Evaluation of Welding Assessment Scores Using Triangulation

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Introduction

The welding process is prevalent and crucial to agricultural mechanics (Stone et al. 2011a). Abrams et al. (1974) identified that corrective feedback is necessary for the development of the psychomotor skills required to perform an acceptable weld. In the feedback stage, the instructor must first assess the quality of work provided by the learner. Assessment is the stage of the educational process in which the instructor collects, analyzes, and interprets information regarding students' work, and assigns numerical grades based on criterion relating to quality (Ghaincha, 2016). Performance assessments evaluate the quality of work of students' engaging in a task with a desired outcome, in this case, producing a quality weld (Ghaincha, 2016). In previous studies (Abrams et al., 1974; Byrd et al., 2015; Stone et al., 2011b; Stone et al. 2013; Wells & Miller, 2020) welding assessment was conducted by Certified Welding Instructors (CWIs), however there was no attempt to include self-assessments from the student, nor did they collect assessments from the instructors. As noted by Ghaincha (2016), self-assessment can be beneficial to further develop effective curriculum and overcome the high variability in instructor assessment.

Conceptual Framework

The underlying conceptual framework for this study was constructed using Bloom's Taxonomy (Cullinane, 2009). Bloom's Taxonomy suggests that learning can be achieved through a hierarchical structure of learning objectives composed of knowledge, comprehension, application, analysis, synthesis, and evaluation. According to Bloom's Taxonomy, evaluation requires the highest level of cognition due to its complexity and inclusion of all other objectives. Through evaluation, students assess performance and draw conclusions relating to quality (Cullinane, 2009)

Purpose and Objectives

The purpose of this study was to compare the self-assessed welding scores submitted by the students to the assessment scores provided by the course instructor and the CWI. This study aligns with the American Association for Agricultural Education's (AAAE) National Research Agenda (NRA) Priority Area 4: Meaningful, Engaged Learning in All Environments (Roberts et al., 2016). Roberts et al. (2016) suggest that in order for learning to be meaningful, the learner must engage in the learning process, as opposed to solely receiving knowledge. This study also aligns with the National Career and Technical Education Research Agenda Framework Model (Lambeth et al., 2018) by providing meaningful, personalized learning. As such, including the learners in the evaluation process may provide increased meaning. The objective of this study is to determine if any statistical differences exist between student, instructor, and CWI weld evaluations.

Methods

Students in an Introduction to Agricultural Engineering course at Texas State University (n = 44) were allowed one, one-hour and fifty-minute lab period to practice welding, using 1/4" mild steel in the 2F position, and submitting their highest quality weld for grading. After the conclusion of the lab, using a grading criterion developed by Herren (2009), students were asked to complete a self-evaluation on their submitted weld. The submitted weld was also graded by the course instructor as well as an American Welding Society (AWS) accredited CWI using the same grading criterion as the student. The grading criteria for the weld included general appearance, proper travel and work angles, uniform height and width of weld, and appropriate penetration. Data were analyzed utilizing an independent T test, a T test allows us to compare the values of the two data sets. Data sets consisted of the weld evaluations from the student, instructor, and CWI.

Results

Forty-four participants, the course instructor, and an AWS accredited CWI provided data for our study. The CWI had the highest mean score of 80.66 (*SD* = 11.12), while the course instructor had the lowest mean score of 77.41 (*SD* = 13.71). The t-scores for students compared to CWI was -0.78, the t-scores for instructor compared to CWI was -1.57, the t-scores for students compared to the instructor was 0.51. The degrees of freedom for student compared to instructor and CWI and instructor compared to CWI was 43. No statistically significant differences ($p > .05$) in weld scores were identified.

Table 1.

Comparison of Student and Course Instructor Welding Scores to Certified Welding Inspector (CWI) Score

Grade	*N*	*M*	*SD*	*t*	*df*	*p*
Student vs CWI	44	78.68	16.76	-0.78	43	0.44
Instructor vs CWI	44	77.41	13.71	-1.57	43	0.12
Student vs Instructor	44	78.68	16.76	0.51	43	0.61
Instructor vs Student	44	77.41	13.71			

Note. CWI *M* = 80.66; *SD* = 11.12

Conclusions, Discussions, Recommendations

Although no statistically significant differences were identified between weld scores provided by the student, course instructor, and CWI, the mean scores were relatively consistent between evaluations. We conclude this consistency displays that students and the course instructor, both possess adequate knowledge to evaluate welds on par with industry standards. It is also important to note that the students and the course instructor had higher standard deviations than the CWI. Given this, we recommend that students and the course instructor continue to practice welding evaluation to decrease the variability in their evaluations. We recommend replicating this study with an industry validated evaluation sheet. An industry validated sheet might provide more specific criteria that align the industry standards and reduces variability within evaluation scores.

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