday section, ranked a "4" (i.e., neutral) for learning from a male and female in the pre-survey, yet adjusted her answers drastically in the post-survey. She then ranked a "2", disagreeing she would learn more from a female and a "6" agreeing she would learn more from a male in the welding course.

A paired samples *t*-test was conducted and a significant difference was found between the male participant's pre-survey ( $M = 2.90, SD = 1.37$ ) and post-survey ( $M = 3.77, SD = 1.64$ ) in regard to the statement, "I would learn more from a female instructor";  $t(27) = -2.39, p = 0.02, d = 1.42$ . Therefore, receiving instruction from a female instructor had a positive influence on the male participant's beliefs of whether they could learn from a female instructor. No significant difference was found between the male participant's pre-survey ( $M = 3.20, SD = 1.60$ ) and post-survey ( $M = 3.88, SD = 1.65$ ) in regard to the statement, "I would learn more from a male instructor;"  $t(27) = -1.66, p = 0.10, d = 1.47$ . Therefore, we reject the null hypothesis; a significant difference was found

regarding the male participant's perception of learning from a female after receiving instruction from a female instructor.

No significant difference was found between the female participants' pre-survey ( $M = 4.15$ ,  $SD = 1.34$ ) and post-survey ( $M = 3.92$ ,  $SD = 1.08$ ) in regard to the statement, "I would learn more from a female instructor;"  $t(11) = 1.14$ ,  $p = 0.27$ ,  $d = 0.75$ . No significant difference was found in the female participants' pre-survey ( $M = 3.92$ ,  $SD = 1.08$ ) and post-survey ( $M = 3.92$ ,  $SD = 1.08$ ) in regard to the statement, "I would learn more from a male instructor";  $t(11) = 0.00$ ,  $p = 1.00$ ,  $d = 0.85$ .

### ***Question 5***

Study participants were asked to respond to the statement, "I believe my gender is why I will be successful in welding," measured on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). We conducted independent samples  $t$ -tests to determine if significant differences were present between the Tuesday and Thursday course sections and between the male and female participants. We also conducted paired-samples  $t$ -tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

**Tuesday vs. Thursday Results.** At the beginning of the semester, the Tuesday section began with receiving instruction from a male instructor and averaged a pre-survey mean of 1.67 ( $SD = 1.34$ ) in regard to the statement, "I believe my gender is why I will be successful in welding." The Thursday section

began with receiving instruction from a female instructor and averaged a pre-survey mean of 1.60 ( $SD = 1.14$ ) (see Table 20).

In the post-survey the Tuesday section's mean was 2.04 ( $SD = 1.78$ ) and the Thursday section's mean in the post-survey was 1.79 ( $SD = 1.22$ ). All means were in the strongly disagree or disagree range indicating the majority of participants disagreed with the statement, "I believe my gender is why I will be successful in welding."

No significant difference ( $t = 0.17(42)$ ,  $p = 0.86$ ,  $d = 1.25$ ) was found between the Tuesday and Thursday course sections in the pre-survey. No significant difference ( $t = 0.52(41)$ ,  $p = 0.60$ ,  $d = 1.56$ ) was found between the Tuesday and Thursday course sections in the post-survey, yet the Tuesday course section's mean was higher than the Thursday course section's mean (see Table 20).

**Table 20**

*Tuesday vs. Thursday Course Sections: "I Believe my Gender is Why I will be Successful in Welding"*

	Tuesday	Thursday	$t$	$df$	$p$	<i>Cohen's d</i>
	$M/SD$	$M/SD$				
Pre-Survey Score	1.67/1.34	1.60/1.14	0.17	42	0.86	1.25
Post-Survey Score	2.04/1.78	1.79/1.22	0.52	41	0.60	1.56

*Note.* Construct items scaled from 1 "Strong disagree" to 7 "Strongly agree"

A paired samples *t*-test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding the statement, “I believe my gender is why I will be successful in welding.” There was no significant difference in the Tuesday section’s pre-survey ( $M = 1.67, SD = 1.34$ ) and post-survey ( $M = 2.04, SD = 1.78$ ) scores;  $t(22) = -1.12, p = 0.27, d = 1.67$ . No significant difference was found in the Thursday section’s pre-survey ( $M = 1.60, SD = 1.18$ ) and post-survey ( $M = 1.79, SD = 1.22$ ) scores;  $t(17) = -0.62, p = 0.54, d = 0.75$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the Tuesday and Thursday course sections or between the sections’ pre-survey and post-survey.

**Male vs. Female Results.** The male participants averaged a pre-survey mean of 1.33 ( $SD = 1.02$ ) in regard to the question, “I believe my gender is why I will be successful in welding.” The female participants averaged a pre-survey mean of 2.15 ( $SD = 1.40$ ). Both the male and female participants disagreed with the statement indicating their gender is not a factor toward being successful in welding. The male participants indicated a mean in the strongly disagree category whereas the female participants indicated a mean in the disagree category (see Table 21).

In the post-survey, the males’ mean score was 1.63 ( $SD = 1.52$ ) and the females’ mean score was 2.50 ( $SD = 1.44$ ) the majority of participants disagreed with the statement, “I believe my gender is why I will be successful in welding.”



All means were in the disagree or strongly disagree range. Unequal variances could not be assumed in the pre-survey, yet no significant difference was found between the male and female participants ( $t = -1.89(17.81)$ ,  $p = 0.07$ ,  $d = 1.15$ ). No significant difference between the male and female participants was also found in the post-survey ( $t = -1.69(40)$ ,  $p = 0.09$ ,  $d = 1.50$ ) (see Table 21).

**Table 21**

*Male vs. Female Participants: "I Believe My Gender is Why I will Be Successful in Welding"*

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	1.33/1.02	2.15/1.40	-1.89	17.81	0.07	1.15
Post-Survey Score	1.63/1.52	2.50/1.44	-1.69	40	0.09	1.50

*Note.* Construct items scaled from 1 "Strong disagree" to 7 "Strongly agree"

A paired samples *t*-test was conducted to determine if a significant difference was found between the male participant's pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant's pre-survey and post-survey regarding the statement, "I believe my gender is why I will be successful in welding." There was no significant difference in the male participant's pre-survey ( $M = 1.33$ ,  $SD = 1.02$ ) and post-survey ( $M = 1.63$ ,  $SD = 1.52$ ) scores;  $t(27) = -1.01$ ,  $p = 0.31$ ,  $d = 1.48$ . No significant difference was found in the female participant's pre-survey ( $M = 2.15$ ,  $SD = 1.40$ ) and post-survey ( $M = 2.50$ ,  $SD = 1.44$ ) scores;  $t(11) = -0.81$ ,  $p =$

0.42,  $d = 1.05$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male and female participants or between their pre-survey and post-survey.

### ***Question 6***

Study participants were asked to respond to the statement, “An instructor who has welding experience is more beneficial to my learning than is their gender,” measured on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). We conducted independent samples *t*-tests to determine if significant differences were present between the Tuesday and Thursday course sections and between the male and female participants. We also conducted paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

**Tuesday vs. Thursday Results.** At the beginning of the semester, the Tuesday section began with receiving instruction from a male instructor and averaged a pre-survey mean of 6.92 ( $SD = 0.40$ ) in regard to the statement, “an instructor who has welding experience is more beneficial to my learning than is their gender.” The Thursday section began with receiving instruction from a female instructor and averaged a lower pre-survey mean of 6.75 ( $SD = 0.44$ ) (see Table 22).

The Tuesday section’s score in the post-survey was a mean of 6.96 ( $SD = 0.20$ ) and the Thursday section’s mean in the post-survey was a mean of 6.53 ( $SD = 1.42$ ). All means were in the strongly agree or agree range indicating the

majority of participants agreed with the statement, “an instructor who has welding experience is more beneficial to my learning than is their gender.”

No significant difference ( $t = 1.29(42)$ ,  $p = 0.20$ ,  $d = 0.42$ ) was found between the Tuesday and Thursday course sections in the pre-survey. Unequal variances could not be assumed in the post-survey, yet no significant difference ( $t = 1.30(18.58)$ ,  $p = 0.20$ ,  $d = 0.95$ ) was found between the Tuesday and Thursday course sections (see Table 22).

**Table 22**

*Tuesday vs. Thursday Course Sections: "An Instructor who has Welding Experience is more Beneficial to my Learning than is their Gender"*

	Tuesday	Thursday	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.92/0.40	6.75/0.44	1.29	42	0.20	0.42
Post-Survey Score	6.96/0.20	6.53/1.42	1.30	18.58	0.20	0.95

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding the statement, “an instructor who has welding experience is more beneficial to my learning than is their gender.” There was no significant difference in the Tuesday section’s pre-survey ( $M = 6.92$ ,  $SD = 0.40$ ) and post-survey ( $M = 6.96$ ,  $SD = 0.20$ ) scores;  $t(22) = -1.00$ ,  $p = 0.32$ ,  $d =$

0.20. No significant difference was found in the Thursday section's pre-survey ( $M = 6.75, SD = 0.44$ ) and post-survey ( $M = 6.53, SD = 1.42$ ) scores;  $t(17) = -0.62, p = 0.54, d = 1.51$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the Tuesday and Thursday course section or between each sections' pre-survey and post-survey.

**Male vs. Female Participant Results.** The male participants averaged a pre-survey mean of 6.90 ( $SD = 0.30$ ) in regard to the question, "an instructor who has welding experience is more beneficial to my learning than is their gender." The female participants averaged a pre-survey mean of 6.85 ( $SD = 0.37$ ). Both the male and female participants agreed with the statement indicating an instructor's welding experience is more important than the instructor's gender (see Table 23).

In the post-survey, the males' mean score was 6.73 ( $SD = 1.14$ ) and the females' mean score was 6.73 ( $SD = 1.14$ ). All means were in the agree or strongly agree range. No significant difference was found between the male and female participants in the pre-survey ( $t = 0.49(41), p = 0.62, d = 0.32$ ) and in the post-survey ( $t = -0.54(40), p = 0.58, d = 0.98$ ) (see Table 23).

**Table 23**

*Male vs. Female Participants: “An Instructor who has Welding Experience is more Beneficial to my Learning than is their Gender.”*

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen’s d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.90/0.30	6.85/0.37	0.49	41	0.62	0.32
Post-Survey Score	6.73/1.14	6.92/0.28	-0.54	40	0.58	0.98

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the male participant’s pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant’s pre-survey and post-survey regarding the statement, “an instructor who has welding experience is more beneficial to my learning than is their gender.” There was no significant difference in the male participant’s pre-survey ( $M = 6.90$ ,  $SD = 0.30$ ) and post-survey ( $M = 6.73$ ,  $SD = 1.14$ ) scores;  $t(27) = 0.75$ ,  $p = 0.43$ ,  $d = 1.18$ . No significant difference was found in the female participant’s pre-survey ( $M = 6.85$ ,  $SD = 0.37$ ) and post-survey ( $M = 6.92$ ,  $SD = 0.28$ ) scores;  $t(11) = -1.00$ ,  $p = 0.33$ ,  $d = 0.28$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male and female participants or between their pre-survey and post-survey.

### *Question 7*

At the beginning semester, the Tuesday section began with receiving instruction from a male instructor and the Thursday section started with receiving instruction from a female instructor. Participants were asked to respond to the following, “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose?” Answer options were male or female. No “either” or “neutral” option was presented to the study participants yet several participants hand wrote their own answer to the question indicating a neutral status. These answers were identified by researchers as “either” or “neutral.”

**Preference toward a Male Instructor.** During the pre-survey, 48% of participants ( $n = 21$ ) selected a preference towards a male instructor. Approximately 76% of those individuals were male ( $n = 16$ ) and 23% were female ( $n = 5$ ). Similar results were found in the post-survey. Several participants adjusted their answers to be more in favor of a female instructor or toward the neutral option. Approximately 45% of participants ( $n = 19$ ) selected a preference of learning from male instructor. Approximately 68% of those individuals were male ( $n = 13$ ) and 31% were female ( $n = 6$ ). Fewer male participants selected preference towards a male instructor on the post-survey (43%) than on the pre-survey (53%). More female participants selected a preference toward a male instructor on the post-survey (46%) than on the pre-survey (38%).

**Preference toward a Female Instructor.** During the pre-survey, 26% of participants ( $n = 11$ ) selected their preference towards a female instructor.

Approximately 54% of those individuals were male ( $n = 6$ ) and 45% were female ( $n = 5$ ). The same percentage of participants who selected a preference towards a female instructor was found in the post-survey yet 63% were male ( $n = 7$ ) and 36% ( $n = 4$ ) were female. Three male participants (i.e., Dave, Ron, and Jack) selected a female instructor in both the pre-survey and post-survey. Participants were given pseudonyms. An increased number of male participants selected preference towards a female instructor on the post-survey (23%) than on the pre-survey (20%). Fewer female participants selected a preference toward a female instructor on the post-survey (30%) than on the pre-survey (38%). Two participants when prompted by the question related to the gender of their welding instructor wrote comments on the survey. Jane, a female participant in the Thursday section, wrote, “It is inspiring having a female instructor, it gives me more confidence and motivation.” Joe, a male participant in the Tuesday section, wrote on the post-survey, “I liked that the instructors switched classes halfway through the class, it made me realize girls can weld just as good as guys.”

**Neutral.** In the pre-survey, 26% of participants ( $n = 11$ ) wrote in their own answer which was coded as neutral. Approximately 72% of those individuals were male and 28% were female. The percentage of individuals indicating a neutral preference rose to 28% of participants ( $n = 12$ ) in the post-survey. Approximately 83% ( $n = 10$ ) of those individuals were male and 17% ( $n = 2$ ) were female (see Table 24). Cameron selected the neutral option in both the pre-

survey and post-survey. Bill when prompted by the question regarding selecting a male or female instructor wrote, “Whoever I like more, this is a sexist question” and did not answer the question.

**Table 24**

*Distribution of Participants Choice of Instructor Gender*

Course Section	Participant Gender	Week 4 Survey			Week 12 Survey		
		<i>Choice of Instructor</i>			<i>Choice of Instructor</i>		
		<i>(f)</i>			<i>(f)</i>		
		<i>Male</i>	<i>Female</i>	<i>Either</i>	<i>Male</i>	<i>Female</i>	<i>Either</i>
Tuesday	Males	13	2	4	10	3	6
	Females	2	1	1	2	1	1
Thursday	Males	3	4	4	3	4	4
	Females	3	4	2	4	3	1

*Note.* Two students did not complete the pre-survey and three students did not complete the post-survey.

### **Question 8**

**Tuesday vs. Thursday Results.** Participants were asked to respond to the true or false statement, “I have no preference towards gender of the instructor if they can teach welding well.” In the pre-survey all participants claimed zero preference towards the gender of their instructor if they can teach welding well by selected “true” with the exception of Rose. She was enrolled in the Thursday section and selected a preference towards a male instructor in the question regarding selecting a male or female instructor (i.e., Given an option of instructors



with similar background and knowledge of welding, which instructor would you choose?) in both surveys.

In the post-survey, all participants claimed zero preference towards the gender of their welding instructor with the exception of three participants: Katie, James, and Rose who selected “false.” James and Rose selected a preference towards a male instructor in regard to the question “given an option of instructors with similar background and knowledge of welding, which instructor would you choose?” Katie indicated a neutral option.

### **Research Objective 3**

The third research objective sought to describe collegiate students’ perceptions toward welding technology and determine any differences between gender and course sections. This construct consisted of seven items on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). Example Likert scale statements included, “welding technology is important to learn” and “if I could enroll in more welding technology courses I would.” We collected data twice during the semester using a pre-survey at week four and post-survey at week 12. Data were analyzed comparing the two different course sections and a comparison of the male and female study participants. We conducted independent samples *t*-tests and paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

### ***Tuesday vs. Thursday: Perceptions of Welding Technology***

Students enrolled in the Tuesday section received instruction from a male instructor for the first half of the semester. In the pre-survey, the Tuesday sections' perceptions of welding technology score was 5.55 ( $SD = 0.96$ ). In the post-survey, Tuesday section's perceptions of welding technology score was 5.63 ( $SD = 0.94$ ).

The Thursday section began with receiving instruction from a female instructor averaged a pre-survey perceptions of welding technology score of 5.42 ( $SD = 5.75$ ). The Thursday section's pre-survey perceptions of welding technology score was 5.75 ( $SD = 0.96$ ). All course section means were in the "5" (i.e., somewhat agree) range indicating the majority of study participants possessed positive perceptions towards welding technology.

