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Safety in the Agricultural Mechanics Laboratory: A Needs Assessment of Tennessee School-Based Agricultural Educators

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Abstract

Accidents occur in all school-based agricultural education laboratories. The extent of these accidents varies by the situation, the individuals involved, and the safety protocols in place. However, it is a teacher's responsibility to limit these accidents and provide a safe learning environment for student academic mastery (Phipps, Osborne, Dyer, & Ball, 2008). According to a review of literature, in many states, researchers have noted that agricultural teachers require some iteration of professional development in the area of safe agricultural mechanics laboratory management. This study investigated the agricultural mechanics laboratory safety professional development needs of Tennessee school-based agricultural educators who teach in and manage an agricultural mechanics laboratory. Data were collected with a web-based questionnaire designed to identify teachers' perceptions of importance and their perceived ability to complete 70 selected agricultural mechanics laboratory competencies. The Borich (1980) needs assessment model was used to assess and evaluate the in-service needs of the teachers concerning laboratory safety. Results indicated Tennessee teachers had in-service needs in 13 of the 14 laboratory safety competencies with the greatest need concerning administering first aid. The researchers recommend that professional development opportunities be developed and offered to teachers concerning this critical need area, be delivered in formats conscious of teachers academic schedules, and in a format that reaches the most people, possibly in a web-based format.

***Keywords*:** safety, agricultural mechanics, Tennessee, secondary education, agricultural education

Introduction and Literature Review

Professional development education for teachers is essential to improving teacher retention, program continuity, and the preparation of fully-qualified and highly-motivated agricultural educators at all career stages (Osborne, 2007). Doerfert (2011) noted that agricultural educators are challenged by the designing, developing, implementing, and assessing pedagogies for meaningful learning. Additionally, the need for professional development, which improves classroom and laboratory teaching methodologies, has continued to exist for school-based agricultural educators (Burris, McLaughlin, Brashears, & Fraze, 2008; Duncan, Ricketts, Peake, & Uesseler, 2006; Joerger, 2002; Roberts & Dyer, 2004). This trend is especially true for agricultural educators who utilize an agricultural mechanics laboratory for student instruction and skill acquisition (McKim & Saucier, 2011a; Saucier & McKim, 2010; Saucier, Terry, & Schumacher, 2009; Saucier, Vincent, & Anderson, 2011). Several studies have found that agricultural educators have professional development needs in several areas of agricultural mechanics laboratory management (Dyer & Andreasen, 1999; Hubert, Ullrich, Lindner, & Murphy, 2003; Johnson, Schumacher, & Stewart, 1990; McKim & Saucier, 2011a; Saucier & McKim, 2010; Saucier et al., 2009; Schlautman & Silletto, 1992; Swan, 1992); consequently, laboratory safety was the area with the most need for professional development in many of these studies. If agricultural mechanics laboratories are to remain a safe place for student educational enrichment, it is critical that professional development opportunities be offered for teachers who instruct students in these specialized educational facilities (McKim & Saucier, 2011a).

For safe laboratory instruction to take place in agricultural mechanics courses, school-based agricultural educators must be competent and knowledgeable in the area of laboratory management (Saucier et al., 2009). Phipps, Osborne, Dyer, and Ball (2008) noted that the agriculture teacher is responsible for identifying safety hazards, providing daily safety instruction, and maintaining safe working conditions for students in an agricultural mechanics laboratory. Furthermore, the agricultural mechanics laboratory can quickly become an underutilized and unsafe learning environment if ill-prepared teachers are thrust into instruction without adequate pre-service preparation (Hubert et al., 2003; Newcomb, McCracken, Warmbrod, 1993). McKim and Saucier (2011a) suggested “learning cannot take place unless agriculture teachers can provide a safe learning environment for students to develop agricultural mechanics related skills” (p. 12). If the ultimate goal of professional development is to improve the learning outcomes of students (Guskey, 2002), then providing teachers with timely and needed professional development opportunities should be the goal of state supervisory staff and teacher educators (Saucier et al., 2009). With the development and revision to nationwide academic standards (Ozturk & Debelkak, 2005) and the ever-increasing change in technology in the area of agriculture mechanics, little professional development education has been offered to Tennessee teachers in recent years in this popular curriculum area (J. Ricketts, personal communication, August 30, 2011).

