Agricultural Mechanics Specialists Identification and Evaluation of Agricultural Mechanics Laboratory Management Competencies: A Modified Delphi Approach

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Agricultural mechanics is an important part of the total agricultural education program (Phipps, 1983). In many courses, the time allocated for instruction in agricultural mechanics comprises 25-40% of the total instructional time (Phipps, 1980). Much of the agricultural mechanics instruction takes place in the agricultural mechanics laboratory. Therefore, efficient management of the agricultural mechanics laboratory is essential if optimal student learning is to occur (Bear & Hoerner, 1986).

According to Webster's New World Dictionary (Guralnik, 1984), management is defined as the ability to direct, conduct, or administer an activity. For the purpose of this investigation, laboratory management competencies were defined as those abilities needed by secondary agriculture teachers to direct, conduct, or administer an agricultural mechanics laboratory.

Review of Literature

The use of appropriate lab management techniques facilitates learning within an agricultural mechanics laboratory (Bear & Hoerner, 1986). The technique one must apply to efficiently manage an agricultural mechanics laboratory are competencies. Agriculture instructors most possess agricultural mechanics laboratory management competencies if maximum laboratory learning is to occur (Henderson, 1983).

According to Shinn (1987), the agricultural mechanics laboratory must be safe and well organized if optimum student learning is to occur. Burke (1986) discussed several practices associated with efficient laboratory management. Burke listed the regulation of environmental factors, storage of tools, and control of consumable supplies, as areas which are important for efficient management of the agricultural mechanics laboratory.

Managing an agricultural mechanics laboratory is a difficult task. Paulter (1971) stated that teachers of laboratory subjects require more organizational and management abilities than do classroom teachers. Barrick and Powell (1986) indicated that first-year agriculture teachers rated the ability to manage laboratory learning as a highly important ability for agriculture teachers. The first-year agriculture teachers also felt that their level of knowledge concerning the management of laboratory learning was lower than 13 of 26 teacher abilities studied.

Agricultural mechanics is a highly visible part of the total agricultural education program. The quality of the agricultural mechanics activities, including laboratory management, affects the image of the local program. Jewell (1987) found that housekeeping of the classroom and shop was the area which North Carolina administrators most frequently cited as being deficient in the performance of agriculture teachers. Foster and Reinsenberg (1985) found that high school administrators in Idaho rated shop safety, shop discipline, and shop organization as above average indicators of overall program quality.

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Polson (1985) determined the technical agricultural mechanics competencies needed by agriculture teachers. However, search of the literature failed to discover any research concerning the identification or validation of effective agricultural mechanics laboratory management competencies. The researchers were unable to clearly identify agricultural mechanics laboratory management competencies which best facilitate the learning process. Therefore, the identification and evaluation of these competencies became the focal point for the investigation.

Purpose and Objectives

The purpose was to determine the laboratory management competencies needed by secondary agriculture instructors. Specific objectives were:

1. To identify the agricultural mechanics laboratory management competencies essential for effective laboratory instruction.

2. To determine the perceptions of agricultural mechanics specialists toward the identified laboratory management competencies.

Procedures

The experts identified were all postsecondary, college, and university agricultural mechanics specialists serving on the National FFA Agricultural Mechanics Contest Committee during the 1986-87 school year (n = 92).

A modified Delphi technique was selected as the research method for this investigation. According to Borg and Gall (1983), the Delphi technique "can be used whenever a consensus is needed from persons who are knowledgeable about a particular subject...it can be used to identify problems, define needs, establish priorities, and identify and evaluate solutions." (p. 13). One assumption inherent in this study was that the agricultural mechanics specialists identified were knowledgeable about laboratory management competencies.

The researchers developed the "Agricultural Mechanics Laboratory Management Competencies Instrument". The instrument contained instructions directing each respondent to list 25 agricultural mechanics laboratory management competencies which they felt were most important in order to effectively manage a secondary school agricultural mechanics laboratory.

The instrument and cover letter were mailed during July, 1987. Approximately two weeks later, a second identical instrument and a revised cover letter were mailed to those who had not yet responded. These mailings elicited a 43% response rate to the first round of the investigation. An additional follow-up letter was deemed unnecessary as competencies mentioned on later returns were essentially identical to those received earlier.