No significant difference was found between the Tuesday and Thursday course section in the pre-survey ( $t = 0.49(42)$ ,  $p = 0.63$ ,  $d = 0.86$ ) and in the post-survey ( $t = -0.41(41)$ ,  $p = 0.67$ ,  $d = 0.95$ ). Therefore, we failed to reject the null hypothesis; no difference between the course sections and their perceptions of welding technology was present. See Table 25 for more information regarding the Tuesday and Thursday course sections perceptions of welding technology scores. The data analysis for the Tuesday section was conducted with 24 participants who completed the pre-survey and post-survey. The data analysis for the Thursday section was conducted with 20 participants who completed the pre-survey and 19 participants who competed the post-survey.

**Table 25***Tuesday vs. Thursday Course Sections Perceptions of Welding Technology*

	Tuesday	Thursday	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	5.55/0.96	5.42/0.72	0.49	42	0.63	0.86
Post-Survey Score	5.63/0.94	5.75/0.96	-0.41	41	0.67	0.95

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding their perceptions of welding technology. There was no significant difference in the Tuesday section’s pre-survey ( $M = 5.55$ ,  $SD = 0.96$ ) and post-survey ( $M = 5.65$ ,  $SD = 0.94$ ) scores;  $t(22) = -0.21$ ,  $p = 0.83$ ,  $d = 0.68$ . No significant difference was found in the Thursday section’s pre-survey ( $M = 5.42$ ,  $SD = 0.72$ ) and post-survey ( $M = 5.75$ ,  $SD = 0.96$ ) scores;  $t(17) = -1.65$ ,  $p = 0.11$ ,  $d = 0.72$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the Tuesday section’s pre-survey and post-survey or the Thursday section’s pre-survey and post-survey.

***Male vs. Female Participants: Perceptions of Welding Technology***

The male participants averaged a pre-survey perceptions of welding technology score of 5.69 ( $SD = 0.73$ ) which then increased to 5.93 ( $SD = 0.68$ ) in the post-survey. The female participants averaged a pre-survey perceptions of

welding technology score of 5.54 ( $SD = 0.81$ ). The female participants score increased to 5.69 ( $SD = 0.98$ ) in the post-survey. The means of the males and females were in the “5” (i.e., somewhat agree) range indicating both the male and female participants had positive perceptions towards welding technology.

Both the male and female participants perceptions of welding technology scores increased between the pre-survey and post-survey after receiving instruction from both a male and female instructor. The female participants consistently possessed lower perceptions of welding technology scores than the male participants in both surveys. No significant statistical difference was found between the male and female participants in the pre-survey ( $t = 1.88(41)$ ,  $p = 0.06$ ,  $d = 0.76$ ), yet a significant statistical difference was found in the post-survey ( $t = 2.23(40)$ ,  $p = 0.03$ ,  $d = 0.81$ ). Therefore, we reject the null hypothesis; there was a significant difference between the male or female participants and their perceptions of welding technology. See Table 26 for more information regarding the males and female participants perceptions of welding technology scores. The data analysis for the male participants was conducted with 30 participants who completed the pre-survey and post-survey. The data analysis for the female participants was conducted with 13 participants who completed the pre-survey and 12 participants who completed the post-survey.

**Table 26***Male vs. Female Participants' Perceptions of Welding Technology*

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	5.69/0.73	5.21/0.81	1.88	41	0.06	0.76
Post-Survey Score	5.93/0.68	5.69/0.98	2.23	40	0.03	0.81

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the male participant's pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant's pre-survey and post-survey regarding their perceptions of welding technology. There was no significant difference in the male participant's pre-survey ( $M = 5.96$ ,  $SD = 0.72$ ) and post-survey ( $M = 6.93$ ,  $SD = 0.68$ ) scores;  $t(27) = -1.52$ ,  $p = 0.12$ ,  $d = 0.61$ . No significant difference was found in the female participant's pre-survey ( $M = 5.21$ ,  $SD = 0.81$ ) and post-survey ( $M = 5.69$ ,  $SD = 0.98$ ) scores;  $t(11) = -0.22$ ,  $p = 0.82$ ,  $d = 0.91$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male participant's pre-survey and post-survey and the female participant's pre-survey and post-survey.

#### **Research Objective 4**

The fourth research objective sought to describe college students' tinkering self-efficacy and determine any differences between gender or course sections. The 7-item construct was adapted from Baker & Krause (2007) tinkering self-efficacy construct to encompass tinkering self-efficacy in an agricultural mechanics setting. This construct consisted of seven items on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). We collected data through a pre-survey at week four and a post-survey at week 12 of the semester. We conducted independent samples *t*-tests to determine if significant differences were present between the Tuesday and Thursday course sections between the male and female participants. We also conducted paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both a male and female instructor. Descriptive statistics were also reported including means and standard deviations.

#### ***Tuesday vs. Thursday: Tinkering Self-Efficacy.***

At the beginning semester, the Tuesday section began with receiving instruction from a male instructor and the Thursday section began with receiving instruction from a female instructor. The Tuesday course section indicated a higher pre-survey tinkering self-efficacy score of 6.63 (*SD* = 0.49) than the Thursday course section 6.21 (*SD* = 0.62),  $p = 0.02$ . There was a significant difference between the Tuesday and Thursday sections in the pre-survey ( $t = 2.41(42)$ ,  $p = 0.02$ ,  $d = 0.56$ ) indicating the Thursday section had significantly lower levels of tinkering self-efficacy than the Tuesday section. Therefore, we

reject the null hypothesis; there was a significant difference between the Tuesday and Thursday course sections regarding their tinkering self-efficacy.

The Tuesday section averaged a post-survey score of 6.57 ( $SD = 0.43$ ) indicating the Tuesday section had high levels of tinkering self-efficacy. The Thursday section indicated a post-survey score of 6.28 ( $SD = 0.73$ ) indicating the Thursday section also had high levels of tinkering self-efficacy.

Unequal variances could not be assumed in the post-survey, yet no there was no significant difference in the post-survey ( $t = 1.49(27.7)$ ,  $p = .14$ ,  $d = 0.58$ ) indicating the Thursday and Tuesday sections had more similar levels in the post-survey after receiving instruction from both a female and male instructor. See Table 27 for more information regarding the Tuesday and Thursday course sections tinkering self-efficacy scores. The data analysis for the Tuesday section was conducted with 24 participants who completed the pre-survey and post-survey. The data analysis for the Thursday section was conducted with 20 participants who completed the pre-survey and 19 participants who competed the post-survey.

**Table 27***Tuesday vs. Thursday Course Section Tinkering Self-Efficacy*

	Tuesday	Thursday	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.63/0.49	6.22/0.62	2.41	42	0.02	0.56
Post-Survey Score	6.57/0.43	6.28/0.73	1.49	27.7	0.14	0.58

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday section and Thursday section regarding their tinkering self-efficacy. There was no significant difference in the Tuesday section’s pre-survey ( $M = 6.63$ ,  $SD = 0.49$ ) and post-survey ( $M = 6.57$ ,  $SD = 0.43$ ) scores;  $t(22) = 1.18$ ,  $p = 0.08$ ,  $d = 0.31$ . No significant difference was found in the Thursday section’s pre-survey ( $M = 6.22$ ,  $SD = 0.62$ ) and post-survey ( $M = 6.28$ ,  $SD = 0.73$ ) scores;  $t(17) = -0.89$ ,  $p = 0.38$ ,  $d = 0.41$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the Tuesday section’s pre-survey and post-survey or the Thursday section’s pre-survey and post-survey.

#### ***Male vs. Female Participants: Tinkering Self-Efficacy***

Both male and female participants indicated high levels of tinkering self-efficacy. Though the female participants consistently indicated significantly lower



tinkering self-efficacy scores than the male participants. The male participants averaged a pre-survey tinkering self-efficacy score of 6.58 ( $SD = 0.52$ ) a post-survey score of 6.60 ( $SD = 0.46$ ). Whereas the female participants averaged a pre-survey tinkering self-efficacy score of 6.14 ( $SD = 0.65$ ) and post-survey score of 6.08 ( $SD = 0.76$ ).

A significant statistical difference was found between the males and females in the pre-survey ( $t = 2.35(41)$ ,  $p = 0.02$ ,  $d = 0.56$ ) and in the post-survey ( $t = 2.17(14.4)$ ,  $p = 0.04$ ,  $d = 0.56$ ) regarding their tinkering self-efficacy levels. The females consistently displayed lower levels of tinkering self-efficacy. Therefore, we reject the null hypothesis; there was a significant difference between the males and female participants in the regarding tinkering self-efficacy. See table 28 for more information regarding the male and female participants' tinkering self-efficacy scores. The data analysis for the male participants was conducted with 30 participants who completed the pre-survey and post-survey. The data analysis for the female participants was conducted with 13 participants who completed the pre-survey and 12 participants who competed the post-survey.

**Table 28***Male vs. Female Participant Tinkering Self-Efficacy*

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.58/0.52	6.14/0.65	2.35	41	0.02	0.56
Post-Survey Score	6.60/0.46	6.08/0.76	2.17	14.3	0.04	0.56

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the male participant’s pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant’s pre-survey and post-survey regarding their tinkering self-efficacy. There was no significant difference in the male participant’s pre-survey ( $M = 6.58, SD = 0.52$ ) and post-survey ( $M = 6.60, SD = 0.46$ ) scores;  $t(27) = 0.47, p = 0.63, d = 0.39$ . No significant difference was found in the female participant’s pre-survey ( $M = 6.14, SD = 0.65$ ) and post-survey ( $M = 6.08, SD = 0.76$ ) scores;  $t(11) = -0.12, p = 0.90, d = 0.33$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male participant’s pre-survey and post-survey and the female participant’s pre-survey and post-survey.

### **Research Objective 5**

The fifth research objective sought to describe college students’ perceptions about learning welding technology and determine any differences regarding participant gender and course sections. A 14-item construct was

created. Example Likert scale statements included, “welding can be used in real life” and “welding technology amazes me”. This construct consisted of fourteen items on a 7-point Likert scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). Data were collected through a pre-survey at week four and a post-survey at week 12 of the semester. We conducted independent samples *t*-tests to determine if significant differences were present between the Tuesday and Thursday course sections and between the male and female participants. We also conducted paired-samples *t*-tests to determine if differences were present over time after receiving instruction from both genders. Descriptive statistics were also reported including means and standard deviations.

#### ***Tuesday vs. Thursday: Perceptions about Learning Welding Technology***

At the beginning of the semester, the Tuesday section began with receiving instruction from a male instructor, and the Thursday section began with receiving instruction from a female instructor. Both the Tuesday and Thursday course sections possessed scores in the “5” to “6” range (i.e., somewhat agree to agree) range indicating they possessed positive perceptions about learning welding technology.

The Tuesday section indicated a perception about learning welding technology pre-survey score of 6.13 ( $SD = 0.70$ ) and an identical score in post-survey (see Table 29). The Thursday section indicated a pre-survey perception about learning welding technology score of 5.84 ( $SD = 0.68$ ) and a post-survey score of 6.16 ( $SD = 0.72$ ).

There was no significant statistical difference between the two sections in the pre-survey ( $t = 1.37(42)$ ,  $p = 0.17$ ,  $d = 0.69$ ) and in the post-survey ( $t = -0.16(41)$ ,  $p = 0.87$ ,  $d = -0.69$ ). Therefore, we failed to reject the null hypothesis; there was no significant difference between the Tuesday and Thursday course sections and their perception about learning welding technology. See table 29 for more information regarding the Tuesday and Thursday course sections' perceptions toward learning welding technology scores. The data analysis for the Tuesday section was conducted with 24 participants who completed the pre-survey and post-survey. The data analysis for the Thursday section was conducted with 20 participants who completed the pre-survey and 19 participants who completed the post-survey.

**Table 29**

*Tuesday vs. Thursday section Perceptions about Learning Welding Technology*

	Tuesday	Thursday	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.13/0.70	5.84/0.68	1.37	42	0.17	0.69
Post-Survey Score	6.13/0.67	6.16/0.72	-0.16	41	0.87	-0.69

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the pre-survey and in the post-survey (i.e., after receiving instruction from both a male and female instructor) in the Tuesday

section and Thursday section regarding their perception about learning welding technology. There was no significant difference in the Tuesday section's pre-survey ( $M = 6.13$ ,  $SD = 0.70$ ) and post-survey ( $M = 6.13$ ,  $SD = 0.67$ ) scores;  $t(22) = 0.61$ ,  $p = 0.54$ ,  $d = 0.40$ . A significant difference was found between the Thursday section's pre-survey ( $M = 5.84$ ,  $SD = 0.68$ ) and post-survey ( $M = 6.16$ ,  $SD = 0.71$ ) scores;  $t(17) = -2.49$ ,  $p = 0.02$ ,  $d = 0.48$ . The Thursday sections perceptions about learning welding technology increased between the pre-survey and post-survey. Therefore, we reject the null hypothesis; a significant difference was present between the Thursday section's pre-survey and post-survey.

### ***Males vs. Female Participants: Perceptions about Learning Welding***

#### ***Technology***

The male participants averaged a pre-survey perception toward learning welding technology score of 6.16 ( $SD = 0.57$ ) and a post-survey score of 6.25 ( $SD = 0.47$ ). The female participants indicated a pre-survey score of 5.78 ( $SD = 0.74$ ) and a post-survey score of 6.08 ( $SD = 0.77$ ). No significant statistical difference was found between the male and female participants in the pre-survey ( $t = 1.18(41)$ ,  $p = 0.07$ ) and post-survey ( $t = 0.71(14.4)$ ,  $p = 0.8$ ,  $d = 0.57$ ). Therefore, we failed to reject the null hypothesis; no significant difference was present between the male and female participants their perception about learning welding technology. See Table 30 for more information regarding the male and female participants perception about learning welding technology scores. The data analysis for the male participants was conducted with 30 participants who completed the pre-survey and post-survey. The data analysis for the female

participants was conducted with 13 participants who completed the pre-survey and 12 participants who completed the post-survey.

**Table 30**

*Males vs. Females Perception about Learning Welding Technology Scores*

	Males	Females	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M/SD</i>	<i>M/SD</i>				
Pre-Survey Score	6.16/0.57	5.78/0.74	1.81	41	0.07	0.62
Post-Survey Score	6.25/0.47	6.08/0.77	0.71	14.4	0.48	0.57

*Note.* Construct items scaled from 1 “Strong disagree” to 7 “Strongly agree”

A paired samples *t*-test was conducted to determine if a significant difference was found between the male participant’s pre-survey and post-survey (i.e., after receiving instruction from both a male and female instructor) and the female participant’s pre-survey and post-survey regarding their perceptions of welding technology. There was no significant difference in the male participant’s pre-survey ( $M = 6.16$ ,  $SD = 0.57$ ) and post-survey ( $M = 6.25$ ,  $SD = 0.47$ ) scores;  $t(27) = -0.51$ ,  $p = 0.61$ ,  $d = 0.47$ . No significant difference was found in the female participant’s pre-survey ( $M = 5.78$ ,  $SD = 0.74$ ) or post-survey ( $M = 6.08$ ,  $SD = 0.77$ ) scores;  $t(11) = -2.03$ ,  $p = 0.06$ ,  $d = 0.43$ . Therefore, we failed to reject the null hypothesis; no significant difference was present between the male participant’s pre-survey and post-survey and the female participant’s pre-survey and post-survey.

### **Research Objective 6**

The sixth research objective sought to explain the relationship between college students' demographics and perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology, and their attitudes about the gender of the male and female welding instructors. In simpler terms, this objective sought to describe how participants' demographics (i.e., age, gender, and degree of study) affected the following: perceptions toward welding technology, tinkering self-efficacy, perceptions about learning welding technology and their attitudes about the gender of the male and female welding instructors.

We conducted 12 individual statistical tests to compare the independent variables and dependent variables. All statistical tests utilized the post-survey dataset of combined spring and fall data. Cameron was not included in several of these statistical tests due to lack of numbers and ability to perform correlation statistical analysis with only one non-binary individual.

#### ***Gender vs. Perceptions of Welding Technology***

We conducted an independent samples *t*-test to determine if a difference was present between participant gender and perceptions of welding technology scores. The overall sample consisted of 43 participants who completed the post-survey. There were 30 male participants, 12 female participants and one non-binary student who was not included in this particular statistical analysis.

A significant difference ( $t = 2.23(40)$ ,  $p = 0.03$ ,  $d = 0.81$ ) was found between gender and the perceptions of welding technology scores. The male participants possessed higher perceptions of welding technology scores compared to their female counterparts. Therefore, we reject our null hypothesis; a significant difference was present between gender and perceptions of welding technology.

