Using Triangulation Scoring to Improve Student Evaluations

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Introduction

The welding process is crucial to agricultural mechanics and requires effective corrective feedback in the learning process to achieve the adequate skills necessary to perform quality welds (Stone et al., 2011; Abrams et al., 1974). Previous methods of welding evaluation sought feedback from the instructor or a certified welding inspector (CWI) but had no formal attempt to include the student. Ghaincha (2016) noted that self-assessment can prove beneficial to further develop effective educational curriculum and increase learning outcomes. According to Bloom's Taxonomy of educational objectives, evaluation requires the highest level of cognition, employing knowledge, comprehension, and analysis (Cullinane, 2009). In order to include the students' self-evaluation, the instructor evaluation, and the CWI evaluation, we developed the triangulation of welding evaluations.

How it Works

Triangulating welding evaluations is an idea that focuses on collecting three evaluations of a weld to analyze students' performance. To accomplish the three points of evaluation, it is imperative to gain access to a CWI. We partnered with a local industry entity that focuses on welding and pipe fabrication, that provided an American Welding Society (AWS) accredited CWI for the lab periods involving weld testing.

Students had undergone one lab period of welding training using the traditional live-weld training protocol prior to the test week. They received a demonstration of an acceptable weld and had the remaining portion of the lab to practice welding. Students were encouraged to seek verbal feedback from the instructor on welding performance periodically throughout their practice session. During the test week, students were instructed to practice welding for the entirety of a one-hour and fifty-minute lab period. During the practice session of the test week, students were encouraged to seek verbal feedback from the instructor and the CWI to further understand welding evaluation. At the conclusion of the lab, students submitted the weld they determined was the highest quality to the instructor for grading. Upon submission, students completed their welding self-evaluation using a criterion sheet developed by Herren (2009). Using the same criterion sheet as the students, the weld was evaluated independently by both the instructor of the course and the CWI. Once the three evaluations were completed, the students received the feedback provided by the course instructor and the CWI.

Table 1.

Steps to Triangulating Welding Evaluation

Steps	Activity	Description
Step 1	Welding quality	Students receive technical knowledge from the course instructor relating to weld quality.
Step 2	Demonstration	The instructor provides a demonstration of an acceptable weld.
Step 3	Practice welding	Students practice welding, receiving feedback from the instructor.

Step 4	Test week	Students practice welding, receiving feedback from the instructor and the CWI, submitting their highest quality weld for grading
Step 5	Self-assessment	Students assess their welds.
Step 6	Instructor assessment	The course instructor independently evaluates the students' welds.
Step 7	CWI assessment	The CWI independently evaluates the students' welds.
Step 8	Triangulation of evaluation	Students receive the feedback from the course instructor and the CWI.

Results To Date

We integrated this idea into the Introduction to Agricultural Engineering course at Texas State University. Forty-four students, the course instructor, and an AWS accredited CWI provided data, giving us a total of 132 welding scores. It is important to note, we identified a decreasing level of variability in scores as prior welding knowledge increased. The CWI had lower variability in welding evaluations than the students and the course instructor which is consistent with the level of welding knowledge possessed amongst each group. Additionally, the students had the highest variability in welding evaluations. Moreover, males had a higher self-evaluation mean score than the CWI scores while conversely, the females had a lower self-evaluation mean score than the CWI scores, suggesting that males are more confident in their performance than females are.

Future Plans/Advice to Others

We recommend that welding educators begin using a triangulation of evaluation in welding education. We further recommend that a scoring sheet be developed that is consistent with those used by AWS accredited CWIs. Although not explicitly stated to the students, additional resources were available in the lab such as welding defect kits, welding defect flashcards and welding defect posters. We recommend that these resources be integrated into the curriculum to provide examples of welding defects and increase the effectiveness of student evaluations.

Costs/Resources Needed

Costs associated with this project were minimal to our department. The average cost for a 2F joint welding certification from a CWI is approximately $250 per certification plus an additional average consulting fee of $70/hour, however the department partnered with a local industry entity that provided temporary access to a CWI at no cost. In lieu of a welder certification that requires a destructive test, the CWI provided certificates of achievement for students that passed a visual examination. If an instructor elects to include welding defect posters, they can request those free of charge from Miller Welding and Lincoln Electric or purchased for $59 through Realityworks. The Weld defect Flashcards can be purchased for $179 and the weld defect classroom kit can be purchased for $999 through Realityworks There were no additional costs beyond those typically associated with teaching the welding position of this course.

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