Theoretical Framework

To guide this non-experimental, quantitative study, two theories were used to form the theoretical base: Bandura’s theory of self-efficacy (Bandura, 1997) and Knowles’ theory of andragogy (Knowles, Holton III, & Swanson, 2005). Bandura (1997) defined self-efficacy as the “beliefs in one’s capabilities to organize and execute the course of action required to produce given attainments” (p. 3). Furthermore, self-efficacy influences a person’s choices, actions, the amount of effort they give, how long they persevere when faced with obstacles, their resilience, their thought patterns and emotional reactions, and the level of achievement they ultimately attain (Bandura, 1986). In education, teacher self-efficacy is an important concept of understanding teacher motivation (Knobloch & Whittington, 2002). By understanding a teachers’ beliefs about completing an activity, or their self-efficacy level, professional development opportunities can be developed to address these inadequacies (see Figure 1).

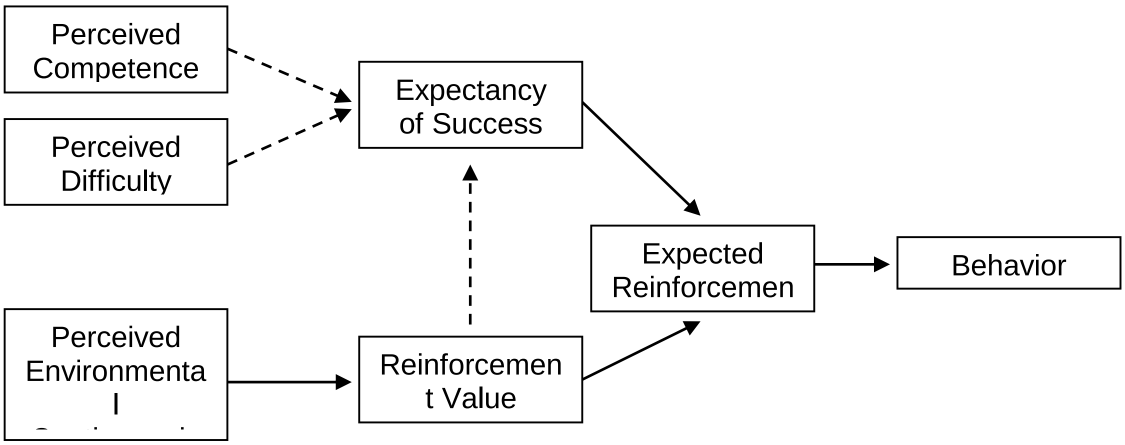

Figure 1. An illustration of the theory of self-efficacy (Bandura, 1997).

According to the theory of andragogy (Knowles et al., 2005), the adult learner must know why they must know a concept, which will likely motivate them to engage in the learning process. Furthermore, adults learn experientially, learn as problem solvers, and learn best when the topic is of immediate value to them. Moreover, adults should be engaged in the development of their own learning experiences. In addition, it is probable that adult learners may be highly confident and self-directed in one domain of learning, but dependent and hesitant about another (Knowles et al., 2005; Pratt, 1988). By including adults in the development, implementation, and evaluation of professional development education (e.g. needs assessment research), providers of professional development can offer timely and meaningful opportunities to stakeholders (Knowles et al., 2005; see Figure 2).

Therefore, it is critical to understand teachers’ professional development education needs in the area of agricultural mechanics laboratory safety for future professional development opportunities to be planned, delivered, and evaluated by teacher educators and state agricultural education leaders. Due to the limited amount of research regarding the agricultural mechanics laboratory safety needs of Tennessee agricultural educators and the continual need for research regarding professional development of these specialized teachers (Doerfert, 2011; Osborne, 2007), a current assessment of these needs was warranted.

