Students' Perceptions of Male and Female Post-Secondary Agricultural Mechanics Welding Instructors

S. Kjersti Decker[1], Michael L. Pate[2], Tyson J. Sorensen[2], Michelle S. Burrows[2], Katie Kraus[3], and Don Edgar[4]

[1]Maple Mountain High School
[2]Department of Applied Sciences, Technology, and Education, Utah State University
[3]Department of Nutrition, Dietetics, and Food Sciences, Utah State University
[4]Department of Agricultural Education, Leadership & Communications, University of Idaho

Author Note

Correspondence regarding this article should be addressed to Michael L. Pate, Department of Applied Sciences, Technology, and Education, Utah State University, 2300 Old Main Hill, Logan UT 84322-2300. Email: michael.pate@usu.edu. Phone: 435-797-0989

Abstract

Females are underrepresented in construction and trades, including welding. Studies have shown that female students often face gender-associated challenges due to being enrolled in male-dominated education programs. Similarly, some female teachers in male-dominated disciplines face gender-associated challenges. Yet, little is known if such gender stereotypes and bias exist among post-secondary students in welding courses. The purpose of this quasi-experimental study was to examine students' perceptions of learning from both a female and male instructor in a post-secondary welding course. Data were collected during the 2022 spring and fall semesters through a pre-survey at week 4 and a post–survey at week 12 of the course. We examined differences in key variables based on the demographics of the students which included age, gender, and degree of study. Some statistical differences were found among male and female participants regarding their perceptions of learning from a male and female welding instructor, indicating potential gender bias among participants exists based on welding instructor gender. Future research should focus on the variables influencing female welding students' perspectives. Additional research with a larger sample size should be conducted to verify the results of this study.

Keywords: Gender bias, welding, post-secondary, agriculture

Globally, employers have reported struggling to fill skilled positions (Manpower Group, 2018). In the U.S., there is a concern over not having enough skilled laborers to meet demand, partially due to an aging skilled trade population and lack of new people entering the trades (Kalleberg & von Wachter, 2017; Pogue, 2017). The demand for welders and cutters is expected to grow over the next decade (U.S. Bureau of Labor Statistics, 2021).

Females are underrepresented in construction and trades, including welding, where they represent less than 1% of the welding workforce (U.S. Bureau of Labor Statistics, 2021). It is possible that females do not pursue welding careers because of the challenges associated with training and working in a male-dominated field. Studies have shown that female students often face gender-associated challenges due to being enrolled in male-dominated education programs including lack of support, gender stereotypes, and unwelcoming environments (Buschor et al., 2014; Cadaret et al., 2017; Fluhr et al., 2017; Ray et al., 2018; Simon et al., 2017). Research also shows that female teachers in male-dominated disciplines face similar gender-associated challenges. For example, female high school agriculture teachers, many of which teach welding and trades, have been shown to experience challenges of bias and stereotypes from their students and administrators due to their gender (Baxter et al., 2011; Kelsey, 2007). Yet, little is known if such gender stereotypes and bias exist among post-secondary students in welding courses. This study explores student perceptions about gender of their post-secondary welding instructor. It is critical to gain an

understanding of gender stereotypes and bias in post-secondary welding courses to recognize and address the challenges associated with meeting the workforce demand.

Theoretical Framework & Literature Review

We used the Pygmalion theory as a lens for this research. The Pygmalion theory applied to a teacher-student relationship conveys the effect of an individual's influence upon another (Karakowsky et al., 2016). An application of this theory would be when a student has high expectations of a teacher's performance or skills, the instruction will likely be of higher quality due to the increase of the teacher's confidence with the subject matter. In an educational setting, gender stereotypes largely influence students' perceptions of their teachers (Karakowsky et al., 2016; MacNell et al., 2015; Mitchell & Martin, 2018). Karakowsky et al., (2016) suggested it is essential for targets (e.g., students) to perceive their leader (e.g., teacher) as credible to be responsive to the leader's efforts.