### ***Gender vs. Tinkering Self-Efficacy***

We conducted independent samples  $t$ -test to determine if a difference was present between participant gender and tinkering self-efficacy scores. The overall sample consisted of 43 participants who completed the post-survey. There were 30 male participants, 12 female participants and one non-binary student who was not included in this particular statistical analysis.

Unequal variances could not be assumed, yet a significant difference ( $t = 2.17(14.30)$ ,  $p = .04$ ,  $d = 0.56$ ) was found between participant gender and tinkering self-efficacy scores. Male participants indicated a significantly higher perceptions of welding score ( $M = 6.6$ ,  $SD = 0.46$ ) than the female participants ( $M = 6.08$ ,  $SD = 0.76$ ). Male participants indicated higher tinkering self-efficacy scores than their female counterparts. Therefore, we reject the null hypothesis; a significant difference was present between gender and their tinkering self-efficacy.

### ***Gender vs. Perceptions about Learning Welding Technology***

We conducted an independent samples  $t$ -test to determine if a difference was present between participant gender and perceptions about learning welding



technology scores. The overall sample consisted of 43 participants who completed the post-survey. There were 30 male participants, 12 female participants and one non-binary student who was not included in this particular statistical analysis.

No significant difference was found between participant gender and their perception about learning welding technology scores ( $t = 0.87(40)$ ,  $p = 0.38$ ,  $d = 0.57$ ). Therefore, we failed to reject our null hypothesis; no significant difference was present between gender and their perception about learning welding technology.

### ***Gender vs. Choice of the Welding Instructor's Gender***

To test the null hypothesis, we conducted a chi-square test to determine associations between the gender demographic variable and attitudes toward the gender of the welding instructor. The question “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option” and the participant gender were used to conduct the chi-square test. The overall sample consisted of 43 participants who completed the post-survey. There were 30 male participants, 12 female participants and one non-binary student who is not included in this particular statistical analysis.

The chi-square test assumptions include independence and a certain number of expected frequencies. Our table was a 3 X 2 contingency table measuring participant gender (i.e., two categories) and their choice of their welding instructor's gender (i.e., three categories) therefore all expected counts need to be larger than one and no more than 20% of expected frequencies can be

less than five (Field, 2017). Fisher's exact test and the Likelihood ratio are alternatives to Pearson's chi-square in the event of lacking expected frequency values. The likelihood ratio is the preferable option for smaller sample sizes (Field, 2017).

The expected count assumption for the chi-square test was violated as over 20% of cells contained an expected count of less than five in the post-survey. We then utilized the likelihood ratio due to the chi-square assumptions of expected frequencies being violated (Field, 2017). There was not a significant relationship between gender and participants' choice of their welding instructor's gender,  $X^2(2, n = 42) = 1.31, p = 0.51$ . Therefore, we failed to reject our null hypothesis; no significant association was present between gender and participants' choice of their welding instructor's gender.

### ***Degree vs. Perceptions of Welding Technology***

We conducted an independent samples *t*-test to determine if a difference was present between participant's degree of study and perceptions of welding technology scores. The overall sample consisted of 43 participants who completed the post-survey in fifteen different majors. Participants were grouped based on similar majors. Majors related to technology were coded as "technology-oriented" and all other majors were coded as "non-technology oriented." The technology-oriented group possessed a higher perceptions of welding technology score than the non-technology oriented group.

No significant difference ( $t = 0.34(41), p = 0.72, d = 0.95$ ) was found between the technology-oriented and the non-technology oriented groups

regarding perceptions of welding technology. Therefore, we failed to reject the null hypothesis; no significant difference was present between participant degree of study and their perceptions of welding technology.

### ***Degree vs. Tinkering Self-Efficacy***

We conducted an independent samples *t*-test to determine if a difference was present between participant's degree of study and tinkering self-efficacy scores. The overall sample consisted of 43 participants who completed the post-survey in fifteen different majors. Participants were grouped based on similar majors. Majors related to technology were coded as a "technology-oriented" group and all other majors were a "non-technology oriented" group.

The technology-oriented group possessed a tinkering self-efficacy score with a mean of 6.61 indicating study participants coded into this group possessed high levels of tinkering self-efficacy. The non-technology oriented group possessed a tinkering self-efficacy score of 6.15. A significant difference ( $t = 2.25(19.6), p = .03, d = 0.95$ ) was found between the technology oriented group and non-technology oriented group regarding tinkering self-efficacy. Therefore, we reject the null hypothesis; a significant difference was present between participant degree of study and their tinkering self-efficacy.

### ***Degree vs. Perceptions about Learning Welding Technology***

We conducted an independent samples *t*-test to determine if a difference was present between participant's degree of study and perception about learning welding technology scores. The overall sample consisted of 43 participants who

completed the post-survey in fifteen different majors. Participants were grouped based on similar majors. Majors related to technology were coded as a “technology-oriented” group and all other majors were a “non-technology oriented” group.

The technology-oriented group possessed a higher mean than the non-technology oriented group, yet no significant difference was found between the technology-oriented and the non-technology oriented groups ( $t = 0.90(41)$ ,  $p = .37$ ,  $d = 0.95$ ). Therefore, we failed to reject the null hypothesis; no significant difference was present between participant degree of study and perception about learning welding technology.

#### ***Degree vs. Choice of the Welding Instructor’s Gender***

To test the null hypothesis, we conducted a chi-square test to determine associations between the degree of study demographic variable and attitudes toward the gender of the welding instructor. The question “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option” and the participant gender were used to conduct the chi-square test. The overall sample had 43 participants who completed the post-survey in fifteen different majors. Participants were grouped based on similar majors. Majors related to technology were coded as a “technology-oriented” group and all other majors were a “non-technology oriented” group.

The chi-square test assumptions include independence and a certain number of expected frequencies. Our table was a 3 X 2 contingency table

measuring participant degree of study (i.e., two categories) and their choice of their welding instructor's gender (i.e., three categories) therefore all expected counts are required to be larger than one and no more than 20% of expected frequencies can be less than five (Field, 2017).

The expected count assumption for the chi-square test was assumed and each cell had a minimum of 5 values. There was no significant relationship between degree of study and participant choice of their welding instructor's gender,  $X^2(2, n = 43) = 0.58, p = 0.76$ . Therefore, we failed to reject our null hypothesis; no significant association was present between participant degree of study and their attitudes towards the gender of their welding instructor.

### ***Age vs. Perceptions of Welding Technology***

We conducted an independent samples *t*-test to determine if a difference was present between participant's age and perceptions of welding technology scores. The overall sample consisted of 43 participants who completed the post-survey with a variety of ages. Participants were coded into two groups: a traditional student and non-traditional student group. The traditional student groups consisted of all participants ages 18-23 and the non-traditional student group consisted of all participants over 24 years of age. There were 34 participants coded into the traditional student group and nine participants coded into the non-traditional student group.

The traditional student group possessed a mean perceptions of welding technology score of 5.65 and the non-traditional student group possessed a higher mean score of 5.80. No significant difference was found between the two groups,

( $t = -.56(23.88)$ ,  $p = 0.56$ ,  $d = 0.95$ ). Therefore, we failed to reject our null hypothesis; no significant difference was present between participant age and perceptions of welding technology.

### ***Age vs. Tinkering Self-Efficacy***

We conducted an independent samples  $t$ -test to determine if a difference was present between participant's age and tinkering self-efficacy scores. The overall sample consisted of 43 participants who completed the post-survey with a variety of ages. Participants were coded into two groups: a traditional student and non-traditional student group. The traditional student groups consisted of all participants ages 18-23 and the non-traditional student group consisted of all participants over 24 years of age. There were 34 participants coded into the traditional student group and nine participants coded into the non-traditional student group.

The traditional student group possessed a mean tinkering self-efficacy score of 6.45 and the non-traditional student group possessed a mean score of 6.39. No significant difference, ( $t = .26(41)$ ,  $p = 0.78$ ,  $d = 0.60$ ) was found between the two groups. Therefore, we failed to reject our null hypothesis; no significant difference was present between participant age and their tinkering self-efficacy.

### ***Age vs. Perceptions about Learning Welding Technology***

We conducted an independent samples  $t$ -test to determine if a difference was present between participant's age and perception about learning welding

technology scores. The overall sample consisted of 43 participants who completed the post-survey with a variety of ages. Participants were coded into two groups: a traditional student and non-traditional student group. The traditional student groups consisted of all participants ages 18-23 and the non-traditional student group consisted of all participants over 24 years of age. There were 34 participants coded into the traditional student group and nine participants coded into the non-traditional student group.

The traditional student group possessed a mean tinkering self-efficacy score of 6.14 and the non-traditional student group possessed a mean score of 6.15. No significant difference ( $t = -.22(41)$ ,  $p = 0.98$ ,  $d = 0.69$ ) was found between the two groups. Therefore, we failed to reject our null hypothesis; no significant difference was present between participant age and their perception about learning welding technology.

### ***Age vs. Choice of the Welding Instructor's Gender***

To test the null hypothesis, we conducted a chi-square test to determine associations between the age demographic variable and attitudes toward the gender of the welding instructor. The question "Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option" and the participant gender were used to conduct the chi-square test.

The overall sample consisted of 43 participants who completed the post-survey with a variety of ages. Participants were grouped based on age on nontraditional and traditional. Students between the ages of 18-23 were included

in the traditional student group and students over the age of 24 were included in the non-traditional student group.

The chi-square test assumptions include independence and a certain number of expected frequencies. Our table was a 3 X 2 contingency table measuring participant age (i.e., two categories) and participant choice of their welding instructor's gender (i.e., three categories) therefore all expected counts need to be larger than one and no more than 20% of expected frequencies can be less than five (Field, 2017). Fisher's exact test and the Likelihood ratio are alternatives to Pearson's chi-square in the event of lacking expected frequency values. The likelihood ratio is the preferable option for smaller sample sizes (Field, 2017).

The expected count assumption for the chi-square test was violated as over 20% of cells contained an expected count of less than 5 in the post-survey. We then utilized the likelihood ratio due to the chi-square assumptions of expected frequencies being violated (Field, 2017). We then utilized the chi-square likelihood ratio due to the chi-square assumptions being violated. There was no significant relationship between age and participants' choice of their welding instructor's gender,  $X^2(2, n = 43) = 2.86, p = 0.23$ . Therefore, we failed to reject our null hypothesis; no significant association was present between participant age and participants' choice of their welding instructor's gender.

### **Research Objective 7**

Objective seven sought to explain the relationship between college students' attitudes about the gender of their male and female welding instructor



and demographics, perceptions towards welding technology, tinkering self-efficacy, and perceptions about learning welding technology. In simpler terms, this objective sought to describe how participants' demographics, perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology affect their attitudes of the gender of their welding instructor.

We conducted six individual statistical tests to compare the independent variables and dependent variables. All statistical tests utilized the post dataset for combined spring and fall data. The non-binary participant was not included in several of these statistical tests due to lack of numbers and ability to perform correlation statistical analysis with only one individual.

#### ***Gender vs. Choice of the Welding Instructor's Gender***

We conducted a chi-square test to determine associations between the gender demographic variable and attitudes toward the gender of the welding instructor. The question "Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option" and the participant gender were used to conduct the chi-square test. The overall sample consisted of 43 participants who completed the post-survey. There were 30 male participants, 12 female participants and one non-binary student who is not included in this particular statistical analysis.

The chi-square test assumptions include independence and a certain number of expected frequencies. Our table was a 3 X 2 contingency table measuring participant gender (i.e., two categories) and choice of their welding instructor's gender (i.e., three categories) therefore all expected counts need to be

larger than one and no more than 20% of expected frequencies can be less than five (Field, 2017). Fisher's exact test and the Likelihood ratio are alternatives to Pearson's chi-square in the event of lacking expected frequency values. The likelihood ratio is the preferable option for smaller sample sizes (Field, 2017).

The expected count assumption for the chi-square test was violated as over 20% of cells contained an expected count of less than 5 in the post-survey. We then utilized the likelihood ratio due to the chi-square assumptions of expected frequencies being violated (Field, 2017). There was no significant relationship between participant gender and choice of their welding instructor's gender,  $X^2(2, n = 42) = 1.32, p = 0.51$ . Therefore, we failed to reject our null hypothesis; no significant association was present between participant gender and choice of their welding instructor's gender.

### ***Degree vs. Choice of the Welding Instructor's Gender***

We conducted a chi-square test to determine associations between the degree of study demographic variable and attitudes toward the gender of the welding instructor. The question "Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option" and the participant gender were used to conduct the chi-square test. The overall sample consisted of 43 participants who completed the post-survey in fifteen different majors. Participants were grouped based on similar majors. Majors related to technology were coded as a "technology-oriented" group and all other majors were coded as a "non-technology oriented" group.

The chi-square test assumptions include independence and a certain number of expected frequencies. Our table was a 3 X 2 contingency table measuring participant degree of study (i.e., two categories) and their choice of their welding instructor's gender (i.e., three categories) therefore all expected counts are required to be larger than one and no more than 20% of expected frequencies can be less than five (Field, 2017).

The expected count assumption for the chi-square test was assumed and each cell had a minimum of 5 values. There was no significant relationship between degree of study and choice of their welding instructor's gender,  $X^2(2, n = 43) = 0.58, p = 0.76$ . Therefore, we failed to reject our null hypothesis; no significant association was present between participant degree of study and their choice of their welding instructor's gender.

### ***Age vs. Choice of the Welding Instructor's Gender***

We conducted a chi-square test to determine associations between the age demographic variable and attitudes toward the gender of the welding instructor. The question "Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option" and the participant gender were used to conduct the chi-square test. The overall sample consisted of 43 participants who completed the post-survey with a variety of ages. Participants were grouped based on age on nontraditional and traditional. Students between the ages of 18-23 were included in the traditional student group and students over the age of 24 were included in the non-traditional student group.

The chi-square test assumptions include independence and a certain number of expected frequencies. Our table was a 3 X 2 contingency table measuring participant age (i.e., two categories) and choice of their welding instructor's gender (i.e., three categories) therefore all expected counts need to be larger than one and no more than 20% of expected frequencies can be less than five (Field, 2017). Fisher's exact test and the Likelihood ratio are alternatives to Pearson's chi-square in the event of lacking expected frequency values. The likelihood ratio is the preferable option for smaller sample sizes (Field, 2017).

The expected count assumption for the chi-square test was violated as over 20% of cells contained an expected count of less than 5 in the post-survey. We then utilized the likelihood ratio due to the chi-square assumptions of expected frequencies being violated (Field, 2017). We then utilized the chi-square likelihood ratio due to the chi-square assumptions being violated. There was no significant relationship between participant age and choice of their welding instructor's gender,  $X^2(2, n = 42) = 2.86, p = 0.23$ . Therefore, we failed to reject our null hypothesis; no significant association was present between participant age and their choice of their welding instructor's gender.

### ***Multinomial Regression Model***

We conducted a multinomial logistic regression to determine if certain constructs in our study (i.e., perceptions of welding technology, tinkering self-efficacy and perceptions toward learning welding technology) were indicators of study participant's choice of their welding instructor's gender.

The logistic regression model was statistically insignificant because Akaike's Information Criterion (AIC) and Schwarz's Bayesian Criterion (BIC) increased after adding perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology to the model. The smaller AIC and BIC values, the increased likelihood for a significant relationship between the variables (Field, 2017).

There is no minimum value amount for a multinomial logistic regression, yet our sample size of 43 individuals enrolled in a variety of majors did not provide enough data for the model to be accurately measured. Therefore, our model was not associated with participant's choice of their welding instructor's gender in this study.

## **Chapter V: Conclusions, Implications, and Recommendations**

### **Introduction**

The purpose of this study was to examine students' perceptions of learning from a female instructor versus male instructor in a post-secondary welding course. We examined associations and differences between students' preference of a male and a female welding instructor as well as individual self-efficacy and perceptions towards using welding technology. This study was designed to evaluate potential bias towards receiving instruction from a male or female welding instructor. This project consisted of a convenience purpose sample of post-secondary welding students at Utah State University in the Spring and Fall 2022 semesters. Several individuals elected not to participate in the research study. A total of 45 individuals elected for their survey information to be utilized in the research. Results were primarily differentiated by course section (i.e., Tuesday or Thursday section) or participant gender. The research was guided by the following question: Are there differences in students' perceptions of female instructors versus male instructors of a welding course?

1. Describe the demographic profile of students in a post-secondary welding course.
2. Describe college students' attitudes toward the gender of their welding instructor and determine any difference between participant gender and course sections.