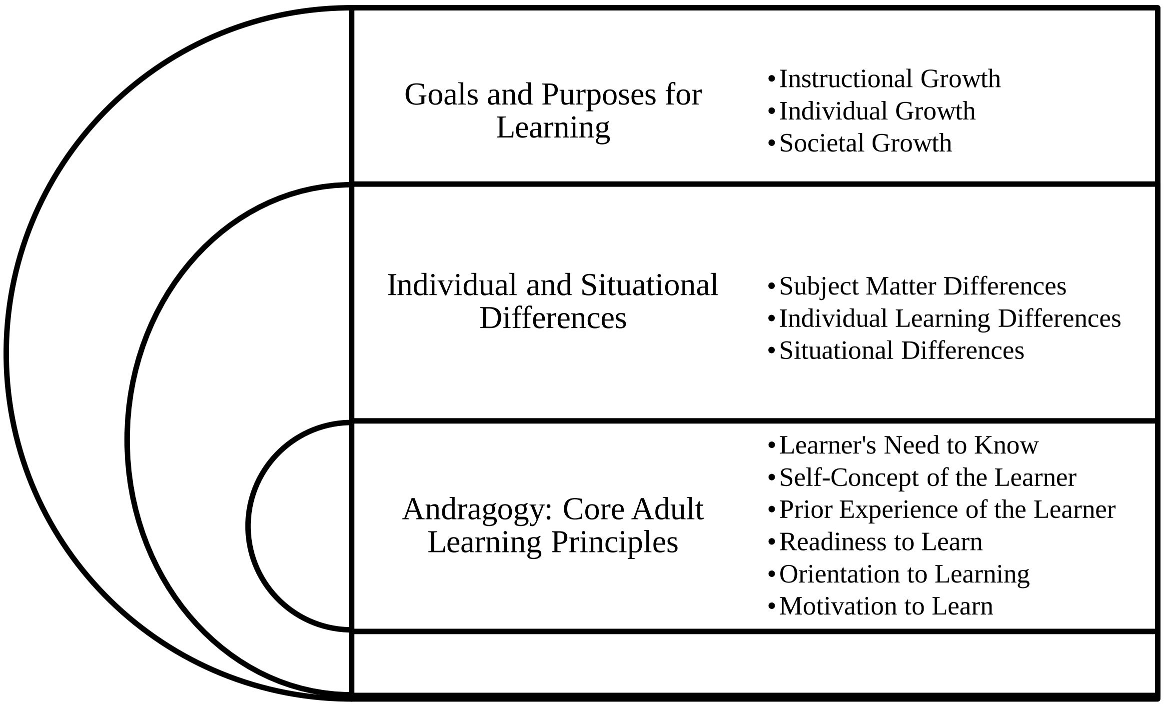

Figure 2. An illustration of andragogy in practice (Knowles et al., 2005).

Purpose and Research Objectives

This study was part of a larger study to determine the laboratory management in-service needs of school-based agriculture teachers in Tennessee. The purpose of this component of the larger study was to describe the laboratory safety professional development needs of agriculture teachers in Tennessee who teach within an agricultural mechanics laboratory. The following research objectives were investigated to accomplish this purpose:

1. Identify the personal and professional characteristics of Tennessee school-based agriculture educators who teach agricultural mechanics courses.
2. Identify the characteristics of agricultural education programs in Tennessee that offer agricultural mechanics courses.
3. Determine the professional development needs of Tennessee school-based agricultural educators, who teach agricultural mechanics courses, regarding selected agricultural mechanics laboratory safety competencies.

Procedures

Population

The population for this non-experimental, quantitative study was school-based agriculture teachers in Tennessee, who taught agricultural mechanics courses that utilized laboratories for instructional purposes during the spring of 2010. The *2009-2010 Tennessee Agricultural Education Directory* included a total of 317 school-based agriculture teachers. A census was conducted to more accurately describe the characteristics of the population and reduce potential errors associated with subject selection and sampling error.

