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Agricultural Mechanics Lab Safety Practices in South Texas

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Abstract

A pressing concern in all agricultural mechanics courses is safety. Lab activities have an inherent propensity to cause serious injury. The safety practices which are taught by teachers are largely dependent on the equipment in the laboratory and the resources available to the program. Various researchers have indicated that problems have existed in the safety instruction of agricultural mechanics for some time. This study sought to determine how safety is taught, what equipment instructors use and attitudes towards teaching safety of agricultural mechanics teachers. The majority of instructors were certified in first aid and felt confident to use that training in the event of an emergency. The average teacher was found to teach high enrollment labs and furnished at no cost to the student eye protection in the form of safety glasses with side shields. It was found that teachers agreed that safety instruction in the lab was important, especially involving power tools, electricity, and industrial quality eye protection. Agricultural programs should be evaluated regularly for inadequate conditions that may exist in facilities, equipment, and safety. Additional research is needed targeting what barriers potentially exist with teachers using recommended safety practices in the instruction of agricultural mechanics.

Keywords: agricultural mechanics; safety practices; agricultural science teachers.

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Introduction

Among the myriad of responsibilities affixed upon the shoulders of agricultural mechanization teachers, the most pressing responsibility is maintaining laboratory safety. Laboratory activities such as metal working, agricultural machinery repair, and wood working have an inherent propensity to cause serious injury or death to the students and instructors. With that said, it is imperative that teachers maintain a high regard for safety by providing adequate supervision to students working in the laboratory, and teaching students safety procedures to follow when working with tools and equipment. Saucier and McKim (2011) indicated that the largest areas of need for preservice teachers in Texas were repairing and maintaining equipment and safety in the laboratory. Although, ensuring student safety is a moral obligation of agricultural mechanics

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teachers, failure to properly maintain a safe working environment can be associated with legal ramifications for teachers (Gliem & Hard, 1988).

According Phipps, Osborne, Dyer and Ball (2008), laboratory activities constitute a large part of most agricultural education programs. Agricultural laboratories serve many purposes and provide inquiry-based learning environments for students. Along with traditional agricultural mechanics laboratories, secondary agricultural programs utilize laboratories such as greenhouses, aquaponics centers, and livestock facilities. Each laboratory possesses unique dangers, but due to the nature of agricultural mechanics laboratories, injuries in these labs are commonplace. One aspect of agricultural mechanics which heightens the propensity for injuries is student-based construction.

At an industry standpoint, construction is also one of the most dangerous industries in the world (Brunette, 2004; Cheng, Lin, & Leu, 2010). There are many job practices in the realm of agriculture mechanics which intersect with practices in the construction industry (e.g., use of power tools, metal fabrication, etc.). Schoonover, Bonauto, Silverstein, Adams, and Clark (2010) noted these industries were particularly dangerous because workers lack the appropriate safety training. Furthermore, Pinto, Nunes, and Ribeiro (2011) indicated a lack of occupational risk assessment (ORA) and safety culture among future employees in these industries.

In regard to both industry and educational settings, enhancing safety climate in work and learning environments is vitally important. Cultivating a culture of safety in students early is a key to reducing laboratory-based injuries (Gillen, Goldenhar, Hecher, & Schneider, 2013). Along with safety climate, Torner and Pousette (2009) added that project characteristics and individual competencies/attitudes are main components contributing to safety standards. Agricultural mechanics, a facet of career and technical education (CTE), aims to prepare students for future careers in various industries. Exposing students to a culture focused on safety in the school setting can bolster students' competencies of safety, and can result in reduced future workforce injuries.

A multitude of previous studies have noted that agricultural education preservice teachers' fail to receive adequate laboratory safety education prior to their first year of teaching (Dyer & Andreasen, 1999; Swan, 1992). The adequacy of teacher preparation programs providing pre-service safety education is important. One possible culprit of the problem is the reduction of credit-hours in undergraduate programs, restricting the implementation of additional agricultural mechanics courses which address safety issues. In support of this notion, Burris, Robinson, and Terry (2005) found that teacher preparation professionals believed agricultural mechanization instruction was important in pre-service programs, yet they indicated the pre-service teachers received less than adequate instruction for the duties they would encounter as a teacher. On the other hand, Lawver (1992) posited that teachers were using recommended safety practices, but failed to provide the practices to the extent warranted when working in a dangerous environment. Along with the noted shortcomings of teachers in regard to knowledge and application of shop safety, Walter (2002) noted agricultural laboratories are lacking in the following areas: appropriate posting of warning signs, appropriate implementation of safety inspections, and the use of proper personal protective equipment (PPE).

