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ABSTRACT

North Dakota secondary agricultural mechanics instructors were surveyed regarding instructional methods and materials, safety practices, and equipment used in the agricultural mechanics laboratory. Usable responses were received from 69 of 89 instructors via self-administered mailed questionnaires. Findings were consistent with results of similar studies. Instructors were not using recommended safety practices or providing student safety and emergency equipment to the extent warranted by the hazards present in the laboratory. Instructional techniques most commonly used in safety instruction were demonstrations conducted by students and instructors in use of power tools. Most instructors (94.2 percent) required students to pass safety examinations. Instructors used safety manuals and booklets and worksheets most often as instructional materials. Industrial-quality eye protection and welding gloves were the most frequently available safety equipment for student use. The most frequently available safety practices, equipment, or materials were as follows: welding booths with screens/curtains, welding exhaust system, safety guards on all equipment, first aid kits/boxes, fire extinguishers, fire alarms, and marked exits. Inservice programs on safety and identification and teaching of safety topics in preservice and inservice educational programs were recommended. (Contains 12 references.) (YLB)

AN ANALYSIS OF AGRICULTURAL MECHANICS SAFETY PRACTICES IN AGRICULTURAL SCIENCE LABORATORIES

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Introduction

Agricultural mechanics students are exposed to equipment, materials, and supplies that are potentially hazardous to their health and that could cause injury or death (Johnson & Fletcher, 1990). Instructional safety programs are a must and therefore should be of high priority to the instructor. The most important responsibility of the instructor is to ensure the safety of the students. It is essential that instructors provide a safe and healthy learning environment for students enrolled in these courses (Padham, 1990). Students in agricultural mechanics learn and pattern future work habits around conditions learned while enrolled in agricultural mechanics courses.

Studies have shown that students must develop more than acquired knowledge and skills in machine operation. Students must develop safe attitudes towards the work environment. Students should be taught that accidents happen and that accident causes can be pre-identified (Reynolds, 1980). Burke (1989) studied accident frequency and found that five student accidents per year per teacher was excessive. Burke concluded that safety instruction should be enhanced and that further studies be conducted. A 1990 study reported that accidents were happening at the rate of more than eight per year per instructor (Hoerner & Bekkum, 1990).

There is evidence that unsafe conditions are found in many agricultural mechanics laboratories. Studies have found that many instructors are not using recommended safety practices or providing safe learning environments (Johnson & Fletcher, 1990). It was noted that these instructors indicated that their preparation in safety practices was deficient in many areas. No current literature was found concerning the state of safety practices in agricultural mechanics laboratories located in North Dakota.

According to Jacobs and Turner (1981) and Storm (1979), 95 percent of all work-related accidents could be avoided if proper safety precautions were employed. Since agricultural mechanics laboratory safety is such an important priority for instructional programs, it was apparent that laboratory safety practices used by instructors needed to be examined.

Purpose and Objectives

The purpose of this study was to ascertain the safety practices currently being used in agricultural mechanics laboratories. A secondary purpose was to provide baseline data from which recommendations for safety program improvements and inservice training could be offered. Specific objectives were as follows:

1. to determine the instructional techniques employed by agricultural mechanics instructors in the agricultural mechanics safety program.

2. to determine instructional materials currently being used by agricultural mechanics instructors to teach laboratory safety.

3. to determine the safety and emergency equipment available in the agricultural mechanics laboratories.

Procedures

The population for this study was composed of all North Dakota secondary agricultural mechanics instructors employed in the 1991-92 academic year. The state supervisor of agricultural education and teacher educator in agricultural education developed a list of all instructors. The entire population (N=89) was surveyed. The data were collected via self-administered mailed questionnaires. The instrument developed by Hoerner & Kesler (1989) was modified to fit specific conditions of the population. The revised instrument consisted of two parts. Part one solicited relevant demographic information. Part two solicited information concerning instructional methods and materials, safety practices, and equipment used in the agricultural mechanics laboratory.

The revised instrument was examined by experts in agricultural engineering and agricultural mechanization and judged to be valid. To further ensure the validity of the instrument, it was pilot tested with students enrolled in an agricultural teaching methods course the spring of 1991. An analysis of the reliability of the instrument was determined to be $r=.84$ using Cronbach coefficient alpha at the .05 alpha level. The statistical computer program Statgraphics was used for data analysis. Descriptive statistics (means, standard deviations, and percentages) were used to describe the population of this study.