- *H<sub>0</sub>: There is no difference between students' gender or course section and their attitudes toward the gender of their welding instructor.*
3. Describe college students' perceptions towards welding technology and determine any difference between participant gender and course sections.
    - *H<sub>0</sub>: There is no difference between students' gender or course section and their perceptions of welding technology.*
  4. Describe college students' tinkering self-efficacy and determine any difference between participant gender and course sections.
    - *H<sub>0</sub>: There is no difference between students' gender or course section and tinkering self-efficacy.*
  5. Describe college students' perceptions about learning welding technology and determine any difference between participant gender and course sections.
    - *H<sub>0</sub>: There is no difference between students' gender or course section and perceptions about learning welding technology.*
  6. Explain the relationship between college students' demographics (i.e., gender, degree of study, and age) and their perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.
    - *H<sub>0</sub>: There is no relationship between participant demographics and their perceptions towards welding technology, tinkering self-*

*efficacy, perceptions about learning welding technology and their choice of their welding instructor's gender.*

7. Explain the relationship between college students' choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology.
  - *H<sub>0</sub>: There is no relationship between college choice of their welding instructor's gender and demographics, perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology.*

### **Summary of Findings**

#### ***Objective #1: Describe the Demographic Profile of Students in a Post-Secondary Welding Course.***

The demographic profile of college students in a post-secondary welding course included a wide representation of students' gender, degree of study, and age. Students also had a variety of previous high school welding experience. The total sample consisted of 45 study participants. Approximately 68% of the participants identified as male, 28% identified as female and 2% identified as non-binary. The female participants tended to be younger than their male counterparts. The average age of the male participants was 23.06 ( $SD = 4.20$ ) whereas the average age of the female participants was 21.46 ( $SD = 2.02$ ).



Study participants were enrolled in a variety of degree programs at Utah State University. A total of 15 different majors were represented in our study by the undergraduate participants. The most common degrees of study participants were pursuing in our study were outdoor product design and development ( $n = 9$ ), agricultural education ( $n = 9$ ), technology and engineering education ( $n = 6$ ), agricultural systems technology ( $n = 5$ ) and technology systems ( $n = 4$ ). Approximately 13% of study participants were studying a major outside of the college of agriculture in a non-technology oriented degree. Approximately 26% of the study participants ( $n = 12$ ) indicated they had previous high school welding experience as they entered the ASTE 3030 welding course. The majority of the sample (i.e., 88%) indicated they enjoyed agricultural mechanization courses.

***Objective #2: Describe College Student's Attitude Toward the Gender of their Welding Instructor and Determine any Difference between Participant Gender and Course Sections.***

The second research objective sought to describe college students' attitudes regarding the gender of their welding instructor and determine any differences between the participant gender and course sections. We collected data through a pre-survey at week four and a post-survey at week 12 to determine if participants preferences changed after experiencing both a female and male instructor in the welding course. Data were collected through six statements on a Likert-scale and two multiple choice questions.

1. "The person who teaches welding does not impact my ability to learn the content."

2. “If I believe the instructor is knowledgeable, I learn more.”
3. “I would learn more from a female instructor in this welding course.”
4. “I would learn more from a male instructor in this welding course.”
5. “I believe my gender is why I will be successful in welding.”
6. “An instructor who has welding experience is more beneficial to my learning than is their gender.”
7. “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose?” Options were male or female.
8. “I have no preference towards gender of the instructor if they can teach welding well.” Options were true or false.

**Question 1: “The person who teaches welding does not impact my ability to learn the content.”** The majority of study participants selected responses in the disagree, somewhat disagree or neutral range indicating the person who teaches their welding courses does impact and have an influence on their ability to learn content. No significant differences were observed between the Tuesday and Thursday course sections or between the male and female participants. No significant difference was found between either section’s pre-survey and post-survey or between the male or female participant’s pre-survey and post-survey.

**Question 2: “If I believe the instructor is knowledgeable, I learn more.”** The majority of study participants selected responses in the somewhat agree or agree ranges indicating if students believe their instructor is

knowledgeable, then they learn more. No significant difference was found between the male and female participants and between the course sections. No significant difference was found between either section's pre-survey and post-survey or between the male or female participant's pre-survey and post-survey.

**Question 3 & 4 : “I would learn more from a female instructor in this welding course and I would learn more from a male instructor in this welding course.”** Regarding question three and four (i.e., “I would learn more from a female instructor in this welding course” and “I would learn more from a male instructor in this welding course”), participants were asked to respond to two statements on a 7-point Likert Scale (1 = strongly disagree, 4 = neutral, and 7 = strongly agree). The researchers recognized the majority of students in both the sections selected identical answers for question three and four (i.e., a participant who selected “3” on the Likert scale for “I would learn more from a female instructor in this welding course” also selected “3” for “I would learn more from a male instructor in this welding course”).

In the pre-surveys, the means for the course sections consisted of a larger difference between learning from the male and female instructor than in the post-survey. The course sections indicated similar answers in the pre-survey; the majority of course sections in the pre-survey ranked learning from a male instructor higher than learning from a female instructor. In the post-survey, many participants adjusted their answer to be more in favor of learning from a female instructor.

The Tuesday course section ranked they would learn more from a male instructor higher than from a female instructor in both the pre-survey and post-survey. The Thursday section ranked they would learn more from a female instructor higher than from a male instructor in both the pre-survey and post-survey. There was no significant differences found between the Tuesday and Thursday course sections. Yet a significant difference was found in the paired samples *t*-tests examining the Tuesday section's pre-survey and post survey in regard to the statement, "I would learn more from a female instructor." The Tuesday section's perceptions of learning from a female instructor changed or were more positive after receiving instruction from a female welding instructor. No significant difference was found between the Thursday section's pre-survey and post-survey regarding either statement.

A significant difference was present between the male and female participants in the pre-survey regarding the statement, "I would learn more from a female instructor." No significant difference was present in the post-survey. A significant different was found between the male participant's pre-survey and post-survey regarding the statement, "I would learn more form a female instructor." The male participants consistently ranked learning from a female instructor lower than from a male instructor. The female participants ranked learning from a female instructor higher in the pre-survey and in the post-survey ranked learning from a male and female equal. Several participants (Michael, Sally, Rose) displayed clear evidence of bias against a female instructor by indicating different scores for statement three (i.e., I would learn more from a

female instructor) and for statement four (i.e., I would learn more from a male instructor).

**Question 5: “I believe my gender is why I will be successful in welding.”** The majority of study participants disagreed or strongly disagreed with the statement indicating study participants did not believe their gender is a factor in their personal welding success. No significant differences were observed between the Tuesday and Thursday course sections or between the male and female study participants. No significant difference was found between either section’s pre-survey and post-survey or between the male or female participant’s pre-survey and post-survey.

**Question 6: “An instructor who has welding experience is more beneficial to my learning than is their gender.”** The majority of study participants agreed or strongly agreed that an instructor with welding experience is more beneficial to their learning than their gender. The male participants’ mean scores were higher compared to the female participants suggesting the male participants felt more strongly about their instructor’s welding experience than their gender. Whereas the female participants presented lower means suggesting an instructor’s gender is a slight consideration when enrolling in a welding course. No significant difference was found between either section’s pre-survey and post-survey or between the male or female participant’s pre-survey and post-survey.

**Question 7: “Given an option of instructors with similar background and knowledge of welding, which instructor would you choose?”** Many study

participants adjusted their answer regarding between the pre-survey and post-survey. In the pre-survey, the majority of male participants selected a preference towards learning from a male instructor. The majority of female participants selected preference toward a female instructor or were neutral. After receiving instruction from a female instructor in the post-secondary welding course, an increased number of participants indicated a preference toward learning from a female instructor or they did not indicate a preference toward the gender of their welding instructor.

**Question 8: “I have no preference towards gender of the instructor if they can teach welding well.”** The majority of study participants indicated zero bias towards the gender of their instructor if they can teach welding well. Three individuals (Rose, James, and Katie) selected “false” indicating they did have a preference of the gender of their welding instructor even if they can teach welding well.

***Objective #3: Describe College Students’ Perceptions towards Welding Technology and Determine any Difference between Participant Gender and Course Section.***

The third research objective sought to describe collegiate students’ perceptions toward welding technology and determine any difference between participant gender and course section. This construct consisted of seven items on a 7-point Likert scale. Example Likert scale statements included, “welding technology is important to learn” and “if I could enroll in more welding technology courses I would.”

The female participants consistently indicated lower perceptions of welding technology scores than the male participants in the spring and fall semesters. No significant statistical difference was found between the male and female participants in the pre-survey. The male participants and female participants indicated significantly different perception of welding technology in the post-survey. As a whole, the majority of students' perceptions of welding technology scores increased between the pre-survey and post-survey. The different sections of the course indicated varying levels of perceptions toward welding technology scores. The mean scores of all the welding sections were in the agree to somewhat agree range. No significant difference was found between either section's pre-survey and post-survey or between the male or female participant's pre-survey and post-survey.

***Objective #4: Describe College Students' Tinkering Self-Efficacy and Determine any Difference between Participant Gender and Course Section.***

The fourth research objective sought to describe college students' tinkering self-efficacy and determine any difference between participant gender and course section. This construct consisted of seven items on a 7-point Likert scale. Example Likert scale statements included, "I enjoy taking apart items and seeing how they work" and "I enjoy repairing equipment."

All means were in the agree range indicating the study participants as a whole had high tinkering self-efficacy. The Thursday course section consistently indicated lower tinkering self-efficacy scores than the Tuesday course section. There was a significant difference between the course sections in the pre-survey

but not in the post-survey. The Thursday course section's tinkering self-efficacy increased after receiving instruction from a male instructor. No significant difference was found between either section's pre-survey or post-survey tinkering self-efficacy score.

The female and male participants indicated varying tinkering self-efficacy scores. The female participants consistently indicated lower levels of tinkering self-efficacy compared to their male counterparts and a significant statistical difference was found between the male and female participants in the pre-survey. No significant statistical difference was found between the male and female participants in the post-survey. No significant difference was found between the male or female participant's pre-survey and post-survey.

***Objective #5: Describe College Students' Perceptions about Learning Welding Technology and Determine any Difference between Participant Gender and Course Section.***

The fifth research objective sought to describe college students' perceptions about learning welding technology and determine any difference between participant gender and course section. This construct consisted of 14 items on a 7-point Likert scale. Example Likert scale statements included, "welding can be used in real life" and "welding technology amazes me."

The female participants consistently indicated lower perceptions about learning welding technology scores than their male counterparts, yet no significant statistical difference was found between the male and participants. After receiving instruction from both the male and female instructor, the majority



of students scores increased. No significant difference was found between the male or female participant's pre-survey and post-survey. The Thursday course section indicated lower perceptions about learning welding technology compared to the Tuesday course section yet no significant difference in the pre-survey and post-survey between the two course sections. No significant difference was found between either section's pre-survey or post-survey.

***Objective #6: Explain the Relationship between College Students'***

***Demographics (i.e., gender, degree of study, and age) and their Perceptions towards Welding Technology, Tinkering Self-Efficacy, Perceptions about Learning Welding Technology, and their Choice of their Welding Instructor's Gender.***

The sixth research objective sought to explain the relationship between college students' demographics and perceptions towards welding technology, tinkering self-efficacy, perceptions about learning welding technology, and their attitudes about the gender of the male and female welding instructors. In simpler terms, this objective sought to describe how participants' demographics (i.e., age, gender, and degree of study) affected the following: perceptions toward welding technology, tinkering self-efficacy, perceptions about learning welding technology, and their attitudes about the gender of the male and female welding instructors.

**Demographics (gender) vs. Perceptions of Welding Technology.** A statistically significant difference was found between gender and the perceptions of welding technology scores. The male participants consistently indicated higher

perceptions of welding technology scores than their female counterparts. Male participants indicated higher perceptions of welding technology scores than their female counterparts.

**Demographics (gender) vs. Tinkering self-efficacy.** A statistically significant difference was found between gender and the tinkering self-efficacy scores. The male participants consistently indicated higher tinkering self-efficacy scores than their female counterparts. Male participants indicated higher tinkering self-efficacy scores than their female counterparts.

**Demographics (gender) vs. Perceptions about Learning Welding Technology.** There was no significant statistical difference present between participants' gender and perceptions about learning welding technology. Both genders indicated statistically similar scores in the "agree" or six-point range on the Likert scale.

**Demographics (gender) vs. Choice of their Welding Instructor's Gender.** We found no statistically significant association between participants' gender and choice of their welding instructor's gender.

**Demographics (degree of study) vs. Perceptions of Welding Technology.** The non-technology oriented group indicated a lower perceptions of welding technology score than the technology oriented group. No statistically significant difference was found between participants' degree of study and perceptions of welding technology.

**Demographics (degree of study) vs. Tinkering Self-Efficacy.** A statistically significant difference was found between participants' degree of study

and tinkering self-efficacy. The technology oriented group indicated a higher tinkering self-efficacy score than the non-technology oriented group.

**Demographics (degree of study) vs. Perceptions about Learning**

**Welding Technology.** No statistically significant difference was found between participants' degree of study and perceptions about learning welding technology.

The technology oriented group indicated a higher perceptions of welding technology score than the non-technology oriented group yet was not significant.

Both groups' means were in the six-point category which indicated participants agreed with the statements in this construct.

**Demographics (degree of study) vs. Choice of their Welding**

**Instructor's Gender.** A non-statistically significant association was found between participants' degree and choice of their welding instructor's gender.

**Demographics (age) vs. Perceptions of Welding Technology.** The non-traditional student group indicated a higher perceptions of welding technology score than the traditional student group. No significant difference was found between age and perceptions of welding technology.

**Demographics (age) vs. Tinkering Self-Efficacy.** The traditional student group indicated a higher perceptions of welding technology score than the non-traditional student group. No significant difference was found between age and tinkering self-efficacy.

**Demographics (age) vs. Perceptions about Learning Welding**

**Technology.** The traditional and non-traditional student groups indicated almost identical perceptions about learning welding technology scores. Age did not have

an effect on their scores. No significant difference was found between age and perceptions about learning welding technology.

**Demographics (age) vs. Choice of their Welding Instructor's Gender.**

No significant relationship between participant age and choice of their welding instructor's gender.

*Objective #7: Explain the Relationship between College Students' Choice of their Welding Instructor's Gender and Demographics, Perceptions towards Welding Technology, Tinkering Self-Efficacy, and Perceptions about Learning Welding Technology.*

**Demographics (gender) vs. Choice of the Welding Instructor's**

**Gender.** A non-statistically significant association was found between participants' gender and choice of their welding instructor's gender.

**Demographics (degree of study) vs. Choice of the Welding**

**Instructor's Gender.** A non-statistically significant association was found between participants' degree and choice of their welding instructor's gender.

**Demographics (age) vs. Choice of the Welding Instructor's Gender.**

No significant relationship between participant age and choice of their welding instructor's gender.

**Multinomial Regression Model - Perceptions of Welding Technology,**

**Tinkering Self-Efficacy and Perceptions about Learning Welding**

**Technology vs. Choice of the Welding Instructor's Gender.** The logistic regression model was statistically insignificant because Akaike's Information Criterion (AIC) and Schwarz's Bayesian Criterion (BIC) increased after adding

perceptions of welding technology, tinkering self-efficacy and perceptions about learning welding technology to the model. Therefore, our model was not associated with participant's choice of their welding instructor's gender in this study.

## **Conclusions & Implications**

### ***Objective #1: Describe the Demographic Profile of Students in a Post-Secondary Welding Course.***

Male students represented the majority of welding course enrollees. This finding is consistent with previous literature indicating female students are the minority in welding courses and male students are the majority (Battis, 2020; William, 2021). The number of female students has increased in recent years in certain agricultural mechanics and welding fields, yet females continue to represent the minority (Oliveira, 2011; U.S. Bureau of Labor Statistics, 2021). Perhaps this finding is related to student's perceptions of certain careers such as welding, STEM and agricultural mechanics, remaining male oriented domains given the sheer ratio of males to females. Females tended to avoid careers in predominately male oriented realms (England, 2010) and perhaps females continue the same pattern today in a subconscious manner searching for careers where they can acquire a greater sense of belonging. As a result, there is a lack of females enrolled in welding courses (e.g., at the post-secondary and secondary levels) and involved in other agricultural mechanics and STEM fields. Humans require a sense of belonging to be satisfied and engaged which can strengthen

one's ability to remain in a profession (Lave & Wenger, 1991). Sense of belonging is critical for the future of females in STEM careers (Brainard & Carlin, 1998) and perhaps sense of belonging not only influences an individual's persistence in a profession but is also an influential factor in regard to an individual entering a profession. If young females were not the minority and had increased opportunities to recognize female role models in welding and STEM, perhaps more females would enroll and pursue those careers (Halpern et al., 2007; Hermann, 2016). This finding has implications for the future of females in STEM and agricultural mechanics fields.