According to Bear and Hoerner (1986), (1) identifying the safety practices taught, (2) the instructional methods by which the teacher informs their students of safety practices, and (3) an investigation of available safety equipment are the three components which must be observed to assess the safety of an agricultural mechanics laboratory. The instructional methods used to teach safety practices varies from teacher-to-teacher. The most common instructional methods used in agricultural mechanics are demonstrations, worksheets, and videos (Dyer & Andreason, 1999;

Lawver, 1992). Burris et al. (2005) noted the demonstration of safety techniques was essential in laboratory settings. In agreement with Burris et al., Harper (1984) found that when teachers demonstrated appropriate safety practices, students were more safety conscious and demonstrated a deeper understanding of safety.

The safety practices which are taught by teachers is largely dependent on the equipment in the laboratory and the resources available to the program. Aside from instruction of safety procedures taught about specific equipment, eye protection safety has been previously noted as a topic which is commonly addressed with high priority (Chumbley, 2015; Lawver & Fraze, 1995). Similar to safety instruction on equipment, training students about PPE is contingent on the tools and machinery used in the agricultural mechanics laboratory. In a laboratory safety practices study conducted in New Mexico, Chumbley (2015) found that industrial quality eye protection, welding gloves, hearing protection, and a shop coat were the most commonly used PPE in the agricultural education laboratory.

To mitigate the unemployment rates in the South United States, and the predominantly Hispanic population living within these areas, technical training is needed to prepare the workforce for the industries (agriculture, construction, engineering, and manufacturing) with projected growth. One such training entity, which equips individuals with the knowledge and soft skills to excel in various industries, is Career and Technical Education (CTE). More specifically, the CTE cluster of Agriculture, Food, and Natural Resources (AFNR) within Agricultural Mechanics that provides students with vocational training for industries such as agriculture, construction, metal fabrication, mechanical skills, woodworking, and agricultural engineering.

While teachers have rated teaching safety as a high priority, their knowledge concerning the management of an agricultural mechanics laboratory has shown to be low. As previously noted, Saucier and McKim (2011) identified laboratory safety and instruction as an area of professional development need for Texas teachers. Approximately 80% of Texas high school agricultural science programs offer some type of agricultural mechanics course (January 2017, Texas State FFA personal communication). To determine the structure of professional development to bolster teachers' ability to teach laboratory safety, it is first important to determine how safety procedures are currently being taught in Texas programs. Hence, there was a need to examine the agricultural safety and laboratory management practice of south Texas teachers. Determining the methods teachers use to provide safety instruction, safety procedures implemented, and personal protective equipment used assist teacher educators and state leaders in providing appropriate training and in-service instruction to their stakeholders. The need for providing effective professional development is called for in the National Research Agenda for Agricultural Education, Research Priority Five: Efficient and Effective Agricultural Education Programs. Thoron, Myers, and Barrick (2016) noted "research in the context of agricultural education… is needed to evaluate the effectiveness of these established professional development attributes and can greatly improve the body of knowledge on effective professional development" (p. 45). Along with these aspects contributing to effective professional development, the ultimate benefit of this research was to provide a safer learning environment for students and instructors in agricultural mechanics laboratories.

Theoretical Framework

The theoretical framework for this study was based around the theory of planned behavior (Azjen, 1985), which is an extension of the theory of reasoned action (Fishbein & Azjen, 1975; Azjen & Fishbein, 1980). Fishbein and Azjean's (1975) theory of reasoned action grew out of the need to better understand behavior because of motivational stimuli (Madden, Ellen, & Ajzen, 1992). Researchers compared and analyzed both theories for ". . . 10 behaviors chosen to represent a range with respect to control over performing the behavior" (Madden, Ellen, & Ajzen, 1992, p. 3). There were two hypothesis analyzed, ". . . the inclusion of perceived behavioral control would significantly enhance the prediction of intentions and target behavior, [and] . . . that the enhancement in the prediction of target behavior would be related to the magnitude of perceived behavioral control" (Madden, Ellen, & Ajzen, 1992, p. 3-4), with both hypothesis supported by the data. Resulting from the research, it was theorized that the theory of planned behavior is superior to the theory of reasoned action when predicting target behavior (Madden, Ellen, & Ajzen, 1992). However, both theories were designed to demonstrate the connection between the influences of information and motivation on performance (Connor & Armitage, 1998).

