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A Performance Competence-based Needs Assessment of Missouri School-based Agricultural Educators in Agricultural Mechanics Laboratory Management

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Abstract

This study investigated the laboratory management in-service needs of Missouri agriculture teachers who were responsible for managing agricultural mechanics laboratories. Teachers' performance competence was assessed using the Borich (1980) needs assessment model to determine the in-service needs of these teachers. Researchers found that teachers were in need of in-service education in numerous areas of laboratory management; however, the most needed areas regarded the handling, storage, and disposing of hazardous materials, administering first aid, and correcting hazardous conditions. Results indicated teacher educators and state supervisory staff should provide continuing education for teachers in the area of laboratory management through technical workshops, summer conferences, and university instructed graduate level courses.

Keywords: performance competence-based, needs assessment, Missouri, school-based, agricultural education, agricultural mechanics, laboratory management

Introduction and Literature Review

According to the National FFA Organization (2010) "…the shortage of qualified agriculture teachers is the greatest challenge facing FFA and agricultural education" (para. 2). Hence, it is imperative to establish and maintain a sufficient supply of well-prepared agricultural professionals (Doerfert, 2011). Such professionals include school-based agricultural educators who must possess the knowledge and skills needed to prepare a diverse workforce to address societal and industry challenges (Doerfert). Skills and knowledge required of these teachers far exceed those of secondary teachers who instruct other academic subject matter (Harlin, Roberts, Dooley, & Murphrey, 2007). These differences have been suggested to exist because school-based agricultural educators must possess the ability to use a variety of teaching methods, both in and out of the traditional classroom setting (Harlin et al., 2007). To help address these issues, teacher education programs should help new teachers reduce the barriers of utilizing laboratories for student instruction, make preparation less daunting, and maximize the impact of the laboratories for student learning (Langley & Kitchel, 2013; Shoulders & Myers, 2013).

One setting where a shortage of qualified teachers exists is in the curriculum area of agricultural mechanics (Wells, Perry, Anderson, Shultz, & Paulsen, 2013). This area of school-based instruction has been noted as a component of "any high quality agricultural education program" (Phipps, Osborne, Dyer, & Ball, 2008, p. 303). Based on a review of literature, agricultural mechanics courses are very popular school-based agricultural education courses offered in many states (Anderson, Velez, & Anderson, 2011). When utilized efficiently, the agricultural mechanics laboratory can provide an opportunity for students to actively engage in scientific inquiry and application (Osborne & Dyer, 2000), and affords students a venue to learn important psychomotor skills through the application of agricultural mechanics curriculum (McKim & Saucier, 2011b). According to a review of literature, planning and organizational skills were among the psychomotor skills needed by effective school-based agriculture teachers (Harlin et al., 2007). In addition to teaching psychomotor skills, teachers must implement skills to manage, maintain, and improve a laboratory (Roberts & Dyer, 2004).

Possessing skills in the psychomotor domain has been important for effective school-based agriculture teachers (Harlin et al., 2007) because the transfer of psychomotor skills from teacher to student were dependent on the teacher's proficiency in that skill (Osborne, 1988). If teachers lack competency in agricultural mechanics laboratory management, they will likely not be effectively able to guide students in developing essential psychomotor skills developed through the application of the agricultural mechanics curriculum (McKim & Saucier, 2011b). Johnson, Schumacher, and Stewart (1990) supported this idea and concluded that students learn important psychomotor skills in agricultural mechanics education and that much of the instruction takes place in the school agricultural mechanics laboratory.

Saucier and McKim (2011b) found in many school-based agricultural education programs, teachers instructed up to four courses per semester that included agricultural mechanics curriculum. Additionally, Shinn (1987) posited that up to two-thirds of the total instructional time in secondary agricultural education programs was devoted to laboratory instruction – many of which were utilized in the agricultural mechanics laboratory. For optimum student learning to occur, the agricultural mechanics laboratory must be a safe and well organized environment (Shinn, 1987), which is achieved through effective management (Saucier, Terry, & Schumacher, 2009). Consequently, Roberts and Dyer (2004) found that the ability to effectively manage, maintain, and improve laboratories is a characteristic of an effective agriculture education teacher.

With the amount of instructional time being spent in agricultural mechanics laboratories across the U.S. (Saucier & McKim, 2011; Shinn 1987), it is critical that agriculture teachers receive agricultural mechanics laboratory management training during pre-service and in-service (Burris, Robinson, & Terry, 2005). According to Hubert, Ullrich, Lindner and Murphy (2003), “If skill development is the focus of laboratory instruction, then thorough attention to all its components, including safety instruction, is essential” (p. 3). Johnson and Fletcher (1990) stated that agricultural mechanics students are exposed to equipment, materials, tools, and supplies that are potentially hazardous to health and that could cause injury or death. Burke (1986) described practices associated with efficient laboratory management and listed the regulation of environmental factors, control of consumable supplies, and storage of tools as areas that are important for efficient and safe management. Further emphasizing the importance of safety in the agricultural mechanics laboratory, Swan (1992) noted that instructional safety programs are a must, and therefore, should be of high priority to the instructor. In a study of Iowa teachers, Perry, Williams, & Anderson (2012) discovered that agricultural mechanics laboratories had several safety concerns that included the proper use of safety signage, the storage of gas cylinders, high noise levels, and the use of disconnect switches on arc welding machines. The most important responsibility of the instructor is to ensure the safety of the students. Therefore, many questions arise about the in-service educational needs of existing teachers in the U.S. and the preparation of future teachers in this critical need area of agricultural education.