Gender bias occurs when an individual is treated differently based on their gender or perceived gender (Cornell Law School, 2020). Mitchell & Martin (2018) suggested males and females are judged based on socially accepted gender roles or stereotypes. Much has changed in the equal treatment of males and females in previous decades and centuries, yet barriers continue to exist for females to enter blue collar trades and STEM fields (Gabriel & Schmitz, 2007; Leaper, 2015; CPWR - The Center for Construction Research and Training, 2007). Observations regarding differences between male and female behavior may seem easily explained by biology (Ellemers, 2018), yet previous studies regarding cognitive and social performances revealed more biological similarities exist than differences between the two genders (Hyde, 2014). Human biology is not the cause of many of the differences between males and females; social stereotypes influence differences between males and females (Ellemers, 2018).

Evidence of gender bias and stereotypes in both secondary education and post-secondary exists in research literature. Several theories acknowledge gender bias in the classroom, but it is important to understand student's expectations. Students, subconsciously or consciously, uphold their teachers to established stereotypical "masculine" or "feminine" manners which comply with the instructor's gender (MacNell et. al., 2015). When gender stereotypical roles are incongruent, social consequences may occur (Karakowsky et al., 2016). Therefore, a female instructor in a course stereotypically identified as "masculine" 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 at post-secondary institutions emphasize gender bias toward professors in undergraduate courses in the United States. MacNell et al., (2015) conducted a research experiment regarding student ratings of instructors 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 section two) 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. 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).

Mitchell & Martin (2018) conducted a similar study with a male and a female instructor who each taught an identical online course. The female instructor received overall lower ratings than the male instructor. Mitchell & Martin (2018) suggested from their study findings that males and females are judged based on different criteria in an educational setting; females are more heavily evaluated on their appearance, personality, and perceptions of intelligence/competence than males.

Research also suggests that gender stereotypes exist in education programs that are male, or female dominated. One study looking at male nursing student perceptions found that male student nurses commonly experienced gender bias throughout their clinical nursing program, a female-dominated profession. The male participants perceived they were not accepted by their female class peers and nursing instructors due to gender bias (Petges & Sabio, 2020).

While there is a dearth of literature at the post-secondary level related to instructor gender in male-dominated fields such as construction and the trades, there is research in secondary agricultural education that helps in understanding the dynamics and perceptions related to instructor gender in a traditionally male-dominated field. Outdated agricultural education literature has suggested females' only role in agricultural education was as horticulture instructors in multi-teacher programs (Bradley, 1971). Thompson et al. (1986) found, more than a decade later, females reported increased amounts of discrimination and struggled with job placement compared to male agricultural educators. More recent research demonstrates evidence of gender bias towards female instructors from their male counterparts, administration, and community members. Kelsey (2006, 2007) found sexism, bias, and discrimination as a hurdle for many female instructors throughout their careers. Female instructors experienced sexism or gender bias that impacted the job search and job interview process as well. Baxter et al., (2011) explored barriers for females in agricultural education and found females experience pressure to prove they were qualified to teach agriculture and perform assigned duties, and sexism from students, co-teachers, and community members.

While gender bias and stereotypes seem to persist among female instructors, little is known about students' gender-based perceptions about welding instructors. Furthermore, there is a dearth of literature at the post-secondary level on this same topic. Research has been recommended to further explore perceptions of gender roles and nontraditional gender education settings, particularly within the male-dominated trades (Fluhr et al., 2017). The

current research aims to accomplish that. This research is important in gaining an understanding of gender bias and recognizing potential issues which may arise in post-secondary welding courses. As a result, we hope to bring clarity in addressing the lack of female students entering welding careers, outdated gender stereotypes among instructors, and shortage of trained workers in the trades.

Purpose/Objectives

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. 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 students' preference of their post-secondary welding instructor's gender; (3) describe students' attitudes toward gender of their welding instructor from different course sections; (4) describe post-secondary male and female students' attitudes toward the gender of their welding instructor; and (5) explain the relationship between post-secondary students' gender and preference of their welding instructor's gender.

