

Research

Evaluating agricultural, food, and natural resource teacher competence in a Computer Numerical Control (CNC) Plasma Arc Cutting workshop: An assessment using the Borich Needs Assessment Model

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Introduction

Agriculture, food, and natural resource (AFNR) education prepares students with the knowledge and skills needed for successful careers (National FFA, n.d.). AFNR programs also teach students real world skills through the three interdependent components: classroom and laboratory instruction, leadership and personal growth through FFA, and supervised agricultural experiences (SAE) (National FFA, n.d.). Within AFNR is a popular subset of the curriculum - agricultural mechanics. Agricultural mechanics has attracted a strong interest from students for over 20 years (Burris, Robinson, & Terry, 2005). According to Leiby, Robinson, and Key (2013), agricultural mechanics is a science-based curriculum that provides teachers with the opportunities to integrate the concepts of physics, chemistry, and mathematics. Stubbs and Myers (2015) further noted that current federal policies have focused on increasing teacher efficacy in order to increase student attainment in science, technology, engineering, and mathematics (STEM) concepts and provide the knowledge and skills needed by students in various industries — with many of these skills are taught in agricultural mechanics courses. According to Saucier, Vincent, and Anderson (2014), laboratories are important educational tools for providing students with opportunities to develop knowledge and skills pertaining to agricultural mechanics; however, in order for laboratories to be effective and safe, agricultural mechanics teachers must be knowledgeable and competent in content, skill performance, and safety management. Sorensen, Lambert, and, McKim (2014) also noted that skilled teachers are crucial to student success; therefore, all teachers should be properly prepared and participate in professional development opportunities in order to teach effectively.

Conceptual and Theoretical Framework

The conceptual framework for this study utilized the Borich's Needs Assessment Model (Borich, 1980). This needs assessment model allows teacher educators, training centers, and researchers the ability to prioritize the needs of teacher professional development (Borich). Additionally, Bandura's theory of self-efficacy was utilized. Bandura defines self-efficacy as ones beliefs in their own ability to execute a task and impacts an individual's decisions, actions, reactions to complications, as well as their overall level of success (Bandura, 1986). According to Ross, Cousins, and Gadalla (1996), teacher efficacy encompasses an individual teacher's expectation that he or she, will be able to convey student learning. Through experiences, teachers are better able to develop a stable belief about their own abilities (Ross, 1998). Furthermore, ones confidence in their own abilities is extremely important when teaching students how to perform tasks that could be potentially dangerous to themselves as well as others in the agricultural mechanics laboratory (McKim & Saucier, 2013).

Purpose and Research Objectives

The purpose of this study was to determine the self-perceived professional development needs of teacher Texas AFNR teachers, who attended a one day CNC Plasma Cutting workshop. The following research objectives guided this study: (1) Describe the change in participants' perceived importance of teaching CNC Plasma Arc Cutting technology professional

development (CNCPD) competencies, their knowledge of CNCPD competencies, and their ability to perform and teach the CNCPD competencies, based on pre- and post-test scores. (2) Describe the change in participants' perceived professional development needs related to participants' perceptions of the importance, knowledge, ability to perform, and ability to teach CNC Plasma Arc Cutting welding technology professional development (CNCPD) competencies, based on pre- and post-test construct scores.

Methods

This quantitative, descriptive census study was conducted in the fall of 2016 at Sam Houston State University. The population for this study were all Texas school-based AFNR teachers who attended a CNC Plasma Arc Cutting workshop ($n = 20$). The overarching construct of this study was to measure perceptions of teachers' knowledge to teach (*Knowledge Competence*), their ability to perform (*Performance Competence*), and teach (*Consequence Competence*) CNC Plasma Arc Cutting technology competencies using the Borich Needs Assessment Model (Borich, 1980). Researchers utilized a similar data collection instrument found in a study by Saucier and Langley (2016). Hence, a two-section instrument to address the research objectives of this study was modified by the researchers from the 26 industry supported curriculum competencies taught during the workshop. A 90% response rate was achieved ($n = 18$). Data was analyzed using Microsoft Excel and IBM SPSS Statistics 22 based upon each research objective.

Results

Results of the workshop indicated that teachers had the greatest change in Mean Weighted Discrepancy Scores (MWDS; Pre vs. Post) for the *Knowledge Competence* with the *Control Software Operation – Trouble-shooting* competency (-6.76). The least change in MWDS for this competence was the *Safety – Fume Control* competency (+0.13). For the *Performance Competence*, the greatest change in MWDS (Pre. vs. Post) was the *Material Finishing – Dross Removal* competency (-7.56). The least change in MWDS for this competence was the *Plasma Power Unit Setup – Physical Placement* competency (-0.38). For the *Consequence Competence*, the greatest change in MWDS (Pre. vs. Post) was the *Material Finishing – Dross Removal* competency (-7.94) with the least change being the *Plasma Power Unit Set-up – Physical Placement* competency (MWDS = -0.37). Additionally, teachers had the following changes in self-perceived efficacy levels based on the four scales of measurement (Pre- vs. Post-test): *Importance to Teach* (+0.16), *Knowledge to Teach* (+1.04), *Ability to Perform* (+1.05), and *Ability to Teach* (+1.01).

Conclusions, Implications, & Recommendations

Overall, teachers indicated professional development needs, across all three competences, (both pre- and post-test), regarding CNC Plasma Arc Cutting competencies. Data concludes that the workshop was successful in improving teacher's *Knowledge, Performance, and Consequence* competences except for *Safety – Fume Control* in the *Knowledge Competence*. In this competency, teachers' perceptions of their knowledge actually decreased (Pre- vs. Post-test) during the workshop. Implications of this research may impact the knowledge and skills that are taught to new and existing teachers across the U.S., in both teacher education programs and for existing teachers. With the push for increasing industry-based Science, Technology, Engineering, and Mathematics (STEM) skills for future workers, providers of professional development education would be remised if they did not offer these skills to future and existing teachers alike.

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