Conceptual Framework

“Competency is an imprecise term” (Borich, 1979, p. 77), largely because the use of the term varies greatly in the literature. Often cited in agricultural education literature, Borich’s implications for developing teacher competencies (Borich, 1979) and a subsequent needs assessment model for multidimensional assessment of teacher competence (Borich, 1980), noted three perspectives of competency—knowledge, performance, and consequence: An individual’s

- Ability to accurately recall, paraphrase, or summarize the procedural mechanics of the behavior on a paper and pencil test [knowledge competence];
- Ability to accurately execute the behavior in a real or simulated environment in the presence of an observer [performance competence]; or
- Ability to elicit learning from pupils by using the behavior in the classroom [consequence competence]. (*Borich, 1980, p. 40)*

Borich (1979) further noted that assessing competency requires a criterion-based cutoff point to determine who is competent and who is not. Each of Borich’s (1980) definitions of competency become progressively more specific and should ideally be validated against student outcomes, which allows for synonymous use of the terms competency and validated competency (Borich, 1979). Unfortunately, validating competency with student outcomes is often difficult to achieve and in many instances impractical (Borich, 1980). Hence, Borich (1980) proposed a model for discrepancy analysis to prioritize in-service needs of teachers (see Figure 1.) A large mean MWDS represents greater in-service needs, while smaller scores represent lesser in-service needs (Borich, 1980).

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

Figure 1. The Borich Needs Assessment Model (Borich, 1980)

Numerous studies in the broader agricultural education literature have used the model to varying extents, since Borich's model was proposed in 1980; therefore, Borich's model was considered an appropriate conceptual framework for this study and served as a guide for the data collection efforts.

Theoretical Framework

When considering a teacher's efficacy (competence) in relation to a single item (competency), teachers may vary. More direct and unambiguous recommendations can be made by creating a list of competency statements, surveying in-service teachers to determine the importance of each competency to their job function, and their ability to perform each competency (Borich, 1980). Because these data were collected through a self-administered survey, rather than observational assessment, individuals are self-assessing their ability to perform a competency; thus, Bandura's (1997) theory of self-efficacy served as the theoretical framework for this study. Bandura (1997) defined self-efficacy as an individual's belief in their ability to "…organize and execute the course of action required to produce given attainments" (p. 3). This is important because it has been purported to influence an individual'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 educational research, including agricultural education, a more specific concept of self-efficacy known as teacher self-efficacy, has been noted to be an important concept of understanding teacher motivation in the classroom and laboratory (Knobloch & Whittington, 2002; Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998). Teacher-efficacy is a teacher's belief in one's ability to create desired outcomes—essentially, one's ability to teach others to execute the course of action required to produce given attainments, not necessarily one's own (Tschannen-Moran & Hoy, 2001). Because this study was focused on assessing agriculture teachers' performance competence of agricultural mechanics laboratory management, rather than teachers' ability to teach others to manage laboratories, self-efficacy was most relevant to guide the objectives of this study. See Figure 2 for an illustration of the theory of self-efficacy (Bandura, 1997).

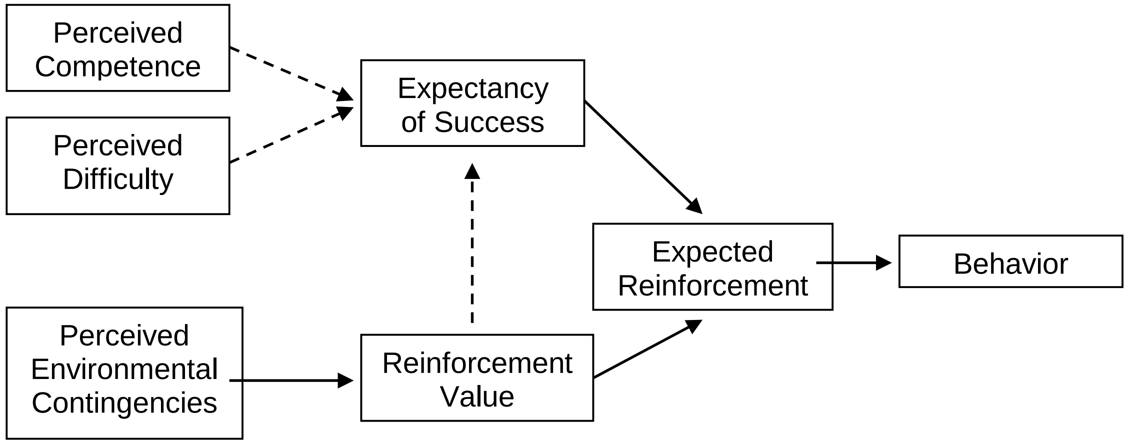

Figure 2. Theory of self-efficacy (Bandura, 1997)