Methods

The research study was a two-group repeated measures counterbalance quasi-experimental design (Johnson & Christensen, 2020; Sullivan, 2008). This research was reviewed and approved by Utah State University's Institutional Review Board. We examined perceptions from two independent groups (i.e., Tuesday and Thursday course sections) to evaluate changes from the beginning to the end of the semester. The treatment variable was the switching of welding course instructors at week eight. We collected data through a pre-survey at week 4 and a post–survey at week 12. Demographic information included age, gender, and degree of study and we examined differences in key variables based on the demographics of the students. The experiments were conducted in the spring of 2022 and fall of 2022 in Utah State University's metal welding processes and technology in agriculture (i.e., beginning welding) course.

Each section was randomly assigned to begin the course with either a female or male instructor. Each instructor taught and associated only with their assigned section. Course instructors collaborated together to ensure all curriculum, teaching strategies, and online course pages were identical in design. The instructors switched course sections at week eight to gain information about students' perceptions of both the male and female instructors.

The pre-survey was administered by an independent observer at week four. At week eight, the instructors switched sections. At week 12, the post-survey was administered 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.

Students were not informed 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. We utilized deception to maintain validity and limit the possibility of the Hawthorne effect. This method was approved by the Institutional Review Board. It is possible that students may have speculated that an experiment was conducted and perhaps conversed with friends and/or potential future study participants regarding the experiment. We predicted these factors did not affect our study during spring and fall 2022 as there was a summer session between the two semesters.

We conducted a pilot study in the fall 2021 semester and the results were used to determine construct reliability and complete minor adjustments to the survey instrument. A limitation of this study was the lack of random samples. As a result, we do not make attempt to generalize these results beyond this study. Our findings provide information to suggest recommendations for future research and practices of gender research in welding instruction, agricultural education, and other post-secondary disciplines. Another limitation with the study design was ensuring the two welding courses were as identical as possible. The male and female instructors collaborated to try to establish identical curriculum, demonstrations, and online course pages. The instructors possessed differing welding and mechanics backgrounds and were both deemed qualified to teach the beginning welding course by a senior faculty member.

The pre-survey and post-survey instruments were identical in nature and gauged student preferences and bias toward learning from a male and female welding instructor. We also collected information regarding student age, degree of study, gender, previous high school welding experience, and if they enjoyed agricultural mechanics courses through

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

open-ended questions. The survey consisted of two independent statements on a seven-point Likert-scale (1 = *strongly disagree*, 4 = *neutral*, 7 = *strongly agree*) and one multiple choice question: (1) Given an option of instructors with similar background and knowledge of welding, which instructor would you choose? Male or Female (Multiple Choice); (2) I would learn more from a female instructor in this welding course (Likert-Scale); (3) I would learn more from a male instructor in this welding course (Likert-Scale).

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. There was open space on the paper survey for students to write opinions or other answers to these questions.

The population of this study was undergraduate students from a variety of majors. We used a convenience sample of undergraduate students enrolled in the beginning welding course at Utah State University in the spring and fall 2022 semesters. A total of 45 individuals elected for their survey information to be utilized in the research. 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 project consisted of two convenience samples to support the statistical analysis and research reliability. A convenience sample was the only viable option for this study due to the lack of ability to create a random sample of students.

All survey responses were entered into IBM SPSS version 28. In the analysis, we aggregated the spring and fall 2022 datasets. We found no statistical evidence to support analyzing the data separately by semester. Descriptive statistics (means and standard deviations) were used to complete analyses for research objectives one and two. Objective three and four analyses consisted of inferential statistics such as independent samples *t*-tests and paired samples *t*-tests to compare differences between the course sections (i.e., Tuesday and Thursday) and participant gender. The objective five analysis consisted of independent samples *t*-tests and chi-square test of association. We hypothesized students' perceptions of their ability to learn welding content from a male and female would change after receiving instruction from a qualified female welding instructor.

Findings

The first research objective sought to describe the demographic profile of students in a post-secondary welding course by gathering information regarding gender, degree of study, and age in a pre-survey and post-survey. The total sample consisted of 45 participants; 31 males, 13 females and one participant who identified as non-binary (see Table 2). 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. A total of 21 students were enrolled in a Thursday section of the course and consisted of 12 male and nine female participants.