It is suggested through the planned behavior theory that an individual's values and beliefs are influenced by knowledge and demographic variables, which influence attitude, intention, and behavior (Chumbley, 2015). The confidence levels of agricultural teachers and their success in teaching laboratory safety are impacted by both the theory of planned behavior and the theory of reasoned action. Behavior is seen as a function of intentions and control, which is represented in the theory of planned behavior (Azjen, 1991). Additionally, those motivational factors that indicate an exertion of effort to perform a behavior are correlated with how hard people are willing to try. This can be linked to the confidence of teachers and Bandura's self-efficacy theory (Bandura, 1984), where their "Self-efficacy can enhance or impair performance through their effects on cognitive, affective, or motivational intervening processes (Chumbley, 2015, p. 4). When an individual has a low self-efficacy level regarding a task, it is highly likely that their success will be low, but when they have perceived a higher level of self-efficacy, then the likelihood for success is considerably higher (Bandura, 1997).

Both theories imply that the experiences and characteristic behaviors of teachers of agricultural mechanics can impact their resolutions to properly teach the safety aspects and standards, as well as the extent to which they deliver the safety instruction in their courses. An understanding of these experiences and characteristic behaviors will allow researchers an enhanced opportunity to determine successful teacher implementation of safety in their courses (Chumbley, 2015).

Purpose and Objectives

The purpose of this study was to identify the safety practices of South Texas agricultural science teachers, specifically focusing on underrepresented teacher populations, for teaching safety and managing an agricultural mechanics laboratory environment. The following objectives guided this study:

1. To determine demographic and safety characteristics of south Texas agricultural science teachers.
2. To determine the availability of selected safety equipment and emergency items in south Texas agricultural mechanics laboratories.
3. To identify the instructional methods and materials used by teachers to teach agricultural safety.
4. To investigate perceptions held by south Texas agricultural science teachers concerning the importance of agricultural mechanics safety instruction and practices.

Methods

The target population for this descriptive study was South Texas secondary agricultural science teachers who offered an agricultural mechanics component within their programs. The majority of these teachers (82%) identify as Hispanic, an underrepresented population in national agricultural education (Roberts et al., 2009). A list of teachers was obtained from the Texas public education department. Dillman's Tailored Design Method (2007) guided the collection of data and correspondence with census participants. The researcher identified individuals from Texas Area X FFA association for the sample population. The Texas FFA Association is comprised of 12 administrative subdivisions (i.e., areas). In general, the areas are separate geographic regions which are realigned every 10 years based on student membership. In fact, in 2016, the Texas FFA added two additional areas, transitioning from 10 to 12 areas. Area [#], located in south [STATE], is comprised of 27 counties, 95 FFA chapters, and over 10,000 FFA members (Texas FFA Association, 2016).

The Area [#] region included 192 agricultural science teachers, of which 172 teachers taught at least one agricultural mechanics course. Those teachers who identified themselves as teaching at least one course in an agricultural mechanics laboratory (N = 172) were asked to complete the survey. Teachers were asked to complete an online survey through Surveymonkey, an online survey software tool. Subjects were contacted up to five times through e-mails from the researcher. There were 118 respondents to the survey, resulting in a response rate of 69%. To control for non-response error, the responses of early respondents were compared to responses of late respondents (Miller & Smith, 1983). Similar to Connors and Elliot (1994), a comparison of the two groups was assessed using t-test on Likert-scale items, which revealed no significant ($p < .05$) differences between the two groups.