Instrumentation

The data collection instrument developed by Johnson et al. (1990) from a previous study by Johnson and Schumacher (1989), and later modified by Saucier et al. (2009), was used for data collection in this study. To address the research questions of this study, a two-section instrument was utilized. The first section of the instrument consisted of a double-matrix (70 statements) that consisted of agricultural mechanics laboratory management competencies. A 5-point summated-rating scale, in a double matrix configuration allowed subjects to respond to each statement twice; once rating the perceived importance of each skill competency (1 = *No Importance*, 2 = *Below Average Importance*, 3 = *Average Importance,* 4 = *Above Average Importance*, 5 = *Utmost Importance*), and also rating the individual's ability to perform the skill competency (1 = *No Ability*, 2 = *Below Average Ability*, 3 = *Average Ability,* 4 = *Above Average Ability*, 5 = *Exceptional Ability*). The second section sought to identify personal, professional, and program demographic characteristics of the respondents and the agricultural education programs' in which they taught at (e.g., age, sex, ethnicity, years of teaching experience, highest degree obtained, largest student enrollment in an agricultural mechanics course, etc.)

The design and format of the data collection instrument was guided by the suggestions of Dillman (2007). To ensure face validity, the researchers used a web-based questionnaire design and delivery service, Hosted Survey™, to create and distribute the instrument to a panel of experts. The panel of experts (*n* = 6) consisted of one faculty member from one regional university in Tennessee, three doctoral graduate students with prior school-based agricultural education teaching experience, an agricultural education faculty member, and an agricultural education faculty member with expertise in instrument development and research methodology.

In 2009, Saucier et al. assessed content validity of their instrument using a panel of experts that consisted of agricultural education and agricultural systems management faculty members who judged the instrument to be valid. The panel further identified five constructs: laboratory and equipment maintenance; laboratory teaching; program management; tool, equipment, and supply management; and laboratory safety. This study used the exact competencies previously determined to be valid in the study conducted by Saucier et al. (2009); therefore, the constructs were considered to be valid.

Cronbach's alpha coefficients for the instrument used in this study were reported by Saucier et al. (2009) in a study of school-based agriculture teachers in the neighboring state of Missouri. Because coefficients for the scales (importance $\alpha = .97$; ability $\alpha = .97$) were acceptable ($\alpha > .80$), the instrument was considered appropriate for use in Tennessee. To ensure the reliability of the instrument for this study, the researchers conducted a *post hoc* reliability estimate using Cronbach's alpha coefficients for both scales (importance and ability) for the laboratory safety construct of the instrument. Reliability estimates of the scales (importance and ability) were .87 and .93 correspondingly (*n* = 78).

Methods

Dillman's (2007) data collection protocol was followed for this study. After five points of contact, a response rate of 24.60% (*n* = 78) was obtained. Nonresponse error was a concern; therefore, procedures for handling response bias were followed as outlined as *Method 1* in Lindner, Murphy, and Briers (2001). Respondents were dichotomously split into early (*n* = 39) and late (*n*

= 39) respondent groups (Miller & Smith, 1983), and served as the independent variable. The scales for laboratory safety—Importance and Ability—were used as the dependent variables. A multivariate analysis of variance (MANOVA) was used to compare the variables of interest. Box's test of equality of covariance was not significant (p = .194), which was an indicator that the assumption of equality of covariance was not violated (Field, 2009). Because "the Hotelling's T^2 is robust in the two-group situation when sample sizes are equal" (Field, p. 604), the results of the MANOVA were interpreted using Hotelling's T^2—Hotelling's trace statistic. There was not a significant effect of respondent group (early or late response) on the scales, T = .004, F (2, 75) = .164, p = .849, η_p^2 = .004. Therefore, external validity in the form of response bias did not threaten the generalizability of the findings of this study to the population (Lindner et al., 2001; Radhakrishna & Doamekpor, 2008).

Data Analysis

Data were analyzed using SPSS® version 18.0 for Windows™ based computers and Microsoft Excel®. In determining the appropriate analysis of the data, the primary guidance was scales of measurement as outlined by Ary, Jacobs, Razavieh, and Sorensen (2006). Research objective one sought to describe the characteristics of school-based agriculture teachers in Tennessee; thus, frequencies and percentages for gender, level of academic degree attained, and type of teacher certification program were calculated. In addition, mean and standard deviations were reported for demographics, including age, years of teaching experience, university semester credit hours earned in agricultural mechanics coursework, hours spent weekly supervising student work in the agricultural mechanics laboratory. For research objective two (characteristics of agricultural education programs in Tennessee that offer agricultural mechanics courses), mean and standard deviations were calculated for the following characteristics: annual student enrollment for agricultural mechanics courses, student enrollment per agricultural mechanics course, age of agricultural mechanics laboratory, and size of agricultural mechanics laboratory, etc.