Purpose and Research Questions

Agricultural education programs and the teachers responsible for those programs teachers must "…stay up-to-date with the ever-changing advancements in education and in the agriculture industry" (Doerfert, 2011, p. 25), which supports the idea that competencies needed in agricultural mechanics programs are not static (McKim & Saucier, 2011b). At the time of this study, nearly 20 years had passed since the competence and educational needs of Missouri school-based agricultural mechanics teachers had been assessed. Although several studies have been published in the past regarding the laboratory management professional development needs of agricultural mechanics teachers (McKim & Saucier, 2011b, 2012, 2013; Saucier & McKim, 2011; Saucier, Vincent, & Anderson, 2011), this study differs due to the fact that it focuses more acutely on combining theory of self-efficacy (Bandura, 1997) with professional development and utilizing the Borich (1980) needs assessment model to more holistically understand the professional development needs of this unique group of teachers. Due to the length of time since the original studies (Johnson & Schumacher, 1988) were conducted and the continual need for research regarding the professional development in-service needs of agricultural educators (Osborne, 2007), an assessment of current professional development needs of agriculture teachers was warranted.

In the state of Missouri, agricultural mechanics continues to be one of the most popular courses (T. Heiman, personal communication, September 2, 2008). Therefore, the purpose of this study was to describe the in-service needs of school-based agriculture teachers in Missouri who were responsible for managing an agricultural mechanics laboratory. The following research questions were investigated to accomplish this purpose:

1. What are the personal and professional characteristics of school-based agriculture teachers in Missouri who are responsible for managing an agricultural mechanics laboratory? These characteristics include: years of teaching experience, sex, university semester credit hours of agricultural mechanics coursework taken, hours spent supervising students in the agricultural mechanics laboratories per week, overall student enrollment in the agricultural mechanics program, and the largest student enrollment in an agricultural mechanics class.

2. What level of importance do agriculture teachers in Missouri, who are responsible for managing an agricultural mechanics laboratory, place upon selected competencies of agricultural mechanics laboratory management?
3. What are the self-assessed needs of agriculture teachers in Missouri, who are responsible for managing an agricultural mechanics laboratory, as related to selected competencies of agricultural mechanics laboratory management?
4. What are the in-service education needs of agriculture teachers in Missouri, who are responsible for managing an agricultural mechanics laboratory, as related to selected competencies of agricultural mechanics laboratory management?

Procedures

Population and Sample

The population for this study was all school-based agriculture teachers responsible for managing an agricultural mechanics laboratory (*N* = 424) in Missouri. Agricultural Education District Supervisors from the Missouri Department of Elementary and Secondary Education identified the members of the population for the researchers. Contact information was attained from the *2007-2008 Missouri Agricultural Education Directory* (Missouri Department of Elementary and Secondary Education, 2007). A simple random sample of 205 teachers was selected based on Krejcie and Morgan's (1970) recommendations for sample size.

Methods

This study was similar to research conducted by Johnson and Schumacher (1988), who surveyed teachers in the same state regarding agricultural mechanics laboratory management. The data collection instrument used by Johnson and Schumacher (1988) included 50 agricultural mechanics laboratory management competency statements developed with input from nationally recognized agricultural mechanics education experts (also see Johnson & Schumacher, 1989 and Johnson, Schumacher, & Stewart, 1990). Modifications to the 1988 instrument were necessary because 16 of the 50 competencies were essentially asking two or three competencies within each competency—*double* or *triple-barreled questions*. After splitting *double* or *triple-barreled questions*, the revised list included 70 competencies.

The two-section data collection instrument used in this study was based on the instrument developed by Johnson and Schumacher (1988) and guided by the design and format suggestions of Dillman, Smith, and Christian (2009). The first section of the instrument consisted of agricultural mechanics laboratory management competency statements in a double-matrix configuration. Importance of each competency was measured using a five-point summated rating scale: 1 = no importance, 2 = below average importance, 3 = average importance, 4 = above average importance, and 5 = utmost importance. Participants' self-perceived ability to perform each competency was measured using another five-point summated rating scale: 1 = no ability, 2 = below average ability, 3 = average ability, 4 = above average ability, and 5 = exceptional ability. The second section of the instrument was designed to collect relevant demographic information from the respondents. Data related to years of teaching experience, sex, university semester credit hours of agricultural mechanics coursework taken, hours spent supervising students in the agricultural mechanics laboratory per week, and student enrollment were collected.

