

Using a Virtual Reality Trainer to Enhance Preservice SBAE Teachers' Welding Self-Efficacy

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Introduction, Literature Review, and Theoretical Framework

School Based Agricultural Education (SBAE) teachers are in a unique position to begin training the welders who will fill the nearly 360,000 positions that will be open by 2027 (AWS, 2023). However, these teachers need help doing so. Despite welding being considered one of the most important and commonly taught subjects within agricultural education (National FFA Organization, 2023; Whitehair et al., 2020; Burris et al., 2005; Lafferty, 2004), their perceived ability to teach the subject is critically low (Clark et al., 2021). For SBAE teachers to feel comfortable and confident with teaching students to weld, they must first be comfortable and confident welders themselves, thus having a high perceived self-efficacy (Bandura, 1994).

One way to increase welding self-efficacy in agriculture students is by using Virtual Reality trainers to supplement instruction (Heibel et al., 2022; Ramos et al., 2022). While previous studies have been done to analyze the benefits of integrating VR welders into postsecondary agricultural mechanics courses (Wells & Miller, 2022; Wells & Miller, 2020), no study has specifically focused on using this technology to evaluate the self-efficacy of preservice SBAE teachers. This study used the Successful Integration of VR into Agricultural Education model (Pulley, 2022) to attempt to accomplish the goal of increasing welding self-efficacy in preservice SBAE teachers. This was done by creating a positive user experience with the virtual welding trainers and allowing participants to address their SMAW process performance through the realistic interpretation of a hands-on activity.

Methodology

The purpose of this study was to determine if using a VRTEX 360 Compact welding trainer increased the self-efficacy of preservice SBAE teachers at Tarleton State University when using the SMAW process. The following objective guided this study:

1. Explore Tarleton State University preservice SBAE teachers' pre- and post-perceptions of self-efficacy in SMAW welding before and after using the VRTEX 360 Compact welding trainer.

Participants ($n = 8$) were in an agricultural mechanics course designed for preservice teachers. Using a mixed-mode survey, we explored Tarleton State University preservice SBAE teachers' pre- and post-perceptions of self-efficacy of the SMAW process before and after using the VRTEX 360 Compact welding trainer. The trainer scores welds from 0-100 based on criteria such as travel and work angle, arc length, travel speed, and position. At the beginning of the study, participants were given a pre-treatment survey to determine their SMAW process self-efficacy on a scale of 1 to 10. They were then asked to explain their rankings. Participants were then introduced to SMAW welding concepts in a lecture setting and signed up for a two-hour practice period for the following week. At the end of the practice period, participants were given a post-treatment survey to determine their SMAW welding self-efficacy after using the virtual trainer.

The survey instrument was tested for content and face validity based on recommendations from Ary et al. (2010) by a panel of three experts who were chosen based on their expertise as researchers in agricultural mechanics and SBAE teacher self-efficacy. Data was checked for normality through analysis of skewness, kurtosis, and QQ plot diagrams using IBM SPSS© Version 28.0 software.

Findings

The pre-treatment survey data indicated that participants ($n = 8$) were not confident in any aspect of the SMAW process. After using the VRTEX, they all saw their scores increase. Comments from participants indicated half of the participants ($n = 4$) had never welded using the SMAW process. The other half had used the SMAW process; however, they did not feel confident due to lack of quality practice. Participant 4 reported having experience with SMAW but did not know how to set up the welder without help. Additionally, Participant 6 felt comfortable enough with SMAW to set it up and use it without help but did not feel confident enough in their own abilities to be able to safely manage a laboratory environment with more than a handful of students. Table 1 shows the increases by question.

Table 1

Pre- and Post-Treatment Self-Efficacy Rankings

Question	<i>M</i>		<i>SD</i>		Range	
	Pre	Post	Pre	Post	Pre	Post
Confidence performing SMAW welding.	3.5	7.0	2.1	1.7	1-6	4-9
Confidence teaching students to SMAW weld.	1.8	5.5	1.2	1.7	1-4	3-8
Confidence to set up SMAW experiences for students.	2.3	4.2	1.6	1.3	1-5	2-6

All participants indicated in the comments the VRTEX 360 Compact welding trainer helped them increase their skills. Participant 3 was quoted as saying the virtual trainer made them “feel much more confident with performing stick welding” because it allowed them to “work on welding skills, receive instant feedback, and correct issues when running the next bead”. They also believe the virtual trainer allowed them to “become more confident, which will in turn help [their] ability to teach welding”. Similarly, Participant 5 stated the virtual trainer allowed them to “pinpoint and correct” their welding using visual and audial cues. They also stated they believe they will be better able to correct students because of their own increased welding ability. The one item not seeing a large increase was the ability to set up welding experiences. Participant 8, for example, stated this experience helped increase their confidence in setting a welder to the correct amperage based on type of consumables used, however, they feel like they need to do more research to be able to purchase supplies and set up effective lessons.

Conclusions/Discussion/Recommendations

Preservice SBAE teachers showed increased self-efficacy in three areas: ability to perform the SMAW process; ability to teach students to perform the SMAW process; and ability to perform the necessary steps to set up a SMAW experience for students. Future studies could be done at other institutions to generalize these results. The virtual trainer offers a low risk, less intimidating environment to practice welding in before adding the potential stress and risk of live welding. It also offers instant feedback and training lenses to master the motions and positions needed to weld successfully. Therefore, it is recommended to use the VRTEX 360 Compact to increase preservice SBAE teacher self-efficacy prior to live welding.

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