The average age of all study participants was 22.5 and ranged between 18 and 39 years. The average age of the male participants was 23.06 (*SD* = 4.20) years. The average age of all the female participants was 21.46 (*SD* = 2.02) years, slightly lower than the age of their male counterparts. Study participants were enrolled in a variety of majors, the majority in the College of Agriculture and Applied Sciences (CAAS). Several students were studying degrees outside of CAAS in non-technology-oriented degrees and one student was pursuing a degree in the College of Engineering. One outdoor product design and development student switched majors to an engineering degree after the pre-survey (see Table 3).

Approximately 26% (*n* = 12) of the sample completed a secondary level welding course; 11 male participants and one female participant. Seventy-one percent (*n* = 32) of the sample claimed they did not complete a high school welding course. Four percent (*n* = 2) of the sample did not provide a response to the question.

Approximately 7% (*n* = 1) of the female participants 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 complete a high school welding course. Approximately 35% (*n* = 11 males) of the male participants reported previous welding experience from a high school welding course whereas 65% (*n* = 20 males) of the male participants claimed they did not complete a high school welding course.

Study participants were asked to select whether they enjoyed agricultural mechanization courses. Approximately 88% (*n* = 40) of the entire sample (i.e., spring and fall course sections) selected "yes" in the pre-survey indicating they enjoyed agricultural mechanization courses. Similar results

Table 2

Distribution of Participant Gender by Section & Semester Term

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

Table 3

Distribution of Participants' Degree of Study by Gender

Participant Degree of Study	Males *f*	Females *f*
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

were found in the post-survey, with 86% (*n* = 39) selecting "yes" to enjoying agricultural mechanization courses. Approximately 9% (*n* = 4) of the sample selected "no" in the pre-survey (*n* = 5 in the post-survey) indicating they did not enjoy agricultural mechanization courses. Of those four participants in the pre-survey, two were male, one was female (*n* = 2 in the post-survey), and one identified as non-binary. One participant did not answer the question.

The second research objective sought to describe collegiate students' preference of their welding instructor's gender. In 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.

Approximately 45% of all participants (*n* = 19) selected a preference of learning from male instructor in the post-survey; 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%).

Several participants adjusted their answers to be more in favor of a female instructor or wrote in their own answer. In 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. It is interesting to note that three male participants (i.e., Dave, Ron, and Jack) selected a female instructor in both surveys.

An increased number of male participants selected preference towards a female instructor on the post-survey (*f* = 7, 23%) than on the pre-survey (*f* = 6, 20%). Fewer female participants selected a preference toward a female instructor on the post-survey (*f* = 4, 33.3%) than on the pre-survey (*f* = 5, 38.5%). In the pre-survey, 25% of students (*f* = 11) wrote their own answer which was coded as neutral such as "I don't care" or "either". Of the 11 students indicating a neutral preference towards instructor gender, approximately 72% of those individuals were male students (*f* = 8) and 27.3% were female students (*f* = 3). The percentage of students indicating a neutral preference rose from 25% (*n* = 11) on the pre-survey to 30.2% (*n* = 13) on the post-survey. Of the 13 students indicating a neutral preference towards instructor gender on the post-survey, approximately 83.3% (*f* = 10) of those individuals were male and 16.7% (*f* = 2) were female (see Table 4).

Research objective three sought to describe the Tuesday and Thursday course section's attitudes toward the gender of their welding instructor. Most students (82% of participants) chose the neutral or the strongly disagree option on the 7-point Likert Scale and selected the same answer for statement 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

Table 4

Distribution of Participants Choice of Instructor Gender

		Week 4 Survey			Week 12 Survey		
		Choice of Instructor *f*			Choice of Instructor *f*		
Course Selection	Participant Gender	Male	Female	Either	Male	Female	Either
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.

and post-survey. To assess if differences existed between students enrolled in the two lab sections prior to receiving instruction, independent samples t-tests were used. No significant difference was found between the Tuesday and Thursday sections in the pre-survey regarding the statement "I would learn more from a female instructor" (t = -0.41(42), p = 0.66, d = 1.47) or the statement "I would learn more from a male instructor" (t = .50(42), p = 0.61, d = 1.53).