The majority of the participants with previous high school welding experience were male, which suggests fewer females are enrolled in welding courses at the high school level than their male counterparts. One-fourth of the study sample indicated they had previous high school welding experience and only one of those participants was a female. Our results cannot be generalizable due to the lack of sample randomization, yet perhaps this trend is similar in other post-secondary welding courses. The small number of females enrolled in high school welding courses may be potentially affected by the lack of female peers in welding courses and/or the agricultural mechanics realm appearing to be male oriented. This finding is consistent with secondary agricultural educator's comments in recent newspapers regarding the lack of females in their welding courses as they receive a mere one or two female students enrolled every year (Battis, 2020; William, 2021). This finding has implications for the future of careers which utilize welding technology and are searching for a diverse

workforce. In this study, the female participants were not as heavily exposed to welding as their male counterparts at the secondary level which can affect the likelihood of females pursuing careers utilizing welding technology after high school. If secondary female students felt a greater sense of belonging in welding courses perhaps more females would pursue careers utilizing welding technology.

The majority of the agricultural education majors in the sample were female. This finding is consistent with previous literature indicating the increased number of female agricultural educators entering the profession (Knight, 1987; Shultz et al., 2014; Smith et al., 2021). Agricultural educators teach a variety of subjects including agricultural mechanics yet only one female participant in our study completed a high school welding course prior to enrolling in the post-secondary welding course. This particular female was an agricultural education major. This finding is critical for the agricultural education profession regarding recruitment of female secondary students into mechanics courses, but also for the increased number of females preparing to teach agricultural mechanics courses at the high school level who, very likely, did not complete a secondary welding course. Increased recruitment efforts for females to enroll in high school welding courses may be warranted to level the number of females and males in the courses and prepare females for careers utilizing hands on skills. These findings developed a question for the agricultural education profession to reflect on; why are so few females enrolled in secondary (and post-secondary) welding courses while the number of female agricultural educators teaching agricultural mechanics continue to rise? Female high school seniors deciding to study agricultural

education should be enrolling in agricultural mechanics courses to better understand and acquire exposure to potential courses which they may teach someday. Approximately 3.5% of welders in the United States are female (U.S. Bureau of Labor Statistics, 2021) and our sample had more females than the number of female welders in the industry, yet the majority of females in this course were not studying to be welders but to be agricultural educators or work in a non-technology oriented career.

The majority of study participants engaged in a technology-oriented degree program were male. This finding is consistent with literature regarding gender in STEM related fields (Baker & Krause, 2007; Beckwitk et al., 2006; Bond, 2016; Crismond, 2001). Several technology-oriented degrees represented in this sample did not have any female participants: outdoor product design and development, engineering, and technology systems. Many STEM careers have been tirelessly facing the demand for increased diversity, especially for females, to utilize their unique perspectives and potential innovations (Bond, 2016), and have had little success. This finding is not necessarily recently developed or new yet manifests the continuous gender divide in STEM related fields.

***Objective #2: Describe College Students' Attitudes toward the Gender of their Welding Instructor and Determine any Difference between Participant Gender and Course Section.***

**Quantitative Data.** The majority of participants agreed they would learn more from a male instructor than a female instructor in the welding course. The overwhelming majority of participants claimed they had zero preference towards



the gender of their welding instructor if they can teach welding well, yet the majority of the course participants selected a preference toward a male instructor at the beginning of the course when stipulated to choose between a male and female instructor in the pre-survey. Perhaps this finding is a result of normalcy or the instructor's gender students would most likely expect to be teaching a welding course. Students did not want to appear biased therefore they claimed they did not possess bias. Students most likely did not expect to be receiving instruction from a female instructor, especially the Tuesday course sections which began with receiving instruction from a male instructor both semesters. These findings indicate gender bias was possibly prevalent in the collegiate welding course and is consistent with previous literature displaying evidence of gender bias in other collegiate courses (MacNell, 2015; Mitchell & Martin, 2018).

Students believe an instructor with welding experience is more important and beneficial to their learning than the instructor's gender. Even though several individuals displayed noticeable indicators of gender bias through survey questions, the majority of students indicated an instructor's gender does not and should not matter if they can teach welding well. Several individuals displayed noticeable indicators of gender preference towards either a male or female instructor. It is interesting to note three participants (Rose, James, and Katie) who indicated a preference towards the gender of their welding instructor even if they can teach welding well. One of these participants (Rose) claimed she had a preference towards the gender of their welding instructor and selected a preference toward a male instructor regardless of his ability to teach content.

James perhaps developed a bias over the course of the semester because he did not claim a preference in the pre-survey yet indicated an negative perceptions toward receiving instruction from a female regardless of her ability to teach content. Katie perhaps developed a bias over the course of the semester as well because she did not claim a preference in the pre-survey yet indicated a preference in the post-survey.

After receiving instruction from a female welding instructor, participant perceptions altered toward whether they could learn welding content from a female instructor. It is important to note the statistically significant difference between the male participants' pre-survey and post-survey and the Tuesday sections' pre-survey and post-survey regarding the statement, "I would learn more from a female instructor." The male participants and Tuesday sections' mean score increased indicating receiving welding instruction from a female instructor had an impact on male participants and on the Tuesday section's beliefs of whether they could learn from a female instructor in the welding course. For many participants, this may have been the first time they received instruction from a female teacher in an agricultural mechanics course. Learning from an experienced female instructor perhaps changed their perceptions of ability to learn welding curriculum from a female.

It is interesting to note the number of participants (approximately 25%) who selected preference toward an instructor of the opposite gender than their own gender in the pre-survey and post-survey. This finding is not consistent with previous research regarding individual preference to associate with others sharing

certain similarities such as gender, personality, and hobbies (Montoya et al., 2008; Seldman, 2018). Perhaps these participants had previous negative learning experiences (e.g., in a classroom or elsewhere) with a teacher of the same gender as themselves.

It is interesting to note the Thursday sections of the course began with receiving instruction from the female instructor and consistently had more females enrolled than the Tuesday sections, yet an increased number of males in the Thursday sections selected preference toward a female instructor compared to the males in the Tuesday sections. Perhaps having an increased number of female peers in the course influenced the Thursday male participants' perceptions of females in the welding realm and their perceptions toward receiving instruction from a female instructor.

**Other Responses.** Katie, enrolled in the Thursday section, ranked learning from a female with a five (i.e., somewhat agree) and learning from a male instructor with a four (i.e., neutral) in the post-survey which indicated she felt strongly about learning more from a female instructor than a male instructor in the welding course.

Sally, enrolled in the Thursday section, ranked learning from a female instructor with a four (i.e., neutral) and learning from a male instructor with a six (i.e., agree) in the pre-survey which indicated she felt strongly about learning more from a male instructor than a female instructor in the welding course. She did not complete a post-survey.

George, enrolled in the Thursday section, ranked learning from a female with a seven (i.e., strongly agree) and learning from a male instructor with a six (i.e., agree) in the post-survey which indicated the individual felt strongly about learning more from a female instructor than a male instructor in the welding course.

Rose, enrolled in the Thursday section, ranked learning from a female with a two (i.e., disagree) and learning from a male with a six (i.e., agree) in the post-survey indicating she felt very strongly that she would learn more from a male instructor than a female instructor in the welding course.

Michael, enrolled in the Tuesday section, ranked learning from a female instructor with a three (i.e., somewhat disagree) and learning from a male instructor with a five (i.e., somewhat agree) in the pre-survey which indicated he felt strongly about learning more from a male instructor than a female instructor in the welding course. In the post-survey, he indicated zero bias as he selected identical answers for learning from a male versus a female instructor.

These five individuals each displayed evidence of gender bias; Katie and Michael displayed a preference toward their own gender of instructor whereas Rose, George, and Sally displayed a preference toward an instructor of the opposite gender than their own gender. No statistical conclusions can be formed from five individuals, yet it is critical to recognize the potential for gender bias may continue to exist in education and in welding education.

Several students, when prompted by questions which related to the gender of their welding instructor, wrote comments on the survey instrument or on their

final exam. No statistical conclusions can be formed regarding comments from three individuals, yet these comments hold similar themes compared to other conclusions found throughout this chapter. Bill, when prompted by the question regarding selecting either a male or female instructor wrote, “Whoever I like more, this is a sexist question,” and did not answer the question. Perhaps he felt strongly about remaining neutral between the two genders.

Joe wrote on the post-survey, “I liked that the instructors switched classes half-way through the semester, it made me realize girls can weld just as good as guys.” Perhaps this individual was initially skeptical of receiving instruction from a female welding instructor and was skeptical of his female counterparts welding abilities. Yet after receiving instruction from a female instructor, even if it was only for eight weeks, influenced his perceptions of females’ abilities to weld. Joe was pursuing a career in agricultural education, a career which has experienced a rapid increase in female educators. This individual case is consistent with previous research indicating females experience bias from their male counterparts in agricultural education (Kelsey, 2006; Kelsey 2007).

Jane wrote on the survey instrument, “It is inspiring having a female instructor, it gives me more confidence and motivation.” Jane felt very strongly about having a female welding instructor which indicates receiving instruction from a female instructor (e.g., a female role model) was a positive experience for this female participant. It is interesting to note three key terms she mentioned: inspiring, confidence and motivation. Perhaps Jane felt a greater sense of belonging in the welding environment while receiving instruction from a female

instructor therefore increasing her motivation to learn and confidence. This individual case is consistent with research emphasizing female role models are critical for retention of females in career fields lacking females (Halpern et al., 2007; Hermann, 2016).

***Objective #3: Describe College Students' Perceptions towards Welding***

***Technology and Determine any Difference between Participant Gender and Course Section.***

Male participants are more likely to possess a higher perceptions of welding technology compared to their female counterparts. The female study participants consistently indicated statistically lower perceptions of welding technology scores than their male counterparts in the pre-survey and post-survey. This finding is consistent with previous literature regarding gender in STEM related fields suggesting females possess lower perceptions toward different technologies (Sallee et al., 2013, Satori 2012, Bond, 2016, Baker & Krause, 2007), yet our findings are strictly in regard to welding technology. Welding technology was not as important or seemed less beneficial to the female participants regarding their future careers than to the male participants, which was indicated by the females' consistently lower perceptions of welding technology scores. The females also did not as strongly agree with their male counterparts that more welding technology courses should be taught. Perhaps this is due to the lack of females enrolled in welding courses, involved in welding careers and other careers which require welding technology, and females' lack exposure to welding. These findings have implications for the recruitment of females for the welding

profession and also for welding educators to better understand differences between their male and female students.

Study participants had positive perceptions towards welding technology which increased throughout the semester and after receiving instruction from both a male and female instructor. The mean scores of all welding sections were between the agree and strongly agree range which indicates the participants had positive perceptions toward welding technology. The welding course was likely a positive experience for the majority of participants. Students agreed welding is an important skill to learn and students can benefit from enrolling in a welding course.

***Objective #4: Describe College Students' Tinkering Self-Efficacy and Determine any Difference between Participant Gender and Course Section.***

Females possess lower tinkering self-efficacy levels compared to their male counterparts. In all surveys collected, the female participants indicated significantly lower tinkering self-efficacy than the male participants. This finding is consistent with literature claiming females possess lower tinkering self-efficacy due to lack of hands-on experience utilizing machinery, taking items apart and putting them back together and are more apprehensive toward equipment than their male counterparts (Baker & Krause, 2007; Crismond, 2001). Eagly's social role theory of sex differences suggest many differences between males and females are due to gender stereotypes developed by society, (Eagly, 1987) therefore females possessing significantly lower tinkering self-efficacy compared to males may be a result of modern-day social stereotypes. Females and males are

treated differently beginning at a young age which affects many decisions, including career decisions later in life. The majority of females in this study lacked prior secondary welding experience before enrolling in the post-secondary welding course which may have been a reason why their tinkering self-efficacy was lower. This finding is a crucial implication to modern STEM literature to exhibit the continuous lack of tinkering self-efficacy in females. Literature suggests the lack of females in STEM is partly due to socio-cultural factors (Leaper, 2015) which may include tinkering self-efficacy. Tinkering self-efficacy was a significant difference between the males and females in this study. Previous research suggests self-efficacy and motivation can be predictors of academic success and future career choices (Pajares, 1996). Therefore, the lack of tinkering self-efficacy among females in STEM may have an influence on whether or not a female may even consider entering a STEM profession or be a factor in leaving a career in STEM.

This finding suggests females studying agricultural education possess lower levels of tinkering self-efficacy compared to their male counterparts. The majority of individuals studying agricultural education are female and females are becoming the majority of agricultural educators (Shultz et al., 2014; Smith et al., 2021). This finding has implications for teacher preparation program curriculum as many teacher preparation programs require minimal agricultural mechanics courses (Burris et al., 2005, Byrd et al., 2015). Requiring an increased number of agricultural mechanics coursework may increase tinkering self-efficacy for all pre-service teachers, provide higher quality preparation to teach high school



agricultural mechanics and promote confidence in agricultural mechanics among female (and male) agricultural educators. This finding coincides with pre-service agriculture teachers need for agricultural mechanics professional development to be better prepared to teach and build confidence in their assigned agricultural mechanics courses (Tummons et al., 2017). Teaching agricultural mechanics courses is a demanding task, especially for an educator lacking the necessary previous experience or skills (Byrd et al., 2015). Therefore an increased focus among teacher preparation programs may develop quality and confident agricultural educators in the agricultural mechanics realm. Teacher retention is a critical issue in agricultural education and perhaps lack of tinkering self-efficacy in the agricultural mechanics realm is a factor for some individuals leaving the profession.

***Objective #5: Describe College Students' Perceptions about Learning Welding Technology and Determine any Difference between Participant Gender and Course Section.***

Participants' perceptions about learning welding technology significantly increased throughout the semester after receiving instruction from both a male and female instructor. This finding is consistent with research suggesting female role models are crucial for retention and promotion of careers lacking females (Halpern et al., 2007; Hermann, 2016). The findings of this study suggest female welding instructors (e.g., welding role models) have a positive influence not only on female, but also on male student's perceptions of welding technology.

Therefore, the increase of female agriculture educators teaching secondary

welding courses should be a positive influence for secondary female and male students' perceptions toward learning welding. With more females teaching secondary welding courses, perhaps a rise in female welders will occur as their perceptions toward learning welding will rise and they have female role models. This finding has implications for female enrollment in secondary welding programs, but also for the recruitment of females in the welding industry.

Students possess positive perceptions toward learning welding technology. The majority of study participants indicated they somewhat agreed or strongly agreed with the perceptions about learning welding technology construct, therefore both genders possess high perceptions about learning welding technology. This finding suggests students enjoy their welding courses. Students valued the curriculum and understood the need to learn welding skills as they were continuously applying the curriculum throughout the semester. In our study, males and females possessed strong perceptions about learning welding, yet many more males are enrolled in welding courses than their female counterparts at the secondary and post-secondary levels. Perhaps this was due to the female participants possessing significantly lower perceptions about learning welding technology scores than their male counterparts, yet still in the somewhat agree to strongly agree range. This finding is consistent with literature indicating the lack of experience females possess in machinery settings compared to their male counterparts (Baker & Krause, 2007; Crismond, 2001) and the lack of female influence in the welding industry (U.S. Bureau of Labor Statistics, 2021). The majority of participants indicated they enjoyed agricultural mechanization courses

which is consistent with the theme of students possessing positive perceptions towards learning welding. Perhaps the females in this study indicated lower perceptions of welding technology scores because of their lack of exposure to welding technology at the secondary level. This finding has implications for the agricultural education profession as many pre-service teachers are female lacking secondary welding experience.

***Objective #6: Explain the Relationship between College Students'***

***Demographics (i.e., gender, degree of study, and age) and their Perceptions of Welding Technology, Tinkering Self-Efficacy, Perceptions about Learning Welding Technology, and their Choice of the Welding Instructor's Gender.***

A significant relationship existed between gender and perceptions of welding technology. A male is more likely to indicate a higher perceptions of welding technology score compared to a female. Welding technology was not as important or seemed less beneficial to the female participants regarding their future careers compared to the male participants. Gender identity is a critical part of an individual (Ellemers, 2018); therefore it is practical for gender to be an influential factor of an individual's perceptions regarding a topic. Welding is a career few females pursue as approximately a mere 3.5% of welders in the United States are female (U.S. Bureau of Labor Statistics, 2021). The lack of females in welding careers may be a potential influencing factor regarding the significant relationship between gender and perceptions of welding technology scores. Bond (2016) suggests young females do not see themselves pursuing a STEM career starting at a young age. Since few females are involved in welding and STEM and

few are role models to young females, few females decide to pursue those careers. Previous research in STEM related fields recommends increased female role models to increase the number of females in STEM careers (Bond, 2016; Ellemers, 2015; Halpern et al., 2007; Hermann, 2016). The lack of females in welding and STEM is a potential barrier for many young females to enter the welding field and STEM related fields. The welding industry and STEM related fields should increase efforts towards recruiting females for the industry through role models and helping females see a future and sense of belonging for themselves in those particular industries. Agricultural education is an example of a career in which female educators are currently excelling and captivating. Female agricultural educators are role models for female secondary students to pursue careers in agriculture. Once the gender gap is leveled in welding and STEM related careers, perhaps a significant relationship between gender and perceptions of welding technology will no longer exist. These findings have implications for females in all fields of STEM, agricultural mechanics, welding, agricultural education, and other fields.