The modified instrument was submitted to a panel of experts (*n* = 7) to assess face and content validity. The panel of experts was composed of four university faculty members, each with expertise in one of the following areas: agricultural systems management, agriculture teacher education, a teacher development, and research methods and data collection instrument design. Concluding modifications to the instrument, the instrument was deemed valid by the panel of experts. Additionally, the panel of experts identified five constructs from the 70 competencies through an iterative process: laboratory and equipment maintenance; laboratory teaching; program management; tool, equipment, and supply management; and laboratory safety. These constructs are defined in Table 1.

Table 1. Definitions of Agricultural Mechanics Laboratory Management Competency Constructs (Saucier et al., 2009).

Competency Construct	Definition
Laboratory and equipment maintenance	Maintenance activities that an agriculture teacher must perform to keep the laboratory and equipment in working order
Laboratory safety	Activities that an agriculture teacher must perform to maintain a safe laboratory learning environment
Laboratory teaching	Educational activities conducted in the laboratory by the agriculture teacher to ensure academic and vocational success
Program management	Activities conducted by the agriculture teacher to plan, guide, assess, and evaluate the agricultural mechanics program
Tool, equipment, and supply management	Activities conducted by the agriculture teacher to ensure that all tools, equipment, and supplies are secured and in proper quality and quantity to facilitate the learning process

A pilot test (*n* = 30) was conducted to determine the reliability of the instrument and was composed of randomly selected subjects from the target population who were not selected to be a part of the study sample. Cronbach's (1951) alpha coefficients were calculated for each scale (importance and ability), yielding coefficients of .95 and .97 (*n* = 16) respectively. The Cronbach's alpha coefficients for the five constructs identified by the panel of experts—laboratory and equipment maintenance; laboratory teaching; program management; tool, equipment, and supply management; and laboratory safety—ranged from .69 to .91 (*n* = 16). Using the data collected for this study, *post hoc* Cronbach's alpha coefficients were calculated for the scales (importance and ability), yielding coefficients of .97 and .97 (*n* = 110) respectively. Additionally, the Cronbach's alpha coefficients for the five constructs (*post hoc*) ranged from .87 to .90 (*n* = 110). These alpha levels were deemed to be acceptable indicators of instrument reliability (Nunnally & Burnstein, 1994).

Once validity and reliability were established, the instrument was administered to the study group. Utilizing Dillman, Smith, and Christian's (2009) recommendations for conducting mailed and Internet surveys, subjects were contacted five times via e-mail and U.S. mail. A final response rate of 55% (*n* = 110) was obtained. Non-response error was a relevant concern; therefore, procedures for handling nonrespondents were followed as outlined as *Method 2* in Lindner, Murphy, and Biers (2001). *Days to respond* were used as the independent variable in regression equations, where the primary variables of interest were regressed on the variable *days to respond*, which yielded no significant results (α = .05). Therefore, external validity did not threaten the generalizability of the findings of this study to the target population (Lindner et al., 2001).

Data Analysis

Data were analyzed utilizing SPSS 18.0 and a Microsoft Excel®-based mean weighted discrepancy score calculator developed by McKim & Saucier (2011a). Descriptive statistics were calculated for all agricultural mechanics laboratory management competencies and demographic characteristics of the respondents. For research question one, the mean and standard deviation were calculated for each demographic characteristic as needed. For research question two, three, and four, mean scores, discrepancy scores, mean weighted discrepancy score (MWDS), standard deviations, and rank were calculated for each agricultural mechanics laboratory management competency.

For research question four, the Borich (1980) needs assessment model was used to identify the performance competence needs of agriculture teachers in Missouri. To determine where discrepancies existed, two ratings had to be taken into account simultaneously for each competency. A discrepancy score was determined by taking the importance rating minus the ability rating for each respondent on each activity. A weighted discrepancy score was calculated by multiplying each discrepancy score by the associated mean importance rating. A mean weighted discrepancy score (MWDS) was calculated by taking the sum of the weighted discrepancy scores for each competency and dividing by the number of respondents (see Figure 1.)

To prioritize the competencies in need of attention, competencies were ranked, from high to low, using the mean weighted discrepancy scores. To prioritize the constructs in need of attention, a mean of MWDS ($\overline{x}_{\text{MWDS}}$) was calculated for each construct. Constructs were then ranked from high to low, using the $\overline{x}_{\text{MWDS}}$. Competencies or constructs with high MWDS, or $\overline{x}_{\text{MWDS}}$, indicated the areas needing the most improvement.

Findings

Research Question One

The average respondent taught school-based agriculture for 12 years. The respondents consisted of 86 (78%) male agriculture teachers and 24 (22%) female agriculture teachers. The average student enrollment in agricultural mechanics courses was 72 students per year. Furthermore, the average student enrollment in the largest agricultural mechanics course, as reported by teachers, was 16 students. Table 2 displays a summary of the selected demographic characteristics of Missouri agriculture teachers who manage an agricultural mechanics laboratory.

Table 2. Characteristics of Missouri School-based Agriculture Teachers Who Manage an Agricultural Mechanics Laboratory (n = 110).

