Differences in Post-Secondary Student's Tinkering Self-Efficacy: Implication for Skill Development

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Introduction/Need for Research

Agricultural education and mechanics were overlooked disciplines few females pursued until recent decades. In 1987, 5.1% of agricultural educators were female (Knight, 1987) and in 2021, 76% of SBAE teacher preparation program graduates were female (Smith et al., 2021). Agricultural mechanics coursework is highly prevalent in SBAE. Many agricultural mechanics disciplines today continue to have an unbalanced ratio of male to female workers such as welding. In 2020, 3.5% of workers were female (U.S. Bureau of Labor Statistics, 2021). Females have previously been described as lacking machinery experience, being apprehensive towards mechanics and holding lower levels of tinkering self-efficacy (Baker & Krause, 2007; Beckwitk et al., 2006; Crismond, 2001). Tinkering self-efficacy is an individuals' belief of themselves regarding their ability, experience and comfort levels in manual activities (Baker & Krause, 2007). Lack of self-efficacy may indicate lack of belief or confidence in oneself regarding a subject, leading to lack of effort, poor academic success and problem-solving skills (Baker et al., 2015). In our research, tinkering is in regard to an agricultural laboratory setting. Little research has been conducted to determine tinkering self-efficacy between the genders in agricultural mechanics.

Conceptual Framework

Eagly's Social Role Theory suggests behavioral differences between the two genders is a result of sex stereotypes and the social roles taught to children from adults (Eagly, 1987). In society, there are consistent socially acceptable gender occupations and until recently, agricultural education and mechanics were professions perceived to be reserved for males. Females have previously experienced gender bias from male counterparts and school administration in regard to teaching agricultural mechanics competencies (Kelsey, 2006). Many preservice teachers have indicated a lack of training and knowledge of agricultural mechanics and females may have their own unique challenges to overcome related to self-efficacy concerns of incompetence and losing/gaining credibility from students (Tummons et al., 2017). Developing the skills to confidently teach agricultural mechanics for male and female pre-service teachers is critical for teacher retention. Examining tinkering self-efficacy scores of undergraduate students enrolled in a beginning welding course will reveal differences between the two genders thereby identifying specific needs for targeted interventions to improve females' self-efficacy related to welding.

Methodology

One objective of this study was to describe college student's tinkering self-efficacy and determine if differences in tinkering self-efficacy exist between the male and female students. The population for this study was undergraduate students enrolled in an agricultural mechanics course at Utah State University and the sample was the Fall 2021 beginning welding course (n = 24). Data was collected through paper surveys twice throughout the semester (e.g. pre and post surveys). As a part of a larger study, the survey for this specific objective consisted of seven item Tinkering self-efficacy (adapted from Baker & Krause, 2007) scale measured on a seven-point scale (1 = *strongly disagree,* 4 = *neutral* to 7 = *strongly agree*) with a Cronbach's alpha reliability coefficient of .89. Example statements included; "I enjoy learning how machines

operate" and "I enjoy taking apart items and seeing how they work". Content validity was deemed acceptable by a panel of faculty knowledgeable in survey methods and design.

Results/Findings

Results from Levene's Test for Homogeneity of Variance indicated equal variances could not be assumed for the week four ($F = 4.92$, $p = .038$) and 12 surveys ($F = 5.53$, $p = .032$). The female students averaged a tinkering self-efficacy score of 5.1 ($SD = 1.14$) during the week four pre-survey. The male students averaged a score of 6.59 ($SD = 0.44$). The female's score was significantly lower than the male's score. During the post-survey at week 12, the females score dropped to 4.96 (SD = 1.59) and the males dropped to 6.52 (SD = 0.68). All tinkering self-efficacy scores contained a nonsignificant drop between week four and 12. An independent samples Kruskal Wallis Test was used to investigate differences in tinkering self-efficacy scores between the females, males and the AFAB (e.g. Assigned Female at Birth) student. The females scores were significantly lower than male students at both week four ($H(2) = 7.86$, $p = .020$) and week 12 ($H(2) = 8.26$, $p = .016$). The student who identified as AFAB contained the same pre and post test score of 7. Post-hoc analysis was completed using the Mann-Whitney Test to identify specific differences between the three student gender groups. Significance values have been adjusted by the Bonferroni correction for multiple tests. At week four the males and females were significantly different $U(1) = 9.361$, $p = .032$) and at week 12 were nonsignificant ($H(1) = 8.26$, $p = .021$). The mean laboratory grade for the female students was 84.51% and the male students was 89.13%. Females reported lower tinkering self-efficacy scores and received lower laboratory grades compared to their male classmates.

Table 1. *Tinkering Self-Efficacy*

Study Participants	Week 4 Self-efficacy	SD	Week 12 Self-efficacy	SD
Female Students (n = 4)	5.10	1.14	4.96	1.15
Male Students (n = 20)	6.59	0.44	6.52	0.68

*****1 = *strongly disagree,* 4 = *neutral* to 7 = *strongly agree*

Conclusions/Recommendations/Impact on Profession

Our data revealed female undergraduates enrolled in a post-secondary welding course possessed significantly lower levels of tinkering self-efficacy compared to their male counterparts. Both groups of male and female students tinkering self-efficacy scores dropped between the week four and week 12 surveys. Research suggests self-efficacy is a predictor of academic success and future careers (Pajares, 1996). Perhaps students were more confident in their abilities at the beginning of the semester before being exposed to more difficult welding techniques. It is concerning to see student's self-efficacy levels drop and to find a significant difference between the males and females scores. This finding is consistent with previous research conducted by Baker & Krause (2007) which reported females exhibit lower tinkering self-efficacy. We recommend additional research be conducted to investigate measures which affect tinkering self-efficacy in male and female students in agricultural mechanics and how tinkering self-efficacy affects pre-service female teachers in their future careers as agricultural educators. We further recommend teacher preparation programs focus on agricultural mechanics skills to potentially increase tinkering self-efficacy, for all pre-service teachers.

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