Research objective three sought to prioritize the agricultural mechanics laboratory safety competencies in need of improvement, as perceived by school-based agriculture teachers in Tennessee. To determine the professional development needs of the respondents, the Borich (1980) needs assessment model was utilized to determine the discrepancy (importance level and ability level) for each competency. Mean weighted discrepancy scores (MWDS) were calculated for each competency using an Excel-based MWDS calculator (McKim & Saucier, 2011b). A large mean MWDS represents greater in-service needs, while smaller scores represent lesser in-service needs (Borich, 1980). See Figure 3 for an illustration of the MWDS formula.

$$\text{MWDS} = \frac{[(\text{Importance Rating} - \text{Ability Rating}) \times (M \text{ Importance Rating})]}{\text{Number of Observations}}$$

Figure 3. Mean Weighted Discrepancy Score formula (Borich, 1980).

Findings

Research Objective One

The average respondent was almost 42 (*M* = 41.77; *SD* = 11.33) years of age and had taught school-based agricultural education for more than 15 years (*M* = 15.13; *SD* = 10.86). Respondents indicated completing an average of 10 university semester credit hours of agricultural mechanics coursework (*M* = 10.63; *SD* = 8.39) in their degree program. Additionally, teachers reported that they supervised student work in the agricultural mechanics laboratory for an average rate of more than 10 hours (*M* = 10.05; *SD* = 7.74) per week (see Table 1).

Table 1. Selected Personal Demographics of School-based Agriculture Teachers in Tennessee (n = 78).

Characteristic	*M*	*SD*	Min	Max
Age	41.77	11.33	23	63
Years of teaching experience	15.13	10.86	1	42
University semester credit hours earned in agricultural mechanics coursework	10.63	8.39	0	36
Hours spent weekly supervising student work in the agricultural mechanics laboratory	10.05	7.74	0	45

To further describe the population, a summary of selected personal, professional, and program demographic characteristics of Tennessee school-based agriculture teachers were identified. The respondents consisted of 71 (91.00%) male teachers and 7 (9.00%) female agriculture teachers (see Figure 4). Of these teachers, 97.40% (*n* = 76) self-identified themselves as White or Caucasian; whereas, 2.60% of teachers self-identified themselves as Black or African-American. The greatest number (*f* = 42; 53.80%) of these teachers indicated that they possessed a master's degree and all respondents were certified to teach agricultural education (*f* = 78; 100.00%). Additionally, 96.20% (*n* = 75) of the respondents indicated that they completed a traditional agricultural education teacher certification program. See Table 2 for a more detailed summary of the results listed above.

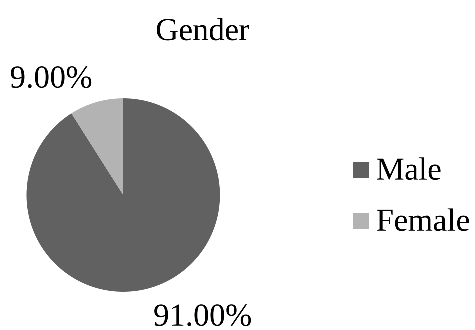

Figure 4. Gender of Tennessee school-based agricultural educators who manage an agricultural mechanics laboratory.

Table 2. Education Levels of School-based Agriculture Teachers in Tennessee (n = 78).