Characteristic	M	SD
Years of agriculture teaching experience	12.20	9.18
University semester credit hours earned in agricultural mechanics coursework	11.30	9.81
Hours spent supervising students in an agricultural mechanics laboratory per week	9.44	7.21
Total students enrolled in agricultural mechanics courses per year	72.26	48.34
Student enrollment in the largest agricultural mechanics course	16.28	6.60

Research Question Two

Question two sought to describe school-based agriculture teachers' perceived levels of importance of selected competencies of agricultural mechanics laboratory management. Mean values of school-based agriculture teachers' perceived levels of importance of selected competencies ranged from 2.99 to 4.90. Providing students safety instruction (*M* = 4.90; *SD* = 0.33), documenting student safety instruction (*M* = 4.75; *SD* = 0.47), safely handling hazardous materials (*M* = 4.66; *SD* = 0.55), properly installing and maintaining safety devices and emergency equipment (*M* = 4.60; *SD* = 0.66), and correcting hazardous laboratory conditions (*M* = 4.56; *SD* = 0.58) were the top five competencies with the highest levels of importance; all of which were related to maintaining a safe laboratory environment for students. One competency had a mean importance value that was less than 3.0, and therefore, was perceived to have a below average level of importance: planning an agricultural mechanics public relations program (*M* = 2.99; *SD* = 1.04), and was related to activities that do not take place in the laboratory environment (see Table 3).

Table 3. Missouri School-Based Agriculture Teachers Perceptions of 70 Agricultural Mechanics Laboratory Management Competencies in rank order of MWDS (n = 110).

Rank	Competency	MWDS	Importance		Ability	
			M	*SD*	*M*	*SD*
1	Safely disposing of hazardous materials (e.g., flammables, acids, compressed gas cylinders).	3.90	4.52	0.68	3.69	1.01
2	Correcting hazardous laboratory conditions.	3.32	4.56	0.58	3.84	0.75
3	Administering first aid.	3.25	4.42	0.87	3.68	0.95
4	Diagnosing malfunctioning agricultural mechanics laboratory equipment.	3.11	4.33	0.74	3.60	0.79
5	Safely handling hazardous materials (e.g., flammables, acids, compressed gas cylinders).	3.09	4.66	0.55	4.04	0.87
6	Safely storing hazardous materials (e.g., flammables, acids, compressed gas cylinders).	3.03	4.56	0.63	3.90	0.91
7	Modifying facilities to accommodate students with disabilities.	2.97	3.88	0.97	3.08	1.01
8	Modifying equipment to accommodate students with disabilities.	2.97	3.75	1.04	2.99	1.01
9	Maintaining the agricultural mechanics laboratory in compliance with OSHA standards.	2.88	4.11	0.92	3.41	0.92
10	Conducting regular safety inspections of the laboratory.	2.76	4.27	0.69	3.66	0.76
11	Providing students safety instruction.	2.67	4.90	0.33	4.35	0.75
12	Documenting student safety instruction.	2.53	4.75	0.47	4.21	0.78
13	Developing procedures to facilitate the storage/checkout/security of tools/equipment.	2.50	3.87	0.85	3.26	0.80
14	Developing an identification system to deter tool/equipment theft.	2.43	4.05	0.82	3.45	0.89
15	Properly installing and maintaining safety devices and emergency equipment (e.g., fire extinguishers, first aid supplies, machine guards, etc.).	2.40	4.60	0.66	3.89	0.82
16	Making major agricultural mechanics laboratory equipment repairs (e.g., replace switches, bearings).	2.36	3.99	0.77	3.40	1.10