The researchers edited and combined the first round responses in a manner designed to preserve the integrity of the original responses. The resulting list of 50 competencies formed the basis for the "Assessment of Agricultural Mechanics Laboratory Management Competencies Instrument". This instrument was designed to determine the importance of each identified competency. The instrument contained instructions directing the respondent to use a Likert-type scale of 1 to 5 to assess the

importance of each competency. A response of 1 represented no importance and a response of 5 represented utmost importance. The instrument and a new cover letter were mailed to the agricultural mechanics specialists during August, 1987. A follow-up instrument and cover letter were mailed approximately two weeks later. These mailings resulted in a 76% response rate.

The researchers summarized the responses to the second round of the Delphi investigation by calculating group means and standard deviations for the 50 agricultural mechanics laboratory management competencies. A summary of the second round, a record of the individual's second round responses, a cover letter, and the third instrument were mailed to each agricultural mechanics specialist during late September, 1987. The cover letter instructed each participant to review the group mean and standard deviation for reach competency, along with their own second round responses, prior to completing the third instrument. The third instrument also contained a section designed to elicit demographic information from the respondents. The third round mailing and the follow-up mailing during October, 1987, resulted in a 73% response rate.

Analysis of the Data

Since all of the agricultural mechanics specialists associated with the 1986-87 National FFA Agricultural Mechanics contest were asked to respond, descriptive rather than inferential statistics were used to analyze the data. Means and standard deviations were computed for each of the agricultural mechanics laboratory management competencies. The demographic data were also analyzed using descriptive statistics. Cronbach's coefficient alpha for the "Assessment of Agricultural Mechanics Laboratory Management Competencies Instrument" was 0.94.

Findings

Demographic information was collected and analyzed to provide verification of the respondents' knowledge and experience in the area of agricultural mechanics laboratory management. The respondents reported a mean age of 45.97 years and an average of 20.43 years of teaching experience. Approximately 60% of the respondents' total instructional time was devoted to technical agricultural mechanics courses. Also, a majority of the respondents (71.7%) reported that they currently had the responsibility for managing one or more agricultural mechanics laboratories. All of the respondents held at least one college degree. The highest degrees held were: Bachelors (1.75%); Masters (17.54%); and Doctorate (80.70%).

Forty-four of the 50 identified laboratory management competencies were perceived by agricultural mechanics specialists as being of average or greater importance as indicated by a group mean score of 3.0 or higher. All 50 competencies received a mean score (MS) of 2.51 or greater. All competencies identified had a standard deviation (SD) of 1.02 or less (Table 1).

Six of the laboratory management competencies received a mean score of 4.5 or greater. These competencies were: (a) document safety instructions (MS = 4.75, SD = 0.50); (b) store hazardous materials safely (MS = 4.64, SD = 0.57); (c) update course offerings (MS = 4.60, SD = 0.63); (d) safely arrange shop equipment (MS = 4.55, SD = 0.61); (e) conduct safety inspections (MS = 4.54, SD = 0.75); and (f) select and maintain protective equipment (MS = 4.51, SD = 0.70).

A total of six of the laboratory management competencies received an overall mean score of less than 3.00. These competencies were: (a) make minor facility repairs (MS = 2.51, SD = 0.98); (b) make major equipment repairs (MS = 2.69, SD = 1.02); (c) install major equipment (MS = 2.84, SD = 0.86); (d) computerize laboratory management functions (MS = 2.91, SD = 0.97); (e) computerize student records (MS = 2.96, SD = 1.02); and, (f) construct welding booths, etc. (MS = 2.99, SD = 0.91).

Table 1
Laboratory Management Competencies Identified by the Agricultural Mechanic Specialists (N = 67)