The Tuesday course section began the course with receiving instruction from a male instructor and then received instruction from a female instructor at week eight. In the pre-survey, the Tuesday section students ranked the statement "I would learn more from a female instructor" with an average of 3.21 out of 7 (SD = 1.25) and averaged 3.58 (SD = 1.47) for statement "I would learn more from a male instructor." Similar results were found in the post-survey. The Tuesday section post-survey average was 3.71 (SD = 1.51) for the statement "I would learn more from a female instructor) and averaged a post-survey rating of 3.88 (SD = 1.59) for "I would learn more from a male instructor." When comparing changes in perceptions of learning from a female instructor between Tuesday's pre- and post-survey responses, there was a significant difference (t (22) = -2.40, p = 0.02, d = 1.03). There was no significant difference the Tuesday section's pre-survey and post-survey responses to the statement, "I would learn more from a male instructor" (t(22) = -1.32, p = 0.20, d = 1.10). 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. See table 5 for descriptive statistics.

The Thursday course section began the course by receiving instruction from a female instructor and then received instruction from a male instructor at week eight. In the pre-survey, the Thursday section ranking of the statement "I would learn more from a female instructor" averaged 3.40 (SD = 1.69) and the statement "I would learn more from a male instructor" ranking averaged 3.35 (SD = 1.59). Similar results for the Thursday section were found in the post-survey. The Thursday section post-survey ranking of "I would learn more from a female instructor" averaged 3.79 (SD = 1.51) and averaged 3.74 (SD = 1.36) for the statement "I would learn more from a male instructor." No significant change was found between the Thursday section's pre-survey (M = 3.40, SD = 1.69) and post-survey (M = 3.79, SD = 1.51) regarding the statement "I would learn more from a female instructor" (t(17) = -0.44, p = 0.66, d = 1.58). No significant change was found in the Thursday section's pre-survey and post-survey regarding the statement "I would learn more from a male instructor" (t(17) = -0.90, p = 0.38, d = 1.57).

Research objective four sought to describe male and female students' attitudes toward the gender of their welding instructor. See table 6 for descriptive statistics by student gender. For the pre-survey, a significant difference was found between the male and female participants regarding statement "I would learn more from a female instructor" (t = -2.79(23.33), p = 0.01, d = 1.36). No significant difference was found between the male and female participants in the pre-survey regarding the statement "I would learn more from a male instructor: (t = -1.98(30.06), p = 0.05, d =1.49). In the post-survey, no significant difference was found between the male and female participants regarding the statement "I would learn more from a female instructor" (t = -0.46(40), p = 0.64, d = 1.56) or the statement "I would learn more from a male instructor" (t = - 0.28(40), p = 0.77, d = 1.51).

A paired samples t-test was used to determine if a significant change in male participants' attitudes towards instructor gender occurred. A significant change was found between the male participant's pre-survey and post-survey for the statement "I would learn more from a female instructor" (t(27) = -2.39, p = 0.02, d = 1.42). No significant difference was found between the male participant's pre-survey and post-survey regarding the statement, "I would learn more from a male instructor," t(27) = -1.66, p = 0.10, d = 1.47.

In the pre-survey, most female participants (f = 10, 76.9%) responded "neither agree or disagree" for the statement "I would learn more from a female instructor" and for statement four "I would learn more from a male instructor" most females (f = 10, 76.9%) indicated "neither agree nor disagree." In the post-survey, a little over half of female participants (f = 7, 58.3%) responded "neither agree or disagree for the statement "I would learn more from a female instructor" while 83.3% of female participants (f =10) responded "neither agree or disagree" for the statement

Table 5

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

Course Section	Item	Week 4 Survey			Week 12 Survey		
		f	*M*	*SD*	*f*	*M*	*SD*
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." The Tuesday course began with a male instructor and the Thursday course began with a female instructor.