The instrument used for this study was one previously employed by Lawver (1992) to assess safety practices of teachers in [STATE]. This instrument is a modified version of an original instrument developed by Hoerner and Kessler (1989). The instrument used in this study has been successfully exercised in similar studies of other states (Johnson & Fletcher, 1990; McKim & Saucier, 2011; Chumbley, 2015). To ensure face and content validity a panel of experts (N = 9) consisting of five university faculty and four agricultural science teachers were consulted. Recommendations to update language in the instrument were considered and integrated into the instrument. Cronbach's alpha coefficients were used to measure internal consistency in order to establish reliability. The data revealed a reliability Cronbach's alpha coefficient of .823, exceeding the appropriate reliability threshold ($\alpha = \geq .70$) posited by Fraenkel and Wallen (2000).

Part one of the instrument focused on demographic information and the safety materials most readily used and available in the agricultural science laboratory. This included information about years of teaching experience, college hours in agricultural mechanics, number of students enrolled in the program, what certifications the teacher had received concerning safety and average number of courses taught. The instrument also sought to identify the number of major and minor accidents that occurred in the agricultural mechanics laboratory. Injuries in the lab can vary greatly based on the type of work being performed and environment. Major injuries were characterized as injuries that resulted in a student not being able to effectively perform laboratory duties for more than one day after the injury. Examples provided to teachers included second degree burns, concussions, major falls, and broken bones. The researcher felt this was important as employers with 10 or more employees are required by the Occupational Safety and Health Administration (OSHA) to report similar information.

The second section of the survey instrument solicited responses concerning most commonly used safety practices and instructional methods utilized for teaching safety. The teachers were asked to indicate the availability and use of PPE in their shop. More specifically, teachers were asked about the types of eye protection (e.g., full face shields, spectacles, goggles) and general PPE items (e.g., hearing protection, gloves, jackets, respirators, hard hats, or steel toed boots) most frequently used in the school shop. The instrument also inquired if the PPE was school furnished or student furnished. The second section of the survey also sought to determine the instructional strategies and materials used by the teachers to teach safety. For example, teachers were asked "where do you devote the most time in teaching safety in agricultural mechanics?" and "what teaching materials do you use to teach safety?"

This section of the survey concluded with questions pertaining to teacher's perceptions of safety in the agricultural mechanics laboratory. On a five-point Likert-Type scale (1 = *little importance* to 5 = *highest importance*), the agricultural mechanics teachers were asked to indicate their perceived importance of agricultural safety instructional topics (e.g., teaching power tool safety, administering safety exams, teaching electrical safety). On the same five-point scale, teachers were asked to report their perceived preparedness to teach safety related to various topics (e.g., developing safety posters, teaching about state safety laws or welding exhaust systems).

Findings

Objective One

The first objective was to describe characteristics of the South Texas agricultural mechanics programs and of the teachers who were supervising these programs. As stated earlier in the manuscript, 82% of the respondents identified as Hispanic. The average respondent had 12 years teaching experience with the most novice teacher having six months of teaching experience and the most senior having 39 years of teaching experience. Table one illustrates the average number of college agriculture mechanics courses teachers had taken.

Table 1

Frequency of College Agricultural Mechanics Course Enrollment (n = 118)

Number of Courses Taken	*f*	%
None	9	7.63%
1	10	8.47%
2	15	12.71%
3	23	19.49%
4	27	22.88%
5 or more	34	28.81%

Teachers taught an average of one (*n* = 20; 16.95%), two (*n* = 20; 16.95%), three (*n* = 29; 24.58%), four (*n* = 19; 16.1%), five (*n* = 12; 10.17%) and six or more (*n* = 18; 15.25%) of agricultural mechanics courses per semester. Thirty-one percent of the Texas Agricultural Science Teachers reported having liability insurance (i.e., up to $100,000), 54% of the teachers were unsure if they were covered, and 15% indicated they had no liability insurance at all. All programs surveyed had some type of separate agricultural mechanics lab with the average size ranging from 1,000 to 2,000 square feet. Table two describes additional characteristics of the agricultural mechanics programs.

Table 2

Characteristics of the Agricultural Mechanics Programs (n = 118)

Characteristic	*M*	*Min*	*Max*
Number of students in agricultural mechanics program	192	22	600
Average class size	18	4	30

We found that 60% (*n* = 71) of teachers were certified in first aid compared to 40% (*n* = 47) who were not. Of those trained in first aid, 88% of teachers felt confident to use that training in an emergency. The two most common safety certifications teachers had received included the National Center for Construction Education and Research (NCCER) and Occupational Safety and Health Administration (OSHA) safety certifications. Some other safety certifications teachers identified included university safety certifications and American Welding Society (AWS). Teachers felt "moderately" to "very well prepared" (*n* = 112, 94.92%) to provide safety instruction within their classes. It was found that 56% (n = 66) of teachers kept a written report of all accidents in their lab.