Findings/Results

Usable responses were received from 69 of 89 agricultural mechanics instructors for a 77.5% response rate. Comparison of early and late respondents on identified demographic variables, safety practices used, and safety and emergency equipment available revealed no significant difference ($p<.05$) existed. Therefore, the results were generalized to the population (Miller & Smith, 1983).

The composite instructor respondent had 10.5 years of teaching experience, had completed 8 quarter hours of college-level agricultural mechanics course work as an undergraduate, had liability insurance coverage in excess of $150,000 (79.6%), and had 13.1 students in his agricultural mechanics courses. The typical agricultural mechanics laboratory was 2000 square feet or more in size (60.1%) and

over 15 years old (75.5%). The typical agricultural mechanics instructor devoted 58.3% of his instructional time to teaching agricultural mechanics, felt somewhat prepared to very well prepared to provide safety instruction in agricultural mechanics (63.2%), and devoted 15.1% of his agricultural mechanics instructional time to safety related instruction.

When asked to record the number of major accidents (requiring medical attention) that occurred in the agricultural mechanics laboratory during the past five years, the mean response was 1.3 accidents per year. Instructors' reported the occurrence of minor accidents (requiring bandage but not doctor or nurse attention). During the same five year period, the mean number of accidents was 13.3 accidents per year. Four instructors reported 40 or more minor accidents, while 45 (65.2%) of the instructors indicated they did not maintain written accident report files.

Instructors were asked to identify instructional techniques used in their safety instructional program in agricultural mechanics. Table 1 lists the number and percentage of respondents who reported using each of the instructional techniques in their agricultural mechanics safety programs. The instructional techniques used most often were students demonstrating safe use of power tools and teachers conducting safety demonstrations on power tools (97.1%). The least used instructional technique was providing each student with a copy of appropriate safety laws (18.8%).

Table 1
Instructional Techniques Used by Agricultural Mechanics Instructors in the Agricultural Mechanics Safety Program (N=69)

Instructional Technique	Use Technique n	%	Do Not Use n	%
Students demonstrate safe use of power tools	67	97.1	2	2.9
Teacher conducts safety demonstrations - power tools	67	97.1	2	2.9
Students study safety subject matter	65	94.2	4	5.8
Student pass safety examinations	65	94.2	4	5.8
Teacher conducts safety demonstrations - hand tools	65	94.2	4	5.8
Students demonstrate safe use of hand tools	61	88.4	8	11.6
Students' safety examinations are filed	55	79.7	14	20.3
Clean up schedules are used by students	45	65.2	24	34.8
Unscheduled safety inspections are conducted	36	52.2	33	47.8
Scheduled safety inspections are conducted	25	36.2	44	63.8
Students each have a copy of appropriate safety laws	13	18.8	56	81.2

Agricultural mechanics instructors were asked to identify the instructional materials used in the safety instruction. Table 2 identifies manuals and booklets as the most commonly used instruction material (94.2%). The use of microcomputer programs was identified as the least used by respondents (24.6%).

Table 2
Instructional Materials used by Agricultural Mechanics Instructors in their Instructional Safety Programs (N=69)

	Use Technique		Do Not Use	
Instructional Materials	n	%	n	%
Manuals and booklets	65	94.2	4	5.8
Worksheets	59	85.5	10	14.5
Videotapes	53	76.8	16	23.2
Transparencies	49	71.0	20	29.0
Slides and filmstrips	42	60.9	27	39.1
16 mm films	24	34.8	45	65.2
Microcomputer programs	17	24.6	52	75.4

The safety equipment or materials which are available for student use in agricultural mechanics laboratories are listed in Table 3. The most commonly provided items of safety equipment are industrial quality eye protection and welding gloves (97.1%). The safety equipment or material provided least was steel toes shoes/boots (2.9%).