Degree Attained	*f*	%
Associates	1	1.30
Bachelors	30	38.50
Masters	42	53.80
Specialist	5	6.40

Research Objective Two

On average, annual student enrollment for agricultural mechanics courses was 63 students per year (*M* = 69.78; *SD* = 45.41). Respondents indicated the average student enrollment in the largest agricultural mechanics class was more than 21 students (*M* = 21.32; *SD* = 3.83). Teachers also reported, on average, the agricultural mechanics laboratory was slightly more than 24 years of age (*M* = 24.21; *SD* = 13.67) and 2,642 square feet (ft^2) in size (*M* = 2,642.28; *SD* = 1,995.85). Based on an average calculated from the largest number of students enrolled in an agricultural mechanics course and the size of the agricultural mechanics laboratory (ft^2), each student was provided with 123.37 ft^2 (*SD* = 78.19 ft^2) of laboratory workspace. Also, the average consumable budget for agricultural mechanics programs was $1,704.10 (*SD* = $1,648.65). Furthermore, the consumable budget spent per student in a Tennessee agricultural mechanics program was $30.25 (*SD* = $34.01). See Table 3 for an expanded summary of the results indicated above.

Table 3. Selected Program Demographics of School-based Agriculture Teachers in Tennessee (n = 78).

Characteristic	*M*	*SD*	Min	Max
Largest student enrollment in agricultural mechanics courses	21.32	3.83	10	26
Total student enrollment in agricultural mechanics courses	69.78	45.41	10	250
Size of agricultural mechanics laboratory (ft^2)	2,642.28	1,995.85	0	12,000
Size of agricultural mechanics laboratory work space per student (ft^2)	123.37	78.19	0	360
Age of the agricultural mechanics laboratory	24.21	13.67	0	50
Consumable budget ($)	1,704.10	1,648.65	0	8,000
Consumable budget ($) per student	30.25	34.01	0	229

The largest number of Tennessee school-based agricultural educators indicated that they instructed students at schools located in rural communities (*f* = 40; 51.30%) where total student enrollment in the agricultural education program was between 75 to 149 students (*f* = 41; 52.60%). Additionally, these teachers worked in a two-teacher agricultural education program (*f* = 31; 39.70%), and taught in a school that utilized a 4 x 4 block style class schedule (*f* = 40; 51.30%).

Research Objective Three

The construct *Laboratory Safety* was operationally defined by Saucier et al. (2009, p. 13) as “all activities that an agriculture teacher must perform to maintain a safe laboratory learning environment for students.” In the laboratory safety construct, the average MWDS was 1.97. In this construct, the laboratory management competency *administering first aid* ranked as the highest in-service need with a MWDS of 3.03. The laboratory management competency with the least need for in-service education in this construct was *arranging equipment in the agricultural* *mechanics lab to enhance safety/efficiency/learning* with a MWDS of -1.33. The remainder of the data are presented in Table 4.

Table 4. Mean Weighted Discrepancy Scores (MWDS) for Competencies Related to Laboratory Safety (n = 78).

			Importance		Ability	
Rank	Laboratory Safety Competencies	MWDS	$\overline{X}$	*SD*	$\overline{X}$	*SD*
1	Administering first aid	3.03	3.53	0.72	2.62	0.83
2	Maintaining the agricultural mechanics laboratory in compliance with Occupational Safety and Health Administration (OSHA) standards	2.81	3.42	0.78	2.60	0.83
3	Safely handling hazardous materials (e.g., flammables, acids, and compressed gas cylinders)	2.59	3.67	0.55	2.96	0.86
4	Correcting hazardous laboratory conditions	2.56	3.56	0.64	2.85	0.74
5	Properly installing/maintaining safety devices/emergency equipment (e.g., fire extinguishers, first aid supplies, machine guards, etc.)	2.47	3.38	0.71	2.65	0.79
6	Maintaining protective equipment for student use (e.g., safety eyewear)	2.35	3.40	0.63	2.71	0.79
7	Developing an accident reporting system	2.25	3.51	0.75	2.87	0.81
8	Providing students safety instruction	2.18	3.87	0.41	3.31	0.71
9	Selecting protective equipment for student use (e.g., safety eyewear)	2.11	3.58	0.73	2.99	0.78
10	Conducting regular safety inspections of the laboratory	2.09	3.40	0.65	2.78	0.77
11	Documenting student safety instruction	1.86	3.54	0.64	3.01	0.76
12	Maintaining healthy environmental conditions in the laboratory (e.g., temperature, light, ventilation)	1.45	3.14	0.73	2.68	0.71
13	Promoting laboratory safety by color coding equipment/marking safety zones/posting appropriate safety signs and warnings	1.22	2.81	0.82	2.37	0.88
14	Arranging equipment in the agricultural mechanics lab to enhance safety/efficiency/learning	-1.33	2.54	0.73	3.06	0.65
Grand mean rating for scales (Importance & Ability)			3.13	0.43	3.09	0.44
Average MWDS for the laboratory safety construct		1.97				