Objective Two

Objective two was to determine the availability of selected safety equipment and emergency items in south Texas agricultural mechanics laboratories. Teachers were also asked to respond to the use of eye protection in their educational laboratories. Full face shields and Spectacles (ANSI Z87+) with side shields were the most common types of eye protection found in the laboratory environment. Most teachers were found to provide eye protection to the students at no cost. It was found that 83% of programs stored safety glasses in the lab either by use of a commercial cabinet or custom made storage device, the remaining programs had students store glasses on their own and bring to class. The types of eye protection most often found in the agricultural mechanics lab and how teachers managed their use are listed in table three.

Table 3

Teachers' Use of Eye Protection in the Agricultural Mechanics Lab (n = 118)

	f	%
Most Common Types Used		
Full Face Shields	103	92.79
Spectacle with Side Shields	86	77.48
Goggles	79	71.17
Spectacles without Side Shields	52	46.85
How is Eye Protection Provided		
School Furnished at No Cost to Student	103	92.79
Students Furnish Their Own	8	7.21

The researchers found that teachers had an extensive amount of available safety equipment in the lab. The most prevalent items found in the lab include industrial quality eye protection, welding gloves and welding aprons or jackets. The least common safety items found were hard hats, steel toed boots and fire resistant shirts. Table four provides information about what safety items were available in the laboratory to students.

Table 4

Frequency and Percentages of Available Safety Equipment (n = 118)

Safety Items	*f*	%
Industrial Quality Eye Protection	107	96.40
Welding Gloves	106	95.50
Welding Apron or Jacket	94	84.68
Hearing Protection	83	74.77
Shop Coat or Overalls	53	47.75
Respirators	41	36.94
Hard Hats	21	18.92
Steel Toed Boots	11	9.91

Other safety items provided in the lab included welding sleeves, steel toed boots, and donated old welding shirts. The most common safety materials and practices involved the use of fire extinguishers, industrial quality eye protection, welding gloves, properly marked exits, fire alarms, and eye wash stations. Safety posters, marked safety zones, and fire blankets were the least common safety materials found in the agricultural mechanics laboratories.

Objective Three

The third objective sought to identify the instructional methods and materials used by teachers to teach agricultural safety. Teachers were found to devote a range of times to teaching safety, with 41% (n = 48) devoted to teaching safety less than a third of their time, 36% (n = 42) devoting 1/3 to half of their time to teaching safety and the remaining 23% (n = 27) using over half their instructional time teaching safety topics. Teachers were prompted with the questions "Where do you devote the most time in teaching safety in agricultural mechanics?". The researchers found that 25.23% (n = 30) taught safety as a separate unit, 24.32% (n = 29) taught safety by integrating into each instructional unit and 50.45% (n = 59) taught safety equally in a separate unit and within other instructional units.

Safety in the agricultural mechanics lab was found to be taught in a variety of ways. The most common lessons included safety demonstrations with hand tools (n = 115, 97.3%), demonstration lessons with power tools (n = 113, 95.5%), assessments on laboratory safety exams (n = 114, 94.59%) and using a laboratory clean up schedule (n = 82, 69.37%). Only 37% (n = 44) utilized routine safety inspections along with 26% (n = 31) designating a cleanup foreman along with the cleanup schedule.

When asked what materials are used to teach safety to their high school students, teachers were most likely to take advantage of hands-on safety materials (*n* = 113, 95.5%), videos (*n* = 105, 90%), worksheets (*n* = 104, 89.2%) and computer program (*n* = 70, 59.2%). Other instructional materials utilized included transparencies, YouTube, textbooks, and local presenters from industry representatives.

Objective Four

The final objective was to investigate what teachers perceived was the most valuable in regards to safety topics in the agricultural mechanics lab. Respondents were asked to rank the importance of various agricultural safety instructional topics. The value of each topic was measured on a Likert-Type scale ranging from 1-5 (1 = *little importance* to 5 = *highest importance*). Teachers felt the most important topics were power tool and electrical safety. Respondents felt that the least important topics were the development of safety posters and accident report forms. Table five presents a rank order listing of most important topics identified by teachers.