Table 3
Safety Equipment or Materials That Are Used or Available for Students in the Agricultural Mechanics Laboratory (N=69)

	Not Available		Available	
Safety equipment/materials	n	%	n	%
Industrial quality eye protection	67	97.1	2	2.9
Welding gloves	67	97.1	2	2.9
Shop coats or coveralls	59	85.5	10	14.5
Welding aprons or jackets	42	60.9	27	39.1
Dust masks	31	44.9	38	55.1
Hard hats	21	30.4	48	69.6
Hearing protection - ear plugs	14	20.3	55	79.7
Hearing protection - ear muffs	10	14.5	59	85.5
Respirators	10	14.5	59	85.5
Bump/Skull caps	4	5.8	65	94.2
Steel-toed shoes/boots	2	2.9	67	97.1

Table 4 identifies the safety practices, equipment or materials found agricultural mechanics laboratories. The most common practice, equipment or material found were

welding booths with screens/curtains and welding exhaust systems (97.1%). It should be noted that 4 respondents did not have fire extinguishers available and 8 respondents did not have fire alarms located in their laboratories. Panic buttons (14.5%) were the least frequently reported safety item reported. Less then half of the safety or emergency items identified in Table 4 were available in more than 70.0% of the respondents' agricultural mechanics laboratories.

Table 4
Safety Practices, Equipment or Materials Used in the Agricultural Mechanics Laboratory (N=69)

Safety practices, equipment, materials	Used n	Used %	Not Used n	Not Used %
Welding booths with screens/curtains	67	97.1	2	2.9
Welding exhaust system	67	97.1	2	2.9
Safety guards on all equipment	66	95.6	3	4.4
First aids kit/boxes	65	94.2	4	5.8
Fire extinguishers available	65	94.2	4	5.8
Fire alarm	61	88.4	8	11.6
Exits marked	59	85.5	10	14.5
Safety cans for flammable liquids	48	69.6	21	30.4
Safety rules posted near power tools	41	57.4	28	40.6
Safety poster posted near power tools	39	56.5	30	43.5
Safety cabinet for flammable /explosive materials	39	56.5	30	43.5
Vehicle safety stands available	39	56.5	30	43.5
Fire blanket	37	53.6	32	46.4
Safety zones around tools	27	39.1	42	60.9
Fume exhaust system	25	36.2	44	63.8
Eye safety laws/rules posted	24	34.8	45	65.2
Color-coded power tools	13	18.8	56	81.2
Non-skid areas around power tools	13	18.8	56	81.2
Eye wash	13	18.8	56	81.2
Panic button	10	14.5	59	85.5

Conclusions and Recommendations

The findings of this study are consistent with the results of similar studies in Missouri (Lamb, 1984), Nebraska (Rudolph & Dillon, 1984), Ohio (Gleim & Hard, 1988), Iowa (Hoerner & Bekkum, 1989), and Mississippi (Johnson & Fletcher, 1990). It is apparent that North Dakota secondary agricultural mechanics instructors are not using recommended safety practices or providing student safety and emergency equipment to the extent warranted by the hazards present in the agricultural mechanics laboratory.

The instructional techniques most commonly used in safety instruction were demonstrations conducted by students and instructors in the use of power tools. Passing of safety examinations was required by most instructors (94.2%).

Safety manuals and booklets and worksheets were the instructional materials most often used by agricultural mechanics instructors. Microcomputer programs related to safety were the least frequently used instructional material.

Industrial-quality eye protection and welding gloves were the most frequently available safety equipment for use by students. The most frequently available safety practices, equipment, or materials were welding booths with screens/curtains, welding exhaust system, safety guards on all equipment, first aid kits/boxes, fire extinguishers, fire alarms, and marked exits. These findings are consistent with the findings of similar studies (Hoerner & Bekkum, 1990; Johnson & Fletcher, 1990).

Based upon the results of this study, it is evident that unsafe conditions exist in many secondary agricultural mechanics programs in North Dakota. Safety program improvements must become an important priority for agricultural mechanics instructors and their administrators.

The following recommendations are based on the results of this study:

1. Inservice programs on agricultural mechanics safety should be conducted for agricultural mechanics instructors and should include local program administrators.
2. Instructor preparation programs should be examined to determine if additional emphasis should be placed on safety instruction in laboratories.
3. Safety topics should be identified and taught during both preservice and inservice educational programs.
4. Local and federal funds should be earmarked for use in improving the safety and emergency equipment available to instructors and students.

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