Note: Importance Scale: 1 = No Importance, 2 = Below Average Importance, 3 = Average Importance, 4 = Above Average Importance, 5 = Utmost Importance; Ability Scale: 1 = No Ability, 2 = Below Average Ability, 3 = Average Ability, 4 = Above Average Ability, 5 = Exceptional Ability.

Conclusions, Implications, and Recommendations

The purpose of this study was not to explicitly compare states, but to report baseline data and provide recommendations regarding the agricultural mechanics laboratory safety professional development needs of Tennessee agricultural educators. Because no known baseline data for minimum criteria for agricultural mechanics laboratories was known to exist, references to conclusions in similar studies were made when appropriate as points of reference.

Research Objective One

Tennessee school-based agriculture educators were, on average, of a greater age (M = 41.77; SD = 11.33) as compared to teachers in Wyoming (M = 37; SD = 10.60) and had more experience (M = 15.1; SD = 10.86) than similar populations in Missouri (M = 12.20; SD = 9.18 and Wyoming (M = 11.86: SD = 9.51 (Saucier et al., 2009; McKim & Saucier, 2011a). Tennessee school-based agriculture educators, on average, completed a similar number of university semester credit hours in agricultural mechanics coursework and supervised student work in the agricultural mechanics laboratory for a similar number of hours, as their colleagues in the neighboring state of Missouri, as reported in a recent study (Saucier & McKim, 2010). Other respondent characteristics from this study were different than those in other recent single-state studies related to agricultural mechanics. In comparison to other recent agricultural mechanics studies, a greater percentage of males participated in this study than in others, 91% of respondents were male; whereas, in other studies, male participants represented 70% to 78% of respondents (Saucier et al., 2009; McKim & Saucier, 2011a). Identifying the percentage of male school-based agriculture educators in Tennessee was not an objective of this study, but the notable difference from other similar studies may justify further investigation and expands the literature related to agricultural mechanics.

Research Objective Two

Recent studies conducted in Missouri by Saucier et al. (2009) and Saucier and McKim (2010) served as a point of comparison with Tennessee school-based agriculture programs. The Tennessee programs had, on average, a student enrollment of 21 students which was greater than the average enrollment of 16 students in Missouri, reported by Saucier, Terry, and Schumacher in 2009. The average consumable budget for agricultural mechanics programs in Tennessee was $1,704.10, considerably less than the average budget of $2,900 reported in Missouri (Saucier & McKim, 2010). Although the annual consumable budget was lower than those in comparable states, the disparity of the budget was more obvious when the budget for consumables was considered on a per student basis. The Tennessee per student consumable budget was approximately $30, in comparison to the nearly $53 consumable budget criticized by Saucier and McKim, (2010) who noted that agricultural mechanics laboratory budgets were not sufficient.

Trend data for Tennessee were not available, but if trends of larger class sizes and smaller agricultural mechanics laboratory size were similar to those in Missouri, it is likely that there are more students in less space. Given the similarities in the size of the facilities, similarity in facility age, and greater number of students enrolled (in comparison to other studies), Tennessee school-based agriculture educators were, arguably, more challenged on a daily basis than their colleagues in other states.

Research Objective Three

Administering first aid and maintaining the agricultural mechanics laboratory in compliance with OSHA standards had the greatest associated discrepancy, based on MWDS, therefore, the greatest need. An important consideration of basing agricultural mechanics laboratory safety compliance on OSHA standards is that OSHA standards are set on the assumption of workers possessing industry-level competence (Storm, 1993). Most secondary students do not possess industry-level competence (Storm); thus, ensuring agricultural mechanics laboratory safety is especially important.