Table 5

Teachers' Perceptions of Important Safety Topics (n = 118)

Safety Topic	*M*	*SD*
Power Tool Safety	4.61	0.57
Electrical Safety	4.60	0.60
Welding Exhaust Systems	4.40	0.76
Hand Tool Safety	4.40	0.68
Administration of Safety Exams	4.32	0.70
Industrial Quality Eye Protection	4.28	0.53
Laboratory Safety Inspections	3.83	0.95
Accident Report Forms	3.50	1.01
Safety Posters	3.34	0.91

Note. Importance scale (1= *little importance* to 5 = *highest importance*).

The final question teachers were asked was to rate how well they felt prepared to provide safety instruction related to various instructional topics. The responses were measured on a five point scale of 1 = *poorly prepared* to 5 = *very well* prepared. Respondents felt the best prepared to teach the industrial eye protection and welding exhaust systems. They felt the least prepared to teach various safety topics related to color coding of shop equipment, developing safety posters, making accident report forms, and state safety laws. Table six lists teacher preparedness to teach various safety topics in rank order.

Table 6

Teachers' Preparedness to Provide Safety Instruction (n = 118)

Safety Topic	*M*	*SD*
Industrial Quality Eye Protection	4.33	0.74
Welding Exhaust Systems	4.02	0.90
Electrical Safety	3.98	0.82
Clean Up Schedules	3.62	0.89
Developing Safety Posters	3.59	0.96
State Safety Laws	3.51	0.83
Color Coding Safety Equipment	3.50	1.02
Accident Report Forms	3.48	1.02

Note. Preparedness scale (1 = *poorly prepared* to 5 = *very well prepared*).

Conclusions and Recommendations

The purpose of this study was to identify the safety practices of South Texas agricultural science teachers, specifically focusing on underrepresented teacher populations, for teaching safety and managing an agricultural mechanics laboratory environment. Findings of the study indicated participants perceived themselves to be adequately prepared in many aspects of safety in a school-based agricultural education program. The teachers' indication of preparedness provides insight on the teachers' perceived behavioral control of providing a safe work environment.

Although attitudes, normative beliefs, and perceived behavioral control constitute the three largest contributing factors in the theory of planned behavior (Azjen, 1985), other background factors can have an indirect impact on an individual's actions. According to Peng, Zhi-cai, and Lin-jie (2014), the theory of planned behavior "recognizes the importance of background factors, such as personality, emotions, education, age, gender, and experience; although if they affect behavior, it would be via beliefs" (p. 3). The teachers in this study had an average of 12 years of teaching experience and over 70% of the teachers had previously taken three or more agricultural mechanics courses. It is implied the teachers past experiences influenced their safety behaviors. Through the lens of self-efficacy (Bandura, 1984), the teachers' beliefs in their abilities to teach safety in agricultural mechanics will positively influenced their ability to provide safety instruction in the laboratory. Bandura (1997) posited a teacher's self-efficacy can be enhanced by four sources (i.e., mastery learning experiences, physiological and emotional states, social persuasion, and vicarious experiences). The educational and professional experiences of the teachers indicate their engagement in these four sources of self-efficacy.

The teachers indication of being "*moderately*" to "*very well prepared*" to provide safety instruction stands in opposition the findings of previous studies which reported teachers lacked the necessary skills to instruct laboratory safety (Dyer & Andreasen, 1999; McKim & Saucier, 2011; Swan, 1992). Findings from the aforementioned studies indicated both in-service and pre-service teachers were inadequately prepared to provide safe instruction, which may indicate that a teacher's experience may not have a large impact on their preparedness to teach safety. Dyer and Andreasen

(1999) attributed the teachers lack of preparedness to a "serious void" (p. 50) in teacher preparation. Moreover, Dyer and Andreasen (1999) indicated teachers were inattentive to safety laws (i.e., local, state and national) and incognizant of their ability to provide safe working environments in the laboratory. The present study failed to examine teachers' knowledge of safety laws which could possibly represent an area of training need for the Texas agricultural science teachers. This area of safety instruction should be addressed in future studies which focus on agricultural science teachers' preparedness to instruct safety.

