Metal Fabrication Equipment Adequacy and Competence to Teach of Kansas Agricultural Educators

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Introduction/ Literature Review/ Theoretical Framework

"Agricultural mechanics instruction is in a constant state of dynamic change" (Shultz et al., 2014, p. 48). No matter the agricultural mechanics content being taught, there are some sort of equipment or tools necessary for students to learn adequately. Metal fabrication, including welding, has a multitude of equipment pieces necessary for student learning of which vary from program to program. Quality equipment allows student learning opportunities to flourish and excel beyond the high school agricultural mechanics laboratory. As McCubbins et al. (2016) state, "adequate tools and equipment are vital in preparing students to fill an expanding, 21st century workforce" (p. 223).

Agricultural educators need to be competent about equipment to successfully teach students metal fabrication competencies (Sultan & Shafi, 2014). There is concern regarding the competence level of agricultural educators to effectively use and safely maintain the multitude of equipment present in an agricultural mechanics laboratory (Chumbley et al., 2018).

It is critical to consider self-efficacy (Bandura, 1997) when evaluating the equipment present in an ag mechanics laboratory and the competence of the ag educator. Self-efficacy can be defined as, "a personal belief in one's capability to organize and execute courses of action required to attain designated types of performances" (Artino, 2012, p. 76). Ag educators must have self-efficacy to create competence, which allows them to teach their students agricultural mechanic competencies.

Purpose and Objectives

The purpose of this study was to investigate the metal fabrication equipment needs of Kansas high school agricultural mechanic teachers. The following research objectives guided this study: 1.) Determine what metal fabrication equipment is present; 2.) Describe the adequacy of metal fabrication equipment present; 3.) Describe Kansas agricultural educators' competence to utilize metal fabrication equipment to teach their students agricultural mechanics competencies.

Methods

A Qualtrics survey consisting of four sections was disseminated to Kansas agriculture teachers during the summer of 2021 ($N = 275$). Three reminder emails were sent in weekly intervals to assure survey completion. The survey remained open for three weeks. The survey sections explored mechanics program information, equipment present in agricultural mechanic labs, adequacy of equipment, and competence to teach with the equipment. The survey was modified from one used by McCubbins et al. (2017) which reported acceptable reliability coefficients. Content validity was reviewed by a team of two university professors as well as a KSU Ph.D. student with experience and expertise in agricultural education and ag mechanics. Additional survey questions were added to the survey through the process to address newer agricultural mechanic competencies and equipment. Surveys were completed by 73 Kansas agricultural educators (26.5% response rate). Data was analyzed using SPSS.

Results

The population of this study was relatively young with over sixty-seven percent (n = 51) reporting 10 years or less, followed by 11-20 years of teaching experience (n= 11, 14.47%), and 21 years or more (n = 14, 18.42%). Agricultural mechanics competencies were taught to 2,623 students by 72 teachers during the 2020-2021 school year. The mean was 36.43 students per teacher, with a range of 0 to 175.

Research objective one sought to identify the metal fabrication equipment present in Kansas agricultural mechanic laboratories. ARC welders (M = 6.71) and MIG welders (5.31) were the highest quantity metal fabrication equipment per program. The next most common pieces of equipment were cutting torch (M = 2.33), chop saws (M=1.49), multi-process welders (M=1.47), drill presses (M=1.25), hand-held plasma cutters (M=1.21), and TIG welders (M=1.12). Band saws (M=0.68), iron workers (M=0.62), and plasma tables (M=0.51) all averaged less than one piece per program.

Research objective two sought to examine the reported adequacy of the metal fabrication equipment present. Teachers reported the two pieces of equipment most adequate in their laboratories ("very strong" or "strong") were chop saws (54.69%) and arc welders (46.88%). The pieces of equipment least adequate ("not at all" or "somewhat") were plasma table (60.34%) and TIG welder (59.02%). Research objective three examined the teachers' competence to utilize the equipment in their laboratories. The two pieces of equipment teachers were most competent (rated "strong" or "very strong") to use were also chop saws (91.42%) and arc welders (87.14%). TIG welders (55.71%) and plasma tables (37.14%) were the two items teachers were least competent to use (rated "not at all" or "somewhat").

Conclusions, Implications, & Recommendations

Self-efficacy is a process. Pekmezi et al. (2009) stated, "Past performance is considered the most powerful method of developing self-efficacy" (p. 3). Adequate equipment increases the competence of agricultural educators which in turn creates more meaningful learning opportunities for students to learn agricultural mechanic competencies.

When looking at the perceived *adequacy* of metal fabrication equipment, ag educators showed several trends in their responses. Not one piece of equipment had "very strong" as the highest rated adequacy. MIG welders, arc welders, chop saws, cutting torches, and hand-held plasma cutters were all rated as "strong" adequacy. TIG welders, iron workers, band saws, plasma tables, and multi-process welders were all rated "not at all adequate" most often. Six pieces of equipment were rated "strong" and "very strong" *competence* the most frequent (MIG welders, arc welders, drill presses, chop saws, cutting torches, and hand-held plasma cutters). The highest frequency for TIG welders and plasma tables were "not at all" and "somewhat."

It is recommended to focus on the least adequate equipment in agricultural mechanic laboratories with increased funding and training by universities and industry. Future research should investigate industry needs to best design and support future professional development and training. Additionally, research to identify how teacher preparation programs are addressing skill development in metal fabrication can help identify gaps in knowledge and self-efficacy to teach this content.

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