Table 6

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

Participants	Item	Week 4 Survey			Week 12 Survey		
		f	*M*	*SD*	*f*	*M*	*SD*
Male	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	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"

"I would learn more from a male instructor." One student chose not to answer these post-survey questions

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

Individual responses varied by gender. Upon further analysis, we found that one 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 but adjusted to a "4" (i.e., neutral) in the post-survey. One female participant in the Thursday section, ranked a "4" (i.e., neutral) for learning from a male and female in the pre-survey and adjusted her responses to a "2," (i.e., disagree) for learning from a female instructor and to a "6" (i.e., agree) to learn more from a male in the welding course in the post-survey. Another 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. 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.

Research objective five sought to explain the relationship between participant's gender and students' choice of their welding instructor's gender. 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). We found no significant relationship between participants' gender and their choice of welding instructor's gender, $X^2(2, n = 42) = 1.31$, $p = 0.51$. No significant association was present between gender and participants' choice of their welding instructor's gender.

Conclusions, Implications & Recommendations

There is an increase in the number of female students participating in certain agricultural mechanics and welding fields at the secondary and post-secondary levels, yet females continue to represent the minority of welding course participants (Milgram, 2011). Similarly, female students continue to be the minority regardless of the recent increase of females in STEM, agriculture, and welding (Battis, 2020; William, 2021). This underrepresentation may be influenced by student's observations that more males than females have careers in welding, STEM, and agricultural mechanics, though social stereotypes for males and females may also play a role in these trends. Colleges of agriculture have experienced an increase in the number of female post-secondary students completing agricultural educator programs in recent years (Knight, 1987; Shultz et al., 2014; Smith et al., 2021). Because these educators teach a variety of subjects including agricultural mechanics and welding, adequate training in these subjects is warranted. In this study, only one female participant completed a high school welding course prior to beginning her college career, which suggests the importance of post-secondary welding education.

This study investigated the post-secondary students' perceptions of their welding instructors relative to the instructor's gender. After receiving instruction from a post-secondary female welding instructor, students indicated their agreement with the statement "I would learn more from a female instructor". The male participants and Tuesday sections' mean score increased indicating learning from a female instructor had a significant 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 at the secondary or post-secondary level. Learning from an experienced female instructor perhaps changed their perceptions of their ability to learn welding curriculum from a female and their view of females in the welding industry.

Two unsolicited participant comments provide additional context for the students' change in perceptions. One student 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 receiving instruction from a female instructor, even if it was only for eight weeks, influenced his perceptions of females' abilities to weld. This participant was pursuing a career in agricultural education, a career which has experienced a rapid increase in female educators over the past few decades. This individual case is consistent with previous research indicating females experience bias from their male counterparts in agricultural education (Kelsey, 2006; Kelsey 2007).

One female participant wrote on the survey instrument, "It is inspiring having a female instructor, it gives me more confidence and motivation." This comment suggests that the student 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; Herrmann et al., 2016).

It is interesting to note the number of participants (approximately 25%) who selected preference toward a post-secondary 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.

Another interesting finding was that 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 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. These findings indicate gender bias was possibly prevalent in the post-secondary welding course and is consistent with previous literature displaying evidence of gender bias in other collegiate courses (MacNell et al., 2015; Mitchell & Martin, 2018).

Post-secondary agricultural educators are tasked with preparing the next generation of secondary agricultural educators for all courses that they may be required to teach in the future. Special care should be taken to ensure that female students are recruited into post-secondary welding courses, especially if they didn't receive welding training in the secondary setting. Whenever possible, post-secondary agricultural educators should make visible female professionals in the field whether via full-time faculty, preceptors, or guest presenters to provide positive role models for female students. In addition, post-secondary agricultural educators should address gender bias issues in teaching methods courses to prepare female educators to combat issues which may arise with male and female student regarding rapport in agricultural mechanics courses. Future research should be conducted to better understand female welding students' perspectives and experiences as the minority in a heavily male dominated field and additional research with a larger sample to determine factors which influence gender bias and verify gender bias in agricultural education.

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