In addition to the assessment of teachers' perceived ability to provide safety instruction, this research study sought to determine the availability of selected safety equipment and emergency items in South Texas agricultural mechanics laboratories. It was determined that teachers had an extensive amount of safety equipment available for their use in the learning laboratory. Commonly used safety equipment such as industrial quality eye protection, welding gloves, and welding aprons /jackets were the most prevalent. In practice, safety materials utilized and discussed in the programs included the most prevalent safety equipment available to the programs, and additionally included fire extinguishers, properly marked exits, eye wash stations, as well as the use of properly marked safety exits. In support of this research, Chumbley (2015) and Lawver and Fraze (1995) found that eye protection was a safety topic commonly addressed as a high priority item in school-based agricultural mechanics programs. The teachers' perceived ability to teach safety topics was related to the safety equipment and systems within their shops. For example, teachers which taught in laboratories without marked safety zones, safety posters, and fire blankets had little preparedness in teaching safety on those topics.

Regarding the approach to instruction of safety, those researched identified that materials utilized in the instruction of safety were likely to consist of hands-on safety materials (95.5%), videos (90%), worksheets (89.2%) and computer program (59.2%). This finding was consistent with findings in previous studies (Dyer & Andreason, 1999; Lawver, 1992) which indicated that the most common instructional methods utilized to instruct safety consisted of classroom and laboratory demonstrations, student worksheets, and instructional videos.

Recommendations for Research

Additional research is needed targeting what barriers potentially exist with teachers using recommended safety practices in the instruction of agricultural mechanics. More so, cost of laboratory programs, equipment, and consumables (Saucier, Vincent & Anderson, 2014) continues to be a barrier behind inadequate instruction not only in content, but in safety practices associated with them. Research targeting solutions and their application should be further conducted.

It was identified through the findings that teachers felt "*moderately*" to "*very well prepared*" (94.92%) to provide safety instruction within their classes. In reference to the theory of planed behavior (Azjen, 1985), these findings shed light on the teachers' perceived behavioral control in providing safety instruction, but fails to assess the teachers attitude toward the behavior and subjective norms associated with the behavior. These important factors, which have an influence on an individual's intention to pursue an action, need to be assessed in this context. Montaño and Kasprzyk (2015) advocated the use of an integrated behavioral model to evaluate the planned behavior of individuals. The integrated model assesses four components which directly affect behavior, including: knowledge and skill in behavior performance, behavior salience, environmental constraints, and habitual behavior. Future research should focus on these aspects of behavioral intention to provide a deeper understanding on teachers' intentions to implement safety procedures in agricultural mechanics laboratories.

Recommendations for Practice

Although teachers were "*moderately*" to "*very well prepared*" in regard to providing safety instruction overall, teachers indicated a lack of preparedness in certain aspects (i.e., safety zones, safety posters, and fire blankets) of safety instruction. While fire blankets many not be applicable in every shop situation, it is important the teachers consider the implementation of safety zones and safety posters to bolster the safety in their laboratories. Regarding safety zones, teachers should use OSHA as a resource to properly mark the equipment and work areas of their laboratories. The implementation of safety zones will serve two purposes, it will enhance the safety of the students in the school shop, while familiarizing them with safety colors used in future industry settings. Teachers can acquire safety posters online and from industry resources, but safety posters can also be developed by students, serving as a class activity.

Teacher educators, corporate entities (e.g., Lincoln Electric, Miller, Briggs and Stratton, Kohler, etc) and governmental entities (e.g., OSHA) can play an important role in providing teachers with safety training, in pre-service and in-service settings. The proposed agricultural mechanics safety trainings should focus on the areas in which teachers indicated the lowest level of perceived preparedness.

While the teachers felt prepared to instruct safety and maintain a safe working environment for students, the teachers' shop safety preparedness should be perpetually evaluated. The burden of assessment falls on the shoulders of teacher educators (for pre-service teachers), school district administrators, CTE directors, and district safety inspectors (for in-service teachers). Dyer and Andreasen (1999) posited school administrators should actively monitor laboratory safety and assist in the procurement of needed safety equipment. The periodic inspections should evaluate the condition of the shop equipment, condition and availability of safety equipment, methods of safety instruction, and the scope of safety exams used in agricultural mechanics courses.

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