When considering the abilities of Tennessee school-based agricultural educators, on average, teachers possessed an overall average ability to perform competencies related to laboratory safety. Although that should be reassuring, one may question whether teachers can accurately assess what they do not know. Despite the perceived average ability of Tennessee school-based agricultural educators, hazards exist in the agricultural mechanics laboratory and have been fatal (McKim & Saucier, 2011a). At what point do educators need in-service training? Perhaps more importantly, is average perceived ability acceptable?

Highly qualified has a different meaning when dealing with students' lives. Various interpretations of the requirements of *highly qualified* under the No Child Left Behind Act (2002) exist, but when an accident occurs in the agricultural mechanics laboratory, the agricultural educator is responsible for immediately administering first-aid. Therefore, competence in safety compliance and first-aid are critical. Only knowledgeable and well prepared agriculture educators can safely and effectively guide the development of practical, hands-on agricultural mechanics skills. It is unlikely that pre-service education has the capacity to address all discrepancies identified through needs assessment, but given the potentially grave importance and narrow scope of this needs assessment, it is recommended that a workshop should be developed to provide in-service teachers with remediation related to agricultural mechanics laboratory safety.

The teacher preparation curriculum in Tennessee should be scrutinized to ensure that the appropriate emphasis is placed on agricultural mechanics laboratory safety during pre-service teacher preparation. More importantly, pre-service education cannot provide everything in-service teachers will need in their careers. Thus, teacher educators must teach their students to embrace self-directed learning (Knowles et al., 2005), so that in-service teachers understand that it is their obligation to remediate or expand their knowledge when needs are identified.

In-service education is necessary to address discrepancies that exist between the teachers' perceived importance of agricultural mechanics laboratory safety competencies and their ability to perform the competencies. In-service education cannot address all discrepancies at once; therefore, pertinent and continuous in-service education should be facilitated each year and focus on one agricultural mechanics laboratory safety competency at a time beginning with the highest priority construct, laboratory safety. In a time when applied coursework has been reduced—in some cases to meet the requirements of *highly qualified* under the No Child Left Behind Act (2002) —mandating additional agricultural mechanics coursework to address the need for laboratory safety education during the pre-service teacher education program may not be realistic. Teacher educators must engrain the concept of self-directed learning (Knowles et al., 2005) in their students, so teachers understand that it is their obligation to remediate or expand their knowledge when needs are identified. To address this need for professional development education and laboratory safety in school-based agricultural education programs, the researchers recommend the following solutions for Tennessee agricultural education:

- Develop a robust and ever evolving professional development program (based on empirical research) for Tennessee school-based agriculture teachers who instruct agricultural mechanics, which would have a central focus on laboratory safety and pedagogy. Professional development programs should also be developed to incorporate aspects noted by Bandura (1997) and Knowles et al. (2005), e.g., reinforcement value, situational differences, and learners' need to know.
- Tennessee state agricultural education supervisory staff should aid teachers with periodic and thorough laboratory inspections to identify hazardous equipment, tools, and

conditions. Laboratory safety instruction, management, and maintenance should also be addressed during these inspections. Inspections, especially in regard to the instructional aspects, should not be approached from a punitive standpoint and should take into account situational and teacher differences (Knowles et al., 2005).

- The expectancy of success in a particular competency is greater when individuals see others with similar attributes succeeding (Bandura, 1997). Therefore, an agricultural mechanics mentor/mentee program should be developed between experienced teachers and novice teachers. This will give the novice teachers a network to seek out advice concerning the safe management of an agricultural mechanics laboratory and gain knowledge regarding student academic instruction within the laboratory.
- Periodic and timely technical professional development programs for Tennessee school-based agricultural education teachers should be offered during summer teachers' conference, during winter breaks, and as online modules for self-guided inquiry. Graduate-level agricultural mechanics courses should also be offered from several of the universities in Tennessee to enhance teacher education. Regardless of the location and time of the programs, it is imperative for program facilitators to express and reinforce the need for learners to know the competencies (Bandura, 1997).

Furthermore, it is important to recognize that the findings of this study must be restricted to those who participated and may not necessarily be reflective of all programs in Tennessee. Nonetheless, the results of this study provide previously unavailable baseline data to understand teachers' professional development education needs in the area of agricultural mechanics laboratory management in Tennessee.

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