Order	Competency	Mean	SD
How important is it that a secondary agriculture teacher:			
1	Provide and document safety instruction	4.75	0.50
2	Store hazardous materials safely	4.64	0.57
3	Update course offerings	4.60	0.63
4	Safely arrange shop equipment	4.55	0.61
5	Conduct safety inspections	4.54	0.75
6	Select and maintain protective equipment	4.51	0.70
7	Maintain/install safety devices	4.44	0.91
8	Develop objective student evaluation criteria	4.30	0.65
8	Develop lab cleanup procedures	4.30	0.85
8	Develop & enforce student discipline policy	4.30	0.95
11	Comply with OSHA standards in the laboratory	4.29	0.76
12	Maintain healthy environmental conditions	4.27	0.67
12	Identify equip. needed to teach mech. skills	4.27	0.73
14	Identify current references and tech. manuals	4.22	0.60
15	Operate within the limits of a budget	4.21	0.84
15	Color code laboratory	4.21	0.86
15	Develop an accident reporting systems	4.21	0.90
18	Document student competencies	4.16	0.67
18	Diagnose malfuntioning lab equipment	4.16	0.81
20	Equip work stations for skill areas	4.13	0.72
20	Develop lab policy	4.13	0.83
22	Maintain consumable supply inventory	4.06	0.65
22	Develop/maintain file of equip. operator manuals	4.06	0.74
22	Arrange for prof. assistance for major repairs	4.06	0.78
25	Recognize quality tools and equipment	4.04	0.73
25	Inventory tools and equipment	4.04	0.77
25	Make minor equipment repairs	4.04	0.79
28	Develop a rotational shop plan	4.03	0.83
29	Perform routine maintenance	4.00	0.89
30	Develop educational projects and activities	3.99	0.88
31	Administer first aid	3.94	0.99
32	Develop procedures to store, secure, and check out tools and equipment	3.93	0.74
33	Prepare bid specifications	3.90	0.82
34	Store and distribute student supplies	3.87	0.74
34	Brand or mark tools to prevent theft	3.87	0.83
36	Develop equipment maintainance schedule	3.82	0.78
37	Maintain file of educational projects	3.81	0.68
38	Utilize tech. manuals to order replacement parts	3.78	0.71
39	Plant and implement student recruitment	3.66	0.79

(table continues)

Order	Competency	Mean	SD
40	Estimate time requirements for students to complete their projects	3.61	0.82
41	Plan a public relations program	3.52	0.82
42	Develop student billing procedures	3.31	0.96
43	Silhouette tool cabinets	3.16	1.01
44	Modify the facility for handicapped students	3.12	0.79
45	Construct welding booths, etc.	2.99	0.91
46	Computerize student records	2.96	1.02
47	Computerize lab management functions	2.91	0.97
48	Install major equipment	2.84	0.86
49	Make major equipment repairs	2.69	1.02
50	Make minor facility repairs	2.51	0.98

Summary, Conclusions, and Recommendations

One assumption inherent in utilizing the Delphi technique is that the respondents must be knowledgeable about the subject matter under study. Based on an analysis of the demographic data reported by the respondents, the researchers felt that this assumption was met.

The competencies identified by the respondents represent their perceptions of competencies which are essential for effective management of the agricultural mechanics laboratory. Eighty-eight percent of the competencies identified were of above average importance to the agricultural mechanics specialists. All of the competencies identified had mean scores higher than 2.50 on a 1 to 5 importance scale. The standard deviation of each mean score reported was less than one for all but three competencies. This indicates a moderately high level of agreement among the respondents as to the importance of the identified competencies. Therefore, the identified competencies represent the skills necessary for effective laboratory management as perceived by the agricultural mechanics specialists.

The agricultural mechanics specialists perceived the provision and documentation of safety instruction as the most important competency that a secondary agriculture teacher must possess in order to effectively manage an agricultural mechanics laboratory. Eleven of the top 18 competencies identified by the respondents were safety related.

The respondents indicated that equipment installation, equipment repair, and facility repair were the least important laboratory management competencies identified. The authors interpreted this finding to mean that although the respondents perceived these competencies to be important, the respondents felt that the instructors' time would be better spent on other laboratory management competencies. The agricultural mechanics specialists identified (a) update course offerings, (b) develop objective student evaluation criteria, (c) identify current references and technical manuals, (d) document student competencies, and (e) develop educational projects and activities, as important competencies for successful agricultural mechanics laboratory management. The mean for each of these competencies was 3.99 or greater. Although these competencies are not unique to laboratory management, the agricultural

mechanics specialists recognized the importance of following sound educational practices when managing the laboratory for maximum student learning.

The identified competencies represent the perceptions of recognized experts concerning the skills needed by high school agriculture teachers as they manage an agricultural mechanics laboratory. Teacher educators should provide present and prospective agriculture teachers with experience designed to develop and enhance these skills.

Further research should be conducted to determine how important the identified agricultural mechanics laboratory management competencies are to secondary agriculture teachers and school administrators. Also, research is needed to determine the extent to which agriculture teachers possess and practice these laboratory management competencies.

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