AN ANALYSIS OF THE AGRICULTURAL MECHANICS LABORATORY MANAGEMENT INSERVICE NEEDS OF MISSOURI AGRICULTURE TEACHERS

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"The primary objective of agricultural mechanics education is the development of the abilities necessary to perform the mechanical activities to be done in agriculture..." (Phipps, 1980, p. 306). This statement implies that agricultural mechanics instruction must include an experiential process as well as classroom instruction whereby students are provided with opportunities to develop manipulative skills.

Since psychomotor skill development is an important part of agricultural mechanics education, much of the instruction takes place in the school agricultural mechanics laboratory. Oomens and Jurshack (1978, p. 39) stated that agricultural mechanics "...laboratory exercises provide the necessary skill development to allow students...to operate equipment in a proper and efficient manner."

Shinn (1987) stated that the amount of time devoted to laboratory instruction may comprise from one-third to two-thirds of the total instructional time in many agriculture courses. Since laboratory experiences are such an integral component of agricultural mechanics instruction, efficient management of the school agricultural mechanics laboratory is essential in order to maximize student learning (Bear and Hoerner, 1986; Burke, 1986; Gliem, 1982; Shinn, 1987).

Noting the importance of effective agricultural mechanics laboratory management, Johnson and Schumacher (1988) conducted a study to ascertain competencies needed by secondary agriculture teachers in order to successfully manage an agricultural mechanics laboratory. A list of 50 competencies was developed by using a modified Delphi technique involving the expertise of postsecondary, college, and university agricultural mechanics experts who served on the 1986-87 National FFA Agricultural Mechanics Contest Committee. Based upon the data collected, Johnson and Schumacher (1988) concluded: The identified competencies represent skills needed by high school agriculture teachers as they manage an agricultural mechanics laboratory. Teacher educators should provide present and prospective agriculture teachers with experiences designed to develop and enhance these (p. 7).

Purpose

The purpose was to ascertain the agricultural mechanics laboratory management inservice needs of Missouri secondary agriculture teachers. More specifically, the following research questions were investigated:

1. What are the inservice needs (as indicated by mean weighted discrepancy scores) of Missouri secondary agriculture teachers for the agricultural mechanics laboratory management competencies identified by Johnson and Schumacher (1988)?

2. What is the relationship between the weighted discrepancy scores for each agricultural mechanics laboratory management competency factor and respondent demographic characteristics?

Procedures

Population and Sample: The population was composed of all secondary agriculture teachers listed in the 1988-1989 Missouri Agricultural Education Directory (Missouri Department of Elementary and Secondary Education, 1988) with primary responsibility for managing an agricultural mechanics laboratory (N = 240). A random sample of 200 teachers was selected.

Needs Assessment Model: The Borich (1980) needs assessment model provided the evaluative framework for assessing and prioritizing agricultural mechanics laboratory management inservice

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needs. In accordance with the model, a mean weighted discrepancy score was calculated for each competency using the following formula (Borich, 1980):

$$\text{Mean weighted discrepancy score} = \frac{[(\text{importance rating} - \text{ability rating}) \times (\text{importance rating})]}{\text{number of observations}}$$

According to the rationale underlying the Borich (1980) model, large mean weighted discrepancy scores represent greater inservice needs, while smaller scores represent lesser inservice needs.

Instrumentation : The survey instrument developed by Johnson and Schumacher (1988) was modified for use in this study. The revised instrument contained two sections. The first section contained the 50 identified agricultural mechanics laboratory management competency statements. Two 1-5 Likert-type scales were provided so that each respondent could independently rate the importance of each competency, and their ability to perform each competency. The descriptors attached to each point on the scales were as follows: 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). The second section of the instrument was designed to collect relevant demographic information from each respondent.

The 50 competencies were worded exactly the same as in the original instrument (Johnson & Schumacher, 1988). Since the original competencies had been developed with input from a panel of nationally recognized agricultural mechanics education experts, the revised instrument was judged to be valid. Results of a pilot test conducted with five teachers not selected for inclusion in the sample indicated that no changes were needed in the instrument or research procedures. Instrument reliability was estimated following data collection. Coefficient alphas of .939 (importance scale) and .934 (ability scale) were obtained.