Rank	Competency	MWDS	Importance		Ability	
			M	*SD*	*M*	*SD*
17	Promoting laboratory safety by color coding equipment/marking safety zones/posting appropriate safety signs and warnings.	2.36	4.03	0.90	3.53	0.95
18	Developing an accident reporting system.	2.05	4.39	0.85	3.91	0.88
19	Arranging equipment in the agricultural mechanics lab to enhance safety/ efficiency/learning.	1.94	4.26	0.67	3.81	0.80
20	Developing a maintenance schedule for agriculture mechanics equipment.	1.87	3.82	0.77	3.33	0.85
21	Developing objective criteria for evaluation of student projects/activities.	1.71	4.03	0.73	3.60	0.78
22	Performing routine maintenance of agricultural mechanics laboratory equipment (e.g., adjust belt tension, lubricate moving parts, dress grinding wheels).	1.63	4.18	0.74	3.83	0.92
23	Enforcing a student discipline policy.	1.57	4.51	0.77	4.19	0.80
24	Developing educational projects/activities for students (e.g., project plans, skill sheets).	1.54	4.02	0.71	3.62	0.88
25	Making minor agricultural mechanics laboratory equipment repairs (e.g., replace worn belts, pulleys).	1.53	4.20	0.70	3.84	0.96
26	Developing a system to document achievement of student competencies.	1.51	3.82	0.81	3.41	0.88
27	Developing a procedure to insure proper agricultural mechanics laboratory clean up.	1.46	4.22	0.76	3.91	0.80
28	Developing a file of educational projects/activities for students.	1.46	3.93	0.71	3.55	0.81
29	Recognizing characteristics of quality tools/equipment.	1.36	4.20	0.68	3.87	0.85
30	Developing a procedure to bill students for materials used in project construction.	1.34	4.10	0.81	3.77	0.90
31	Maintaining protective equipment for student use (e.g., safety eyewear).	1.33	4.30	0.81	3.99	0.74
32	Operating within the constraints of an agricultural mechanics budget.	1.33	4.02	0.91	3.71	0.91
33	Maintaining a file of educational projects/activities.	1.24	3.90	0.73	3.58	0.84
34	Developing an agricultural mechanics laboratory budget.	1.20	3.94	0.85	3.63	0.84
35	Developing procedures for efficient storage/distribution of consumable supplies.	1.10	4.02	0.77	3.75	0.74
36	Equipping work stations for each skill area (e.g., cold metal, arc welding, small engines, electricity, etc.).	1.07	3.81	0.87	3.53	0.83
37	Selecting current references/technical manuals.	1.05	3.61	0.81	3.32	0.78
38	Updating agricultural mechanics course offerings.	1.05	3.71	0.87	3.43	0.88
39	Selecting protective equipment for student use (e.g., safety eyewear).	1.04	4.39	0.69	4.19	0.71

Rank	Competency	MWDS	Importance		Ability	
			M	*SD*	*M*	*SD*
40	Estimating time required for students to complete projects/activities.	1.02	3.66	0.77	3.38	0.83
41	Developing a written statement of agricultural mechanics laboratory policies/ procedures.	1.01	4.01	0.84	3.75	0.89
42	Developing a file of service/operator manuals for agricultural mechanics laboratory equipment.	1.01	3.88	0.83	3.65	0.82
43	Developing an adequate inventory of laboratory consumable supplies.	0.98	3.85	0.71	3.62	0.76
44	Maintaining a file of service/operator manuals for agricultural mechanics laboratory equipment.	0.91	3.87	0.80	3.67	0.84
45	Identifying current references/technical manuals.	0.88	3.59	0.78	3.35	0.76
46	Developing a student discipline policy.	0.86	4.34	0.84	4.18	0.77
47	Maintaining a student discipline policy.	0.86	4.40	0.83	4.19	0.77
48	Maintaining an adequate inventory of consumable supplies.	0.82	3.92	0.65	3.71	0.79
49	Identifying supplies required to teach agricultural mechanics skills.	0.74	4.08	0.71	3.94	0.77
50	Installing stationary power equipment (e.g., assembling equipment, connecting to a power source, performing preliminary adjustments).	0.73	3.69	0.75	3.49	0.96
51	Storing protective equipment for student use (e.g., safety eyewear).	0.70	4.06	0.87	3.85	0.75
52	Arranging for a professional service person to make major equipment repairs (e.g., replace switches bearings).	0.68	3.92	0.90	3.75	0.85
53	Making minor repairs to the agricultural mechanics laboratory facility (e.g., repair doors, windows, masonry).	0.67	3.66	0.89	3.48	0.98
54	Developing a rotational plan to move students through agricultural mechanics skill areas.	0.65	3.75	0.83	3.58	0.84
55	Conducting shop inventory (e.g., tools/equipment/consumable supplies).	0.65	4.02	0.79	3.82	0.80
56	Designating work stations for each skill area (e.g., cold metal, arc welding, small engines, electricity, etc.).	0.60	3.66	0.86	3.50	0.85
57	Identifying equipment required to teach agricultural mechanics skills.	0.55	4.08	0.74	3.94	0.78
58	Preparing bid specifications for equipment/tools/supplies.	0.54	3.74	0.81	3.59	0.84
59	Utilizing technical manuals to order replacement/repair parts for agricultural mechanics lab equipment.	0.53	3.90	0.86	3.76	0.92
60	Implementing student recruitment activities for the agricultural mechanics program.	0.43	3.39	1.01	3.29	0.85
61	Identifying tools required to teach agricultural mechanics skills.	0.36	4.07	0.75	3.98	0.84

Rank	Competency	MWDS	Importance *M*	Importance *SD*	Ability *M*	Ability *SD*
62	Conducting an agricultural mechanics public relations program.	0.35	3.23	1.11	3.12	0.97
63	Ordering equipment/tools/supplies.	0.28	3.80	0.83	3.73	0.86
64	Maintaining healthy environmental conditions in the laboratory (e.g., temperature, light, ventilation).	0.00	4.20	0.76	3.63	0.75
65	Developing computer based laboratory management reports (e.g., inventory, billing, accounting, purchasing).	0.00	3.43	1.02	3.39	1.00
66	Planning student recruitment activities for the agricultural mechanics program.	- 0.06	3.35	1.04	3.36	0.83
67	Maintaining computer based student academic records (e.g., grades, attendance, competency records).	- 0.24	3.74	0.99	3.81	0.96
68	Planning an agricultural mechanics public relations program.	- 0.27	2.99	1.04	3.08	0.84
69	Silhouetting tool/equipment cabinets.	-0.54	3.17	1.04	3.35	0.94
70	Constructing welding booths, work benches, storage areas, etc.	-0.80	3.66	0.88	3.88	0.88