A significant relationship existed between gender and tinkering self-efficacy. This finding is consistent with literature claiming females possess lower tinkering self-efficacy levels (Baker & Krause, 2007; Crismond, 2001). It is also consistent with Parsons (1995) which indicated a social factor may have an influence on an individual's tinkering self-efficacy. Eagly's social theory and societal factors may also influence females lack of tinkering self-efficacy (Eagly, 1987). Baker & Krause (2007) suggest females' lack of experience utilizing

machinery is grounds for females' lack of tinkering self-efficacy. Many factors influence an individuals' tinkering self-efficacy, yet the relationship between gender and tinkering self-efficacy is concerning for many professions, especially for agricultural education. The rates of females pursuing careers in agricultural education is much faster than STEM related careers or the welding industry (Bond 2006; Knight 1987; Smith et al., 2021; U.S. Bureau of Labor Statistics, 2021). The number of females in agricultural education has finally surpassed the number of males in certain regions of the United States (Smith et al., 2021, Teach ag, n.d.) yet the two genders' tinkering self-efficacy levels are significantly different. Many female agricultural educators teach a welding course or some form of a secondary agricultural mechanics course (McKim & Saucier, 2011) and tinkering self-efficacy is a crucial skill in these particular settings (Baker & Krause, 2007). Low tinkering self-efficacy is an indicator of low confidence regarding shop equipment, completing projects, hands-on skills and fixing things which are all skills necessary for agricultural educators. These findings have implications for the future of females in agricultural education and in STEM related fields lacking female influence. It is necessary for teacher preparation programs to dedicate increased resources to ensuring females and all pre-service teachers are prepared to teach welding courses.

There was no significant correlation between gender and perceptions about learning welding technology. Both males and females indicated similar perceptions about learning welding technology; both genders enjoyed the welding course, recognized the value in learning how to weld and believed welding is a

good skill to have. This finding suggests both genders enjoy welding courses in spite of the lack of females enrolled in welding courses and pursuing careers which utilize welding technology. This finding has recruitment implications for secondary welding programs, agricultural education teacher preparation program, welding teachers, and the welding industry.

There was no significant relationship between gender and students' attitude towards the gender of their welding instructor. This finding has major implications for gender bias research in education settings, yet the findings of this study are not generalizable to the entire study population due to the lack of sample randomization and size. Although participant gender may not have a significant relationship to their attitude towards the gender of their welding instructor in our study, other studies have found evidence of gender bias in educational environments (MacNell et al., 2015; Mitchell & Martin, 2018, Kelsey, 2006; Kelsey 2007). Research has not narrowed down all the factors which influence whether an individual possesses bias towards one gender or the other in an educational environment, yet student and teacher gender are a consistent factor researchers investigate regarding the issue. Students may have poor perceptions of an instructor whose gender and teaching subject are conflicting according to stereotypical gender roles (Eagly and Karau, 2002; Eagly et al., 1995; Rosette and Tost, 2010). Our findings indicate gender bias was not an issue for the majority of the study participants, yet several participants displayed indicators of gender bias toward a male or female instructor through several of survey questions. Overall, the study participants displayed less signs of gender bias after receiving

instruction from both a male and female instructor than at the beginning of the course. Perhaps receiving instruction from a female instructor had an influence on students' beliefs on whether they could learn from a female, or perhaps it was their first experience receiving instruction from a female in an agricultural mechanics setting. Several males selected preference towards a female instructor while many females selected preference towards a male instructor. This finding is not consistent with previous research regarding individuals' preference to associate with others who share certain similarities such as gender, personality, and hobbies (Montoya et al., 2008; Seldman, 2018). Perhaps these participants had previous experiences which influenced their perceptions and preference toward the gender of their instructors. Other factors not accounted for in this study may have a more significant relationship to students' attitude towards the gender of their welding instructor and instructors of other disciplines. These findings have implications for the future of gender bias research in educational environments.

We found no significant relationship between participant's perceptions of welding technology or learning welding technology to participant's degree of study. This indicates students studying technology oriented degrees and non-technology oriented degrees are likely to hold similar perceptions of welding technology and learning welding technology.

A significant relationship existed between degree of study and tinkering self-efficacy. Students' studying a technology oriented degree are more likely to possess a higher tinkering self-efficacy score compared to those studying a non-

technology oriented degree. This finding is consistent with research suggesting students possessing higher tinkering self-efficacy levels are more interested in pursuing careers in STEM (Halim, 2018; Halpern, 2007; Herrman, 2016). This finding has implications for the future of STEM because heavy recruitment must be made to keep up with the heavy demand of individuals in STEM. We found no significant relationship between participant's degree of study or age and participant's choice of their welding instructor's gender. We also found age is not a significant indicator of perceptions of welding technology, tinkering self-efficacy, and perceptions about learning welding technology.

***Objective #7: Explain the Relationship between College Students' Choice of their Welding Instructor's Gender and Demographics, Perceptions of Welding Technology, Tinkering Self-Efficacy, and Perceptions about Learning Welding Technology.***

We found no significant relationship between demographic information and students' attitude towards the gender of their welding instructor. Our logistic regression model examining if perceptions of welding technology, tinkering self-efficacy and perceptions about learning welding technology are related students' attitudes toward the gender of their welding instructor were not significant in our study. Perhaps this was due our small sample size, more research needs to be conducted to determine factors which influence gender bias in the classroom.

**Recommendations**

The following areas are recommended for future policy and practice:



1. An increased recruitment effort towards secondary school females to pursue careers in blue-collar field such as a welding and STEM related careers. These efforts ought to take into consideration the differences in levels of exposure to machinery, secondary school mechanics courses and gender stereotypes between males and females.
2. Materials and workshops promoting females to pursue careers in welding and STEM should include female role models to increase the influence and indicate these careers can be held by females and males.
3. An increased effort to recruit females to enroll in secondary school welding and mechanics courses, whether in an agricultural education program or a technical program, should be implemented to break down barriers which exist for young females to enter these courses. This effort will increase females' exposure to new topics, potentially increase tinkering self-efficacy and the number of females pursuing welding careers.
4. An increased number of required agricultural mechanics courses for agricultural education teacher preparation programs should be required to provide increased opportunity for students lacking secondary agricultural mechanics experience to increase their confidence to teach agricultural mechanics.
5. Teacher preparation programs should address gender bias issues in teaching methods courses to prepare female educators to combat issues which may arise with students.

6. Society members should recognize gender stereotypes in their career fields and find strategies to recruit for a more diverse workforce.

The following areas are recommended for future research:

1. Qualitative research such as interviews with female agricultural mechanics instructors should be conducted to better understand their perspective and experiences being female and teaching courses which are heavily male dominated.
2. Qualitative research such as interviews with female agricultural mechanics students at the post-secondary and secondary levels should be conducted to better understand their feelings and experiences being a female in courses with male heavy enrollment and to recognize if gender bias is present.
3. Research should be conducted to determine the factors which increase or decrease an individual's tinkering self-efficacy and how tinkering self-efficacy plays a role in an individual's career choice.
4. Similar research be conducted in a secondary educational setting to verify gender bias from students in agricultural mechanics and course topics.
5. Research needs to be conducted to determine factors which influence gender bias in the classroom.
6. Research be conducted with a larger and more representative sample to determine the number of female welding course enrollees at the secondary and post-secondary levels and to determine if results are generalizable to study population.

**References:**

- Acker, J. (1990). Hierarchies, jobs, and bodies: A theory of gendered organizations. *Gender and Society*, 4(2), 139–158.  
<http://www.jstor.org/stable/189609>
- Andersen, K., & Miller, E. D. (1997). Gender and student evaluations of teaching. *Ps-Political Science and Politics*. 30, 216–219.  
<https://doi.org/10.2307/420499>
- Andrews, M. E., Patrick, A. D., & Borrego, M. (2021). Engineering students' attitudinal beliefs by gender and student division: A methodological comparison of changes over time. *International Journal of STEM Education*, 8 (13). <https://doi.org/10.1186/s40594-020-00269-6>.
- Astin, A. W. (1993). *What Matters in College: Four Critical Years Revisited*, Jossey-Bass, San Francisco
- Baker, D., & Krause, S. (2007). How well do tinkering and technical activities connect engineering education standards with the engineering profession in today's world? Proceedings of the 2007 ASEE Annual Conference & Exposition American Society for Engineering Education, Honolulu, HI
- Balsamo, M., Lauriola, M., Saggino, A. (2012). Personality and College Major Choice: Which Come First?. *Psychology*. 3, 399-405.  
<http://dx.doi.org/10.4236/psych.2012.35056>

- Battis, S. (2020, Jan. 15). Sparking passion: More girls enrolled in Big Spring High welding classes than ever before. *CBS 7*  
<https://www.cbs7.com/content/news/Welding--567026911.html>
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497–529.
- Baxter, L., Stephens, C., Thayer-Bacon, B. (2011). Perceptions and Barriers of Four Female Agricultural Educators Across Generations: A Qualitative Study. *Journal of Agricultural Education*, *52*(4) 13-23.  
<https://dx.doi.org/10.5032/jae.2011.04013>
- Beckwitk, C., Kissinger, C., Burnett, M., Wiedenbeck, S., Lawrance, T., Blackwell, A., & Cook, C. (2006). Tinkering and gender in end-user programmers' debugging. Conference on Human Factors in Computing Systems (pp. 231 – 240) Montréal, Québec, Canada: Publisher AMC.
- Bergmann, B. R. (2011). Sex Segregation in the Blue-collar Occupations: Women's Choices or Unremedied Discrimination?: Comment on England. *Gender & Society*, *25*(1), 88–93.  
<https://doi.org/10.1177/0891243210389813>
- Bennett, S. K. (1982). Student perceptions of and expectations for male and female instructors: Evidence relating to the question of gender bias in

teaching evaluation. *Journal of Educational Psychology*, 74(2), 170–179.

<https://doi.org/10.1037/0022-0663.74.2.170>

Bird, W. A., Bowling, A. M., & Ball, A. L. (2019). The effect teacher led reflection plays on students' civic responsibility perceptions following FFA civic engagement activities. *Journal of Agricultural Education*, 60(1), 128-144. <https://doi.org/10.5032/jae.2019.01128>

Bond, B. J. (2016) Fairy Godmothers > Robots: The Influence of Televised Gender Stereotypes and Counter-Stereotypes on Girls' Perceptions of STEM *Bulletin of Science, Technology & Society*. 36(2) 91-97.  
<https://doi.org/10.1177/0270467616655951>

Boring, A. (2017) Gender Biases in Student Evaluations of Teaching. *Journal of Public Economics*, 145, 27–41.

Bradley, H. R. (1971). A woman vocational agriculture teacher. *The Agricultural Education Magazine*, (44)2.

Brainard, S. G., & Carlin, L. (1998). A six-year longitudinal study of undergraduate women in engineering and science. *Journal of Engineering Education*, 87(4), 369–375. <https://doi.org/10.1002/j.2168-9830.1998.tb00367.x>.

Burris, S., McLaughlin, E. K., McCulloch, A., Brashears, T., & Frazee, S. (2010). A comparison of first and fifth year agriculture teachers on personal teaching efficacy, general teaching efficacy and content efficacy. *Journal*

*of Agricultural Education*, 51(1), 22-31.

<https://doi/10.5032/jae.2010.01022>

Burris, S., Robinson, J.S., & Terry, R., Jr. (2005). Preparation of pre-service teachers in agricultural mechanics. *Journal of Agricultural Education*, 46(3), 23-34. doi:10.5032/jae.2005.03023

Byrd, A.P., Anderson, R.G., Paulsen, T.H., Shultz, M.J. (2015) Does the Number of Post-secondary Agricultural Mechanics Courses Completed Affect Teacher Competence? *Journals of Agricultural Education*, 56(1), 20-31  
10.5032/jae.2015.01020

Cano, J. (1990). Male vocational agriculture teachers' attitude and perceptions towards female teachers of agriculture. *Journal of agricultural education*. 31(3) 19-23. <https://doi/10.5032/jae.1990.03019>

Cornell Law School. (2020) *Legal Information Institute: Gender bias*. Cornell Law School. [https://www.law.cornell.edu/wex/gender\\_bias](https://www.law.cornell.edu/wex/gender_bias)

Crismond, D. (2001). Learning and using science ideas when doing investigate-and- redesign tasks: A study of naive, novice, and expert designers doing constrained and scaffolded design work. *Journal of Research in Science Teaching*, 38(7), 791-820. <https://doi.org/002/tea.1032>

Eagly, A. H. (1987). *Sex Differences in Social Behavior: A Social-Role Interpretation*, Psychology Press. <https://doi.org/10.4324/9780203781906>

- Eagly, A.H., & Karau, S.J. (2002). Role congruity theory of prejudice toward female leaders. *Psychological Review*, Vol. 109, 573-598.  
<https://doi.org/10.1037/0033-295X.109.3.573>
- Eagly, A.H., Karau, S.J., & Makhijani, M.G. (1995). Gender and the effectiveness of leaders: a meta-analysis. *Psychological Bulletin*, Vol. 117, 125-145.  
<https://doi.org/10.1037/0033-2909.117.1.125>
- Ellemers N. (2014). Women at work: how organizational features impact career development. *Policy Insights Behav. Brain Sci.* 1:46–54
- Ellemers N. (2018). Gender Stereotypes. *Annual Review of Psychology*, 69 275-298 <https://doi.org/10.1146/annurev-psych-122216-011719>
- England, P. (2010). The Gender Revolution: Uneven and Stalled. *Gender & Society*, 24(2), 149–166. <https://doi.org/10.1177/0891243210361475>
- England, P., Li S., (2006). Desegregation stalled: The changing gender composition of college majors, 1971-2002. *Gender & Society* 0(5), 657-677. <https://doi.org/10.1177/0891243206290753>
- Field, A., (2017). *Discovering Statistics: Using IBM SPSS Statistics* (5<sup>th</sup> Edition). Sage Publications. <https://www.discoveringstatistics.com/books/dsus/>
- Foster, B. (2001a). Women in agricultural education: Who are you? In Proceedings of the 28th annual National Agricultural Education Research Conference (1-22).