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

Research Question Three

Research question three sought to describe school-based agriculture teachers' perceived ability to perform selected agricultural mechanics laboratory management competencies. Mean values of school-based agriculture teachers' perceived ability to perform selected competencies ranged from 2.99 to 4.35. Teachers' perceived themselves as possessing an average, or better, ability to perform 100% (n = 70) of the competencies. Furthermore, respondents also indicated that they had the highest ability to perform the competency providing students safety instruction (M = 4.35; SD = 0.75) and the least ability to perform the competency modifying equipment to accommodate students with disabilities (M = 2.99; SD = 1.01). Please see Table 3 for a display of the results.

Research Question Four

Research question four sought to prioritize the agricultural mechanics laboratory management competencies and constructs in need of improvement, as perceived by school-based agriculture teachers in Missouri. MWDS of agricultural mechanics laboratory management competencies ranged from 3.90 to -0.80. The top five competencies, with the highest MWDS, were related to laboratory safety, with the highest discrepancy (MWDS = 3.90) associated with *safely disposing of hazardous materials*. Two competencies—maintaining healthy environmental conditions in the laboratory and developing computer based laboratory management reports—had a MWDS of 0.00; therefore, no discrepancy existed. Five competencies (7.15%)—planning student recruitment activities for the agricultural mechanics program (MWDS = -0.06); maintaining computer based student academic records (MWDS = -0.24); planning an agricultural mechanics public relations program (MWDS = -0.27); silhouetting tool/equipment cabinets (MWDS = -0.54); and constructing welding booths, work benches, storage areas, etc. (MWDS = -0.80)—had negative MWDS and were considered negative discrepancies. The negative MWDS indicates that the school-based agriculture teachers' perceived ability to perform each competency was higher than the perceived levels of importance of the associated competency.

Additional data regarding school-based agriculture teachers' perceived levels of importance of agricultural mechanics laboratory management competencies, perceived ability to perform competencies, and MWDS of agricultural mechanics laboratory management competencies are presented in Table 3, ranked by MWDS. Grand means for importance of competencies, grand means for ability to perform competencies, and $\bar{x}_{MWDS}$ for agricultural mechanics laboratory management constructs are reported in Table 4.

Table 4. Missouri Agricultural Mechanics Laboratory Management Competency Constructs Ranked by $\bar{x}_{MWDS}$ (n = 110).

Rank	Competency Construct	$\bar{x}_{MWDS}$	Importance		Ability	
			$\bar{X}$	*SD*	$\bar{X}$	*SD*
1	Laboratory safety.	2.26	3.72	0.78	3.83	0.24
2	Laboratory and equipment maintenance.	1.54	3.72	0.75	3.55	0.28
3	Tool, equipment, and supply management.	1.34	3.80	0.81	3.67	0.20
4	Laboratory teaching.	0.96	3.82	0.93	3.80	0.35
5	Program management.	0.76	3.56	0.75	3.53	0.28

Overall, the MWDS ranged from a high of 3.90 for the competency safely disposing of hazardous materials to a low of -0.80 for the competency constructing welding booths, work benches, storage areas, etc. Sixty-five (92.85%) of the competencies possessed positive MWDS, whereas five (7.15%) received negative scores. Seven competencies studied possessed MWDS greater than 3.0. These competencies were related to laboratory and student safety, hazardous materials, and equipment repair.

The five competencies possessing negative MWDS were related to computerized student academic records, construction of laboratory projects, tool and equipment management, and student recruitment for the agricultural mechanics programs. Agricultural mechanics laboratory management constructs in need of improvement were ranked from high to low using the $\bar{x}_{MWDS}$. Laboratory safety was the construct most in need of improvement ($\bar{x}_{MWDS} = 2.26$), followed by laboratory and equipment maintenance ($\bar{x}_{MWDS} = 1.54$), tool, equipment, and supply management ($\bar{x}_{MWDS} = 1.34$), and laboratory teaching ($\bar{x}_{MWDS} = 0.96$). Program management ($\bar{x}_{MWDS} = 0.76$) was the construct least in need of improvement. See Table 4 for a display of the results.

Conclusions

Research Question One

In this study, researchers desired to understand the demographic characteristics of the respondents. The majority of Missouri agriculture teachers who managed school-based agricultural mechanics laboratories were male (78%) and had more than a decade of teaching experience (*M* = 12.20). Teachers devoted nearly 10 hours a week (*M* = 9.44) instructing and supervising students in the agricultural mechanics laboratory and had more than 70 students per year (*M* = 72.26) enrolled in classes that utilized an agricultural mechanics laboratory for educational purposes. Additionally, these teachers had earned almost 12 hours of university semester credit hours (*M* = 11.30) in agricultural mechanics courses at the post-secondary level and had on average, an enrollment of 16 students (*M* = 16.28) in their largest sized agricultural mechanics course.