- Foster, B. B. (2001b). Choices: A dilemma of women agricultural education teachers. *Journal of Agricultural Education*, 42(3), 1-10.  
<https://doi.org/10.5032/jae.2001.03001>
- Foster, B. (2003). Profiling of agricultural education at the secondary level. J.W. Kotrlik & J.E. Bartlett II (Vol. Eds.) [Electronic version]. *Journal of Career and Technical Education*, 19 (2), 15–28. Retrieved from  
<http://scholar.lib.vt.edu/ejournals/JCTE/v19n2/foster.html>
- Fox, N. S., Brennan, J. S., & Chasen, S. T. (2008). Clinical estimation of fetal weight and the Hawthorne effect. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 141(2), 111-114.  
<https://doi.org/10.1016/j.ejogrb.2008.07.023>
- Gabriel, P. E., & Schmitz, S. (2007). Gender differences in occupational distributions among workers. *Monthly Labor Review*, 130(6), 19–24.  
<http://www.jstor.org/stable/23806779>
- Garlock, J.C. (1975). An Analysis of Female Enrollment and Persistence in Five Selected Industry and Technology Courses. *ERIC Publications*.
- Hagerty, B. M., Lynch-Sauer, J. Patusky, K. L., Bouwsema, M., & Collier, P. (1992). Sense of belonging: A vital mental health concept. *Archives of Psychiatric Nursing*, 6, 172–177. [https://doi.org/10.1016/0883-9417\(92\)90028-H](https://doi.org/10.1016/0883-9417(92)90028-H)



- Halim, L., Rahman, N. B., Ramli, N. A. M., Mohtar, L., E. (2018) Influence of students' STEM self-efficacy on TEM and physics career choice. AIP Conference Proceedings <https://doi.org/10.1063/1.5019490>
- Halpern D., Aronson J., Reimer N., Simpkins S., Star J., Wentzek K. (2007) Encouraging girls in math and science. Washington, DC National Center for Education Research
- Herrman, S.D., Adelman, R.D., Bodford, J.E., Graudejus, O., Okun M. A., Virginia S.Y. Kwan (2016) . The effects of a female role model on academic performance and persistence of women in STEM courses. *Basic and Applied Social Psychology*, 38:5, 25- 268, [10.1080/01973533.2016.1209757](https://doi.org/10.1080/01973533.2016.1209757)
- Howe, L. K. (1978). *Pink collar workers : inside the world of women's work*. New York, N.Y. : Avon Books.
- Hyde J. 2014. Gender similarities and differences. *Annu. Rev. Psychol.* 65:373–98
- Johnson, R., Christensen, L. (2020). *Educational Research: Quantitative, Qualitative, and Mixed Approaches* (7<sup>th</sup> edition). Sage Publications, Inc.
- Johnson, M. L., Kestler J. L. (2013). Achievement Goals of Traditional and Nontraditional Aged College Students: Using the 3x2 Achievement Goal Framework. *International Journal of Educational Research.* 61 48-59 <https://doi.org/10.1016/j.ijer.2013.03.010>

- Karakowsky, L., DeGama, N., & McBey, K. (2016). Deconstructing Higgins: gender bias in the Pygmalion phenomenon. *Gender in Management*, Vol. 32 No. 1, 2-18. <https://doi.org/10.1108/GM-04-2015-0040>
- Karakowsky, L., DeGama, N. and McBey, K. (2012). Facilitating the Pygmalion effect: the overlooked role of subordinate perceptions of the leader. *Journal of Occupational and Organizational Psychology*. 85 579-599.
- Kelsey K. D. (2006). Teacher attrition among women in secondary agricultural education. *Journal of agricultural education*, 47(3) 117-129  
<https://doi.org/10.5032/jae.2006.03117>
- Kelsey K.D. (2007). Overcoming gender bias with self-efficacy: A case study of women agricultural education teachers and preservice students. *Journal of agricultural education*, 48(1) 52-63  
<https://doi.org/10.5032/jae.2007.01052>
- Kite, M. E., Deaux, K., and Haines, E. L. (2008). Gender stereotypes. *Psychology of Women: A Handbook of Issues and Theories*, Vol. 2, 205–236.  
<https://doi.org/10.1177/0361684316634081>
- Knight, J. (1987). Current status of women teachers of vocational agriculture in Ohio and their perception of their place in the profession. Proceedings of the National Agricultural Education Research Meeting. 223-236.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

- Kollmayer, M., Schultes, M.T., Luftenegger, M., Finsterwald, M., Spiel, C.,  
Schober, B. (2020). REFLECT – A Teacher Training Program to Promote  
Gender Equality in Schools. *Frontiers in Education* 5:136.  
<https://doi.org/10.3389/feduc.2020.00136>
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
- Leeper, C. (2015). Do I Belong?: Gender, Peer Groups, and STEM Achievement.  
*International Journal of Gender, Science and Technology*, 7(2), 166–179.  
Retrieved from  
<https://genderandset.open.ac.uk/index.php/genderandset/article/view/405>
- Leopold, C. (2021). *Girls in STEM*. (Publication No. # 28713196) [Ph.D  
dissertation, University of North Dakota)]. ProQuest LLC.
- Oxford University Press. (2022). *Blue-collar worker*. Oxford Reference.  
Retrieved January 14, 2022, from  
<https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095513519>
- Oliveria, Erica (2011). Women in STEM – What’s the Problem. *Technology and Engineering Teacher* 71(3).  
[https://d1wqtxts1xzle7.cloudfront.net/56286365/How-To-Recruit\\_women\\_and\\_girls-with-cover-page-v2.pdf?Expires=1669149050&Signature=DOOg8IqMa7c49bMXcIZsZdqxmfO6zFOXHiQTHRtZmNgg97hDwS9mmFcOxUhDm4hb78rqGl~O3](https://d1wqtxts1xzle7.cloudfront.net/56286365/How-To-Recruit_women_and_girls-with-cover-page-v2.pdf?Expires=1669149050&Signature=DOOg8IqMa7c49bMXcIZsZdqxmfO6zFOXHiQTHRtZmNgg97hDwS9mmFcOxUhDm4hb78rqGl~O3)

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[r7w\\_\\_&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA](#)

McCubbins, O. P., Paulsen, T. H., & Anderson, R. (2018). Examining student perceptions of their experience in a TBL formatted capstone course.

*Journal of Agricultural Education*, 59(1), 135-152.

<https://doi.org/10.5032/jae.2018.01135>

MacNell, L., Driscoll, A., Hunt, A. (2015) What's in a Name: Exposing Gender Bias in Student Ratings of Teaching. *Innovative Higher Education*, 40,

291-30 <https://doi.org/10.1007/s10755-014-9313-4>

McKnight, D.H., Cummings, L.L., & Chervany, N.L. (1998). Initial trust formation in new organizational relationship. *Academy of Management Review*, Vol. 23, 473-490.

<https://doi.org/10.5465/amr.1998.926622>

McKibben, J. & Murphy, T. (2021). The effect of authenticity on project-based learning: A quasi-experimental study of STEM integration in agriculture.

*Journal of Agricultural Education*, 62(1), 144-155.

<http://doi.org/10.5032/jae.2021.01144>

- Merton, R.K. (1948). The self-fulfilling prophecy, *Antioch Review*, Vol. 8, 193-210. <https://doi.org/10.2307/4609267>
- Miller, JoAnn, and Marilyn Chamberlin. 2000. Women Are Teachers, Men Are Professors: A Study of Student Perceptions. *Teaching Sociology* 28 (4): 283–98.
- Mitchell, K., & Martin, J. (2018). Gender Bias in Student Evaluations. *PS: Political Science & Politics*, 51(3), 648-652.  
<https://doi:10.1017/S104909651800001X>
- Montoya, R. M., Horton, R. S., Kirchner, J. (2008). Is actual similarity necessary for attraction? A meta-analysis of actual and perceived similarity. *Journal of Social and Personal Relationships* Volume 25, issue 6 867-1007.  
<https://doi.org/10.1177/0265407508096700>
- National FFA Organization (2022). *FFA Historical Timeline*. FFA.org  
<https://www.ffa.org/ffa-history/>
- National FFA Organization (2006). National FFA Career Development Events Handbook, 2006. National FFA Organization
- Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research*, 66(4), 543–578.  
<https://doi.org/10.3102/00346543066004543>
- Parsons, S. (1995). Making sense of students' science: The construction of a model of tinkering. *Research in Science Education*, 25(2), 203-219.

- Phipps, L. J., Osborne, E. W., Dyer, J. E., & Ball, A. L. (2008). Handbook on agricultural education in public schools (6th ed.). Clifton Park, NY: Thomson Delmar Learning.
- Porter, S. R., Umbach, P. D., (2006). College Major Choice: An analysis of person-environment fit. *Research in Higher Education*, 47, 429–449  
<https://doi.org/10.1007/s11162-005-9002-3>
- Robinson, R (2014). Sample in Interview-Based Qualitative Research: A Theoretical and Practical Guide. *Qualitative Research in Psychology*, 11:1, 25-41 <https://doi.org/10.1080/14780887.2013.801543>
- Rosette, A.S., & Tost, L.P. (2010). Agentic women and communal leadership: how role prescriptions confer advantage to top women leaders. *Journal of Applied Psychology*, Vol. 95, 221-235. <https://doi.org/10.1037/a0018204>
- Sallee, C. W., Edgar, D. W., & Johnson, D. M. (2013). Student Perceptions of Instructional Methods towards Alternative Energy Education. *Journal of Agricultural Education*, 54(2), 130-142.  
<https://doi/10.5032/jae.2013.02130>
- Sartori, S. R. (2012). *The Perceptions of Female High School Students Toward a Comprehensive Technology Education Program* (Order No. 3498199). Available from ProQuest Dissertations & Theses Global. (926193858).
- Saucier, P. R., & McKim, B. R. (2011). Assessing the Learning Needs of Student Teachers in Texas regarding Management of the Agricultural Mechanics

- Laboratory: Implications for the Professional Development of Early Career Teachers in Agricultural Education. *Journal of Agricultural Education*, 52(4), 24-43. <https://doi/10.5032/jae.2011.04024>
- Schein, V.E., Mueller, R., Lituchy, T., & Liu, J. (1996). Think manager – think male: a global phenomenon? *Journal of Organizational Behavior*, Vol. 17, 33-41. [https://doi.org/10.1002/\(SICI\)1099-1379\(199601\)17:1<33::AID-JOB778>3.0.CO;2-F](https://doi.org/10.1002/(SICI)1099-1379(199601)17:1<33::AID-JOB778>3.0.CO;2-F)
- Seldman, G., (2018, December 18). *Why Do We Like People Who Are Similar to Us?* Psychology Today. <https://www.psychologytoday.com/us/blog/close-encounters/201812/why-do-we-people-who-are-similar-us>
- Shultz, M. J., Anderson, R. G., Shultz, A. M., & Paulsen, T. H. (2014). Importance and Capability of Teaching Agricultural Mechanics as Perceived by Secondary Agricultural Educators. *Journal of Agricultural Education*, 55(2), 48-65. <https://doi.org/10.5032/jae.2014.02048>
- Simply Psychology. (2021, May 21). *What is the Hawthorne effect?* Simply Psychology. Retrieved March 26, 2022, from <https://www.simplypsychology.org/hawthorne-effect.html#author>
- Smith, A. R., Foster, D. D., Lawver, R. G. (2021). National Agricultural Education Supply & Demand Study, 2021 Executive Summary. Retrieved from: <http://aaaeonline.org/Resources/Documents/NSD>

- Stratton, S. (2019). Quasi-Experimental Design (Pre-Test and Post-Test Studies) in Prehospital and Disaster Research. *Prehospital and Disaster Medicine*, 34(6), 573-574. <https://10.1017/S1049023X19005053>
- Stringer, H. (2022). The nontraditional student. *American Psychology Association*. <https://www.apa.org/gradpsych/2015/04/nontraditional-student>
- Sullivan, L. (2008). Repeated Measures. *Circulation*, Vol. 117, 1238-1243. <https://doi.org/10.1161/CIRCULATIONAHA.107.654350>
- Teach Ag (n.d.). Teacher Demographics. *Teach Ag California*. from <https://www.teachag.org/teacher-demographics>
- The Center for Construction Research and Training. (2007). The Construction Chart Book 4th Edition. *Electronic Library of Construction Occupational Safety & Health*, 4<sup>th</sup> (9-18), 18. <https://doi.org/https://www.elcosh.org/document/1059/247/d000038/sect18.html>
- Thompson, O. E. (1986). Profile of vocational agriculture teachers: Trends in number, sex, preparation, and satisfaction of credential recipients. (ERIC Document Reproduction Service No. ED 273 789).
- Tummons, J. D., Langley, G. C., Reed, J. J. & Paul, E. E. (2017). Concerns of female preservice teachers in teaching and supervising the agricultural mechanics laboratory. *Journal of Agricultural Education*, 58(3), 19-36. <https://doi.org/10.5032/jae.2017.03019>





- U.S. Bureau of Labor Statistics. (2021, September). *Highlights of women's earnings in 2020*. U.S. Bureau of Labor Statistics. Retrieved March 24<sup>th</sup>, 2022, from <https://www.bls.gov/opub/reports/womens-earnings/2020/pdf/home.pdf>
- U.S. Bureau of Labor Statistics. (2021, July). *Labor Force Statistics from the Current Population Survey*. U.S. Bureau of Labor Statistics. Retrieved January 14, 2022, from <https://www.bls.gov/cps/cpsaat18.htm>
- Vancouver, J. B., & Ilgen, D. R. (1989). Effects of interpersonal orientation and the sex-type of the task on choosing to work alone or in groups. *Journal of Applied Psychology*, Vol. 74, 927-934. <https://doi.org/10.1037/0021-9010.74.6.927>
- VanderStel, A. (2014). The Impact of Demographics in Education. *Honors Projects*. 329. <http://scholarworks.gvsu.edu/honorsprojects/329>
- William, B. (2021, Nov. 3). Girls weld too!: 'Non-Traditional Student' in a welding program producing results. *The Rogersville Review* [https://www.therogersvillereview.com/rogersville/article\\_99c5836b-ca3b-5540-9718-ceec18dc9b1e.html](https://www.therogersvillereview.com/rogersville/article_99c5836b-ca3b-5540-9718-ceec18dc9b1e.html)

APPENDICES

**Appendix A. Institutional Review Board**

## Institutional Review Board


**Expedite #7  
Letter of Approval**

From: Melanie Domenech Rodriguez, IRB Chair   
 Nicole Vouvalis, IRB Director 

To: **Michael Pate**

Date: **September 17, 2021**

Protocol #: **12108**

Title: **Perceptions of Female Instructors of Welding Courses**

Your proposal has been reviewed by the Institutional Review Board and is approved under expedite procedure #7 (based on the Department of Health and Human Services (DHHS) regulations for the protection of human research subjects, 45 CFR Part 46, as amended to include provisions of the Federal Policy for the Protection of Human Subjects, January 21, 2019):

*Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.*

This approval applies only to the proposal currently on file for the period of approval specified in the protocol. You will be asked to submit an annual check in around the anniversary of the date of original approval. As part of the IRB's quality assurance procedures, this research may also be randomly selected for audit. If so, you will receive a request for completion of an Audit Report form during the month of the anniversary date of original approval. If the proposal will be active for more than five years, it will undergo a full continuation review every fifth year.

Any change affecting human subjects, including extension of the expiration date, must be approved by the IRB **prior** to implementation by submitting an Amendment request. Injuries or any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Institutional Review Board. If Non-USU Personnel will complete work on this project, they may not begin until an External Researcher Agreement or Reliance Agreement has been fully executed by USU and the appropriate Non-USU entity, regardless of the protocol approval status here at USU.

Prior to involving human subjects, properly executed informed consent must be obtained from each subject or from an authorized representative, and documentation of informed consent must be kept on file for at least three years after the project ends. Each subject must be furnished with a copy of the informed consent document for their personal records.

Upon receipt of this memo, you may begin your research. If you have questions, please call the IRB office at (435) 797-1821 or email to [irb@usu.edu](mailto:irb@usu.edu).

The IRB wishes you success with your research.

**Appendix B. Informed Consent**



Page 1 of 2  
 Protocol #  
 IRB Approval Date:  
 Consent Document Expires:

## Perceptions of Female Instructors in Agricultural Mechanization

### Introduction

You are invited to participate in a research study conducted by Dr. Michael Pate, Associate Professor, in Applied Science Technology and Education at Utah State University. The purpose of this research is to better understand student perceptions of female instructors who teach welding courses. Your participation is entirely voluntary.

We are asking to use your course grade and data collected from evaluation surveys that were given throughout the semester. Because there are some risks, such as loss of confidentiality, you may not wish to participate. It is important for you to know that you are not required to participate. This form includes detailed information on the research to help you decide whether to participate. Please read it carefully and ask any questions you have before you agree to participate.

### Procedures

Your participation will involve consent to obtain data from survey instruments that were previously issued throughout the semester. If you agree to participate, researchers will use the data from the instructor evaluation surveys and your course grade to better understand student perceptions of female instructors who teach welding courses.

### Risks

This is a minimal risk research study. That means that the risks of participating are no more likely or serious than those you encounter in everyday activities. In order to minimize those risks and discomforts and to protect anonymity and confidentiality, participant codes will be used to protect confidentiality of participants completing the pre/post surveys. The alphanumeric code will be given to each individual agreeing to participate. Grades will not be affected by students' decision to participate in the program. However, programming is part of the regularly scheduled curriculum.

### Benefits

Although you will not directly benefit from this study, it has been designed to learn more about student perceptions of female instructors in agricultural mechanization courses by the students enrolled in the course. Little research has been conducted on student's preferences in agricultural mechanization.

### Confidentiality

The researchers will make every effort to ensure that the information you provide as part of this study remains confidential. Your identity will not be revealed in any publications, presentations, or reports resulting from this research study. To ensure data is confidential and to protect anonymity, personal, identifiable information will be removed from study records and replaced with an identification code. Data information will be securely stored in a restricted-access folder on Box.com, an encrypted, cloud-based storage system and in a locked drawer in a restricted-access office. This form will be kept for three years after the study is complete, and then it will be destroyed.

It is unlikely, but possible, that others (Utah State University, may require us to share the information you give us from the study to ensure that the research was conducted safely and appropriately. We will only share your information if law or policy requires us to do so.