Research Question Two, Three, and Four

Research question two sought to describe school-based agriculture teachers' perceived levels of importance of selected competencies of agricultural mechanics laboratory management. Respondents indicated that the most important laboratory management competencies were related to safety instruction (students safety instruction, documenting student safety instruction), hazardous materials (safely handling hazardous materials), and general laboratory safety (properly installing and maintaining safety devices and emergency equipment, and correcting hazardous laboratory conditions).

Investigators sought to describe school-based agriculture teachers' perceived ability to perform selected agricultural mechanics laboratory management competencies in research question three. Respondents indicated that they had the highest ability to perform competencies related to safety instruction (providing students safety instruction*)* and the least ability to perform the competencies related to teaching students with disabilities (modifying equipment to accommodate students with disabilities).

Research question four sought to prioritize the agricultural mechanics laboratory management competencies and constructs in need of improvement, as perceived by school-based agriculture teachers in Missouri. The top five competencies, with the highest MWDS, were related to laboratory safety (safely disposing of hazardous materials, correcting hazardous laboratory conditions, administering first aid, diagnosing malfunctioning agricultural mechanics laboratory equipment, and safely handling hazardous materials). Furthermore, the study also indicated that respondents had professional development needs in all competency constructs.

Implications & Recommendations

Across the U.S., enrollment in agricultural mechanics courses classes are increasing and ever popular (Anderson, et al., 2011), including Missouri secondary schools (Missouri Department of Elementary and Secondary Education, 2008). Due to popularity and the potential dangers and hazards that exist in agricultural mechanics laboratories, pre-service and in-service education programs are critical and must be provided for teachers who manage these facilities (Burris et al., 2005). Based upon the conclusions from this study, it can be posited that the need for laboratory management education exists among Missouri teachers.

The findings of this study can be interpreted and possibly better understood by using the theory of self-efficacy (Bandura, 1997) as guidance. When considering a teacher's efficacy (competence) in relation to a single item (competency), teachers across varying career and experience levels may differ. To better understand a teacher's competence, researchers often utilize a more specific concept of self-efficacy known as teacher self-efficacy. This concept has been noted to be an important method to understand teacher motivation in the classroom and laboratory (Knobloch & Whittington, 2002; Tschannen-Moran et al., 1998). Teacher-efficacy is a teacher's belief in one's ability to create desired outcomes—essentially, one's ability to teach others to execute the course of action required to produce given attainments, not necessarily one's own (Tschannen-Moran & Hoy, 2001). Based upon the findings of this study, implicative questions should be considered. Since actual or observed ability of the participants were not assessed and therefore is unknown, should future studies be conducted to determine if differences exist between needs assessments based on self-perceived and actual or observed abilities? If differences do occur, why do participants identify with self-perceived abilities different from their actual abilities? Additionally, should school administrators observe teachers instructing in laboratories to ensure that competence related to laboratory management competencies is adequate? Could a laboratory inspection conducted by school administrators and/or OSHA officials help gauge the mastery of these laboratory management competencies? These implicative questions and others provide the ground work for future research in this popular curriculum area of agricultural education.

Although "in-service education cannot address all discrepancies at once; pertinent and continuous in-service education should be facilitated each year and focused on one agricultural mechanics laboratory management competency at a time, beginning with the highest priority construct…" (McKim & Saucier, 2011b, p. 84). The authors suggest that teacher educators and state supervisors in Missouri design in-service programs that address the top five needed agricultural mechanics laboratory management competencies found in this study (safely disposing of hazardous materials, correcting hazardous laboratory conditions, administering first aid, diagnosing malfunctioning agricultural mechanics laboratory equipment, and safely handling hazardous materials). By offering programs to remediate these professional development needs, public school agricultural mechanics laboratories should be safer places for students to learn and master agricultural mechanics skills. The authors also suggest that periodic inspection of these laboratories occur from state supervisory staff and/or school administrators.

In-service programs should be offered to teachers with frequency and variety in mind and should be delivered in formats and at times that will have the greatest impact upon the largest number of teachers. Similar suggestions were recently made in a study by Perry et al. (2012) regarding program improvement and laboratory safety. The goal of in-service education for existing teachers could be accomplished by providing workshops offered during the winter and summer breaks, and for graduate level or continuing education credit. Online, self-directed courses should also be considered as another option for teachers seeking professional development opportunities. Winter and summer workshops focusing on agricultural mechanics laboratory management should be offered at regional locations throughout the state of Missouri and could be located at university or public school facilities. Industry partnerships should also be investigated to determine if industry-delivered workshops can adequately meet the in-service needs of these teachers giving another avenue for in-service.

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