### Voluntary Participation & Withdrawal

[Department Name] | [Department Phone # or website] | [ ] Old Main Hill | Logan, UT 84322



Page 2 of 2  
 Protocol #  
 IRB Approval Date:  
 Consent Document Expires:

v.9

Your participation in this research is completely voluntary. If you choose to not to participate, we will destroy your survey data.

#### Findings

If the researchers learn anything new during this research study that might affect your willingness to continue participation, you will be contacted about those findings. This might include changes in procedures, changes in the risks or benefits of participation, or any new alternatives to participation that the researchers learn about.

#### IRB Review

The Institutional Review Board (IRB) for the protection of human research participants at Utah State University has reviewed and approved this study. If you have questions about the research study itself, please contact the Principal Investigator at [Michael.pate@usu.edu](mailto:Michael.pate@usu.edu). If you have questions about your rights or would simply like to speak with someone other than the research team about questions or concerns, please contact the IRB Director at (435) 797-0567 or [irb@usu.edu](mailto:irb@usu.edu).

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Dr. Michael Pate  
 Principal Investigator  
[Michael.pate@usu.edu](mailto:Michael.pate@usu.edu)

#### Informed Consent

By signing below, you agree to participate in this study. You indicate that you understand the risks and benefits of participation, and that you know what you will be asked to do. You also agree that you have asked any questions you might have, and are clear on how to stop your participation in the study if you choose to do so. Please be sure to retain a copy of this form for your records.

---

Participant's Signature

---

Participant's Name, Printed

---

Date

I do not agree to allow my de-identified information to be used or shared for future research. *You may delete this if, above, you decided that you would not de-identify and store data for potential future research use.*

**Appendix C. Survey Instrument**



Name: \_\_\_\_\_

Date: \_\_\_\_\_

This is a short questionnaire that covers varying topics about the welding instruction you experience in this course. The questionnaire is composed of 5 sections. The first section is composed of 7 statements to determine your perceptions about welding technology. The second section is composed of 7 questions regarding your “tinkering” ability. The third section is made up of 11 questions about learning welding skills. The fourth section looks to evaluate your instructor and contains 5 statements. The final section is a short demographics section that will cover basic question about age and background. Thank-you for completing this survey.

**DIRECTIONS:**

Please take a few minutes and answer the following questions. Please indicate your **level of agreement** with each of the following statements. Circle one response for each statement which most closely reflects your agreement / disagreement with that statement with 1 = **strongly disagree** to 7 = **strongly agree** & 4 = **neutral**.

	<u>Level of Agreement</u>						
<i>Perceptions toward Welding Technology</i>							
1. Welding technology is important to learn	1	2	3	4	5	6	7
2. More welding technology classes should be taught	1	2	3	4	5	6	7
3. Students benefit from taking a welding course	1	2	3	4	5	6	7
4. For my future career, I will utilize welding technology	1	2	3	4	5	6	7
5. In my degree program, welding is important	1	2	3	4	5	6	7
6. More degree programs should emphasize welding technology	1	2	3	4	5	6	7
7. If I could enroll in more welding technology <u>courses</u> I would	1	2	3	4	5	6	7
<i>Tinkering Self-Efficacy</i>							
1. I enjoy taking apart items and seeing how they work	1	2	3	4	5	6	7
2. I enjoy learning how machines operate	1	2	3	4	5	6	7
3. I enjoy working with my hands	1	2	3	4	5	6	7
4. I enjoy working in the lab	1	2	3	4	5	6	7
5. I enjoy making broken items work/run again	1	2	3	4	5	6	7
6. I enjoy repairing equipment	1	2	3	4	5	6	7
7. I enjoy completing projects	1	2	3	4	5	6	7
<i>Perceptions about Learning Welding Technology</i>							
1. I really enjoy learning about safety	1	2	3	4	5	6	7
2. Safety in welding is very practical	1	2	3	4	5	6	7
3. Gas tungsten arc welding is a good skill to have	1	2	3	4	5	6	7
4. Oxy-fuel welding is boring	1	2	3	4	5	6	7
5. I am not interested in learning welding	1	2	3	4	5	6	7

6. I hate welding	1	2	3	4	5	6	7
7. Welding technology amazes me	1	2	3	4	5	6	7
8. Welding can be used in real life	1	2	3	4	5	6	7
9. Welding does not hold my interest at all	1	2	3	4	5	6	7
10. Welding is disliked by all students	1	2	3	4	5	6	7
11. Shielded metal arc welding is a good skill to have	1	2	3	4	5	6	7
12. Gas metal arc welding is a good skill to have	1	2	3	4	5	6	7
13. Plasma arc cutting is a good skill to have	1	2	3	4	5	6	7
14. Oxy-Fuel cutting is a good skill to have	1	2	3	4	5	6	7

***Instructor Evaluation***

1. The person who teaches welding does not impact my ability to learn the content	1	2	3	4	5	6	7
2. If I believe the instructor is knowledgeable, I learn more	1	2	3	4	5	6	7
3. I would learn more from a female instructor in this welding course	1	2	3	4	5	6	7
4. I would learn more from a male instructor in this welding course	1	2	3	4	5	6	7
5. I believe my gender is why I will be successful in welding	1	2	3	4	5	6	7
6. An instructor who has welding experience is more beneficial to my learning than is their gender	1	2	3	4	5	6	7

***Demographics***

1. What is your age as of your last birthday? \_\_\_\_\_ Years
2. Did you take a welding course in high school? \_\_\_\_\_ Yes \_\_\_\_\_ No
3. I enjoy(ed) agricultural mechanization courses. \_\_\_\_\_ Yes \_\_\_\_\_ No
4. What is your gender? \_\_\_\_\_
5. Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Please select one option.  
\_\_\_\_\_ Male instructor \_\_\_\_\_ Female instructor
6. I have no preference towards gender of the instructor if they can teach welding well. \_\_\_\_\_ True \_\_\_\_\_ False
7. What is your major? \_\_\_\_\_
8. What is your student status? Please check one.  
\_\_\_\_\_ Freshman \_\_\_\_\_ Sophomore \_\_\_\_\_ Junior \_\_\_\_\_ Senior
9. What grade do you anticipate receiving in this course? Please check one.  
\_\_\_\_\_ A \_\_\_\_\_ B \_\_\_\_\_ C \_\_\_\_\_ D \_\_\_\_\_ F

**Appendix D. Statistical Results**

**Table 31**

*Objective 2 Summary of Tuesday vs. Thursday Course Section Means and Standard Deviations*

Survey Question	Course Section	Pre-Survey		Post-Survey	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1: "The person who teaches welding does not impact my ability to learn the content."	Tuesday	2.83	2.07	3.42	1.90
	Thursday	3.70	1.80	3.58	2.24
2: "If I believe the instructor is knowledgeable, I learn more."	Tuesday	6.29	0.99	6.29	0.85
	Thursday	5.95	0.94	6.26	0.87
3: "I would learn more from a female instructor in this welding course."	Tuesday	3.21	1.25	3.71	1.51
	Thursday	3.40	1.69	3.79	1.51
4: "I would learn more from a male instructor in this welding course."	Tuesday	3.58	1.47	3.88	1.59
	Thursday	3.35	1.59	3.74	1.36
5: "I believe my gender is why I will be successful in welding."	Tuesday	1.67	1.34	2.04	1.78
	Thursday	1.60	1.14	1.79	1.22
6: "An instructor who has welding experience is more beneficial to my learning than is their gender."	Tuesday	6.92	0.40	6.96	0.20
	Thursday	6.75	0.44	6.53	1.42

**Table 32**

*Objective 2 Summary of Tuesday vs. Thursday Course Section Independent Samples t-test Results*

Survey Question	Pre-Survey Independent Samples <i>t</i> -test:				Post-Survey Independent Samples <i>t</i> -test			
	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
1: "The person who teaches welding does not impact my ability to learn the content."	-1.46	42	0.15	1.96	-0.25	41	0.79	2.06
2: "If I believe the instructor is knowledgeable, I learn more."	1.15	42	0.25	0.97	0.10	41	0.91	0.86
3: "I would learn more from a female instructor in this welding course."	-0.41	42	0.66	1.47	-0.17	41	0.86	1.54
4: "I would learn more from a male instructor in this welding course."	0.50	42	0.61	1.53	0.30	41	0.76	1.50
5: "I believe my gender is why I will be successful in welding."	0.17	42	0.86	1.25	0.52	41	0.60	1.56
6: "An instructor who has welding experience is more beneficial to my learning than is their gender."	1.29	42	0.20	0.42	1.30	18	0.20	0.95

**Table 33**

*Objective 2 Summary of Tuesday vs. Thursday Course Section's Paired Samples t-test Results*

Survey Questions	Course Section	<i>Pre- Survey &amp; Post-Survey Paired Samples t-test:</i>			
		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
1: "The person who teaches welding does not impact my ability to learn the content."	Tuesday	-1.83	22	0.08	1.82
	Thursday	0.19	19	0.85	2.47
2: "If I believe the instructor is knowledgeable, I learn more."	Tuesday	-0.34	22	0.73	1.20
	Thursday	-0.15	17	0.26	1.01
3: "I would learn more from a female instructor in this welding course."	Tuesday	-2.40	22	<b>0.02</b>	1.03
	Thursday	-0.44	17	0.66	1.58
4: "I would learn more from a male instructor in this welding course."	Tuesday	1.32	22	0.20	1.10
	Thursday	-0.90	17	0.38	1.57
5: "I believe my gender is why I will be successful in welding."	Tuesday	-1.12	22	0.27	1.67
	Thursday	-0.62	17	0.54	0.75
6: "An instructor who has welding experience is more beneficial to my learning than is their gender."	Tuesday	-1.00	22	0.32	0.20
	Thursday	-0.62	17	0.54	1.51

**Table 34**

*Objective 2 Summary of Male vs. Female Participants Means and Standard Deviations*

Survey Question	Participant Gender	Pre-Survey		Post-Survey	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1: "The person who teaches welding does not impact my ability to learn the content."	Male	3.07	1.94	3.33	1.84
	Female	3.58	2.27	3.75	2.56
2: "If I believe the instructor is knowledgeable, I learn more."	Male	6.20	0.92	6.37	0.76
	Female	6.15	0.98	6.25	0.86
3: "I would learn more from a female instructor in this welding course."	Male	2.90	1.37	3.67	1.64
	Female	4.15	1.34	3.92	1.08
4: "I would learn more from a male instructor in this welding course."	Male	3.20	1.60	3.77	1.65
	Female	4.08	1.18	3.92	1.08
5: "I believe my gender is why I will be successful in welding."	Male	1.33	1.02	1.63	1.52
	Female	2.15	1.40	2.50	1.44
6: "An instructor who has welding experience is more beneficial to my learning than is their gender."	Male	6.90	0.30	6.73	1.14
	Female	6.85	0.37	6.92	0.28

**Table 35**

*Objective 2 Summary of Male vs. Female Participants Independent Samples t-test Statistics Results*

Survey Question	Pre-Survey Independent Samples <i>t</i> -test:				Post-Survey Independent Samples <i>t</i> -test			
	<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>	<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
1: "The person who teaches welding does not impact my ability to learn the content."	-0.70	41	0.48	2.01	-0.59	15	0.61	2.06
2: "If I believe the instructor is knowledgeable, I learn more."	0.14	41	0.88	0.94	0.43	40	0.66	0.79
3: "I would learn more from a female instructor in this welding course."	-2.79	23.3	<b>0.01</b>	1.36	-0.46	40	0.64	1.56
4: "I would learn more from a male instructor in this welding course."	-1.98	30	0.05	1.49	-0.28	40	0.77	1.51
5: "I believe my gender is why I will be successful in welding."	-1.89	17.8	0.07	1.15	-1.69	40	0.09	1.50
6: "An instructor who has welding experience is more beneficial to my learning than is their gender."	0.49	41	0.62	0.32	-0.54	40	0.58	0.98



**Table 36***Objective 2 Summary of Male & Female Participant's Paired Samples t-test Results*

Survey Questions	Participant Gender	<i>Pre-Survey &amp; Post-Survey Paired Samples t-test:</i>			
		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
1: "The person who teaches welding does not impact my ability to learn the content."	Male	-0.86	27	0.39	2.40
	Female	-0.37	11	0.71	1.52
2: "If I believe the instructor is knowledgeable, I learn more."	Male	-1.00	27	0.32	1.13
	Female	-0.24	11	0.80	1.16
3: "I would learn more from a female instructor in this welding course."	Male	-2.39	27	<b>0.02</b>	1.42
	Female	1.14	11	0.27	0.75
4: "I would learn more from a male instructor in this welding course."	Male	-1.66	27	0.10	1.47
	Female	0.00	11	1.00	0.85
5: "I believe my gender is why I will be successful in welding."	Male	-1.01	27	0.31	1.48
	Female	-0.81	11	0.42	1.05
6: "An instructor who has welding experience is more beneficial to my learning than is their gender."	Male	0.75	27	0.43	1.18
	Female	-1.00	11	0.33	0.28

**Table 37**

*Objective 3-5 Summary of Tuesday vs. Thursday Course Section Means and Standard Deviations*

Survey Construct	Course Section	Pre-Survey		Post-Survey	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Perceptions of Welding Technology	Tuesday	5.55	0.96	5.63	0.94
	Thursday	5.42	0.72	5.75	0.96
Tinkering Self-Efficacy	Tuesday	6.63	0.49	6.57	0.43
	Thursday	6.22	0.62	6.28	0.73
Perceptions about Learning Welding Technology	Tuesday	6.13	0.70	6.13	0.67
	Thursday	5.84	0.68	6.16	0.72

**Table 38**

*Objective 3-5 Summary of Tuesday vs. Thursday Course Sections Independent Samples *t*-test Statistics Results*

Survey Construct	Pre-Survey Independent Samples <i>t</i> -test:				Post-Survey Independent Samples <i>t</i> -test			
	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
Perceptions of Welding Technology	0.49	42	0.63	0.86	-0.41	41	0.67	0.95
Tinkering Self-Efficacy	2.41	42	<b>0.02</b>	0.56	1.49	27.7	0.14	0.58
Perceptions of Learning Welding Technology	1.37	42	0.17	0.69	-0.16	41	0.87	-0.69

**Table 39**

*Objective 3-5 Summary of Tuesday & Thursday Course Section's Paired Samples t-test Results*

Survey Construct	Course Section	<i>Pre-Survey &amp; Post-Survey Paired Samples t-test:</i>			
		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
Perceptions of Welding Technology	Tuesday	-0.21	22	0.83	0.68
	Thursday	-1.65	17	0.11	0.72
Tinkering Self-Efficacy	Tuesday	1.18	22	0.08	0.31
	Thursday	-0.89	17	0.89	0.38
Perceptions about Learning Welding Technology	Tuesday	-0.51	27	0.61	0.47
	Thursday	-2.03	11	0.06	0.43

**Table 40**

*Objective 3-5 Summary of Male vs. Female Participants Means and Standard Deviations*

Survey Construct	Course Section	Pre-Survey		Post-Survey	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Perceptions of Welding Technology	Male	5.69	0.73	5.93	0.68
	Female	5.21	0.81	5.69	0.98
Tinkering Self-Efficacy	Male	6.58	0.52	6.60	0.46
	Female	6.14	0.65	6.08	0.76
Perceptions of Learning Welding Technology	Male	6.16	0.57	6.25	0.47
	Female	5.78	0.74	6.08	0.77

**Table 41**

*Objective 3-5 Summary of Male vs. Female Participants Independent Samples *t*-tests Statistics Results*

Survey Construct	Pre-Survey Independent Samples <i>t</i> -test:				Post-Survey Independent Samples <i>t</i> -test			
	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
Perceptions of Welding Technology	1.88	41	0.06	0.76	2.23	40	<b>0.03</b>	0.81
Tinkering Self-Efficacy	2.35	41	0.02	0.56	2.17	14.3	<b>0.04</b>	0.56
Perceptions of Learning Welding Technology	1.81	41	0.07	0.62	0.71	14.4	0.48	0.57

**Table 42**

*Objective 3-5 Summary of Male & Female Participants Paired Samples t-test Results*

Survey Construct	Course Section	Pre-Survey & Post-Survey Paired Samples <i>t</i> -test:			
		<i>t</i>	<i>df</i>	<i>p</i>	<i>Cohen's d</i>
Perceptions of Welding Technology	Male	-1.52	27	0.12	0.61
	Female	-0.22	11	0.82	0.91
Tinkering Self-Efficacy	Male	0.47	27	0.63	0.39
	Female	-0.12	11	0.90	0.33
Perceptions about Learning Welding Technology	Male	-0.51	27	0.61	0.47
	Female	-2.03	11	0.06	0.43