Data Analysis: Data relative to research question one were analyzed using descriptive statistics. Means, mean weighted discrepancy scores and standard deviations were calculated for each competency. Data relative to research question two were analyzed using factor analysis and stepwise multiple regression. Principal components factor analysis with varimax rotation was utilized to group the 50 competencies into a smaller number of factors. A composite weighted discrepancy score was then calculated for each respondent for each factor. This was accomplished by summing the weighted discrepancy scores for the items in each factor and then dividing by the number of items in the factor (Hair, Anderson, & Tatham, 1987). Stepwise multiple regression was subsequently utilized to determine if a single or linear combination of respondent demographic characteristics could explain a significant portion of the variance associated with the weighted discrepancy scores for each competency factor. In accordance with recommendations contained in the SAS User's Guide: Statistics (SAS Institute, 1985b), the .15 alpha level was selected as the critical standard for stepwise regression analysis.

Results

Usable responses were received from 168 Missouri secondary agriculture teachers for an 84% response rate. Multiple analysis of variance indicated that no significant differences ($p < .05$) existed between early and late respondents on their perceptions of the importance of, or their ability to perform each of the agricultural mechanics laboratory management competency factors. Therefore, the results were judged to be generalizable to the population (Miller & Smith, 1983).

The average respondent reported 11 years of teaching experience and had earned 17 semester credit hours in university agricultural mechanics coursework. The average agricultural mechanics laboratory was 22 years of age and had 3070 square feet of floor space. Table 1 represents a summary of selected respondent demographic characteristics.

The teachers rated the mean importance of 23 (46%) of the competencies 4.0 or higher on a 5.0 scale. The mean weighted discrepancy scores ranged from a high of 3.668 for the competency, administer first aid, to a low of -1.036 for the competency, make minor repairs to the agricultural mechanics lab facility. Forty-eight (96%) of the competencies received positive mean weighted discrepancy scores while only two (4%) received negative scores. A high degree of variability was associated with the mean weighted discrepancy scores as indicated by the large standard deviations. Table 2 lists the mean weighted discrepancy score and standard deviation for each of the agricultural mechanics management competencies.

Table 1
Descriptive Statistics for Selected Demographic Characteristics

Characteristic	n	X	SD
Total years of teaching experience	168	11.0	8.02
Total sem. hours of university ag mech coursework	138	17.4	9.93
Ave. hours per week devoted to ag mech lab instruction	163	10.1	4.91
Number of students in largest ag mech lab class	168	15.4	6.02
Ave. annual number of students receiving ag mech lab instruction	167	50.8	29.12
Age, in years, of ag mech laboratory	160	21.6	12.11
Size (ft^2) of ag mech laboratory	150	3070.1	1517.71
Annual ag mech consumable supply budget ($)	129	2426.7[a]	2442.54
Ft^2 of lab space per student in largest ag mech lab class	150	223	125.56
Annual consumable supply budget ($) per ag mech lab student	120	51.2[b]	52.63

[a]Values ranged from $200.00 to $15,000.00.
[b]Values ranged from $5.88 to $441.18.

Table 2
Mean Weighted Discrepancy Scores and Standard Deviations for the Agricultural Mechanics Laboratory Management Competencies (n = 168)

Competency	X	SD
1. Administer first aid.	3.67	4.585
2. Safely store, handle, and dispose of hazardous materials.	3.39	3.732
3. Provide and document student safety instruction.	3.39	3.999
4. Conduct regular safety inspections and correct hazardous conditions.	3.14	3.639
5. Select, store, and maintain protective equipment for student use.	3.08	3.656
6. Diagnose malfunctioning agricultural mechanics lab equipment.	2.89	3.609
7. Maintain healthy environmental conditions in the lab.	2.56	3.558
8. Maintain the ag mech lab in compliance with OSHA standards.	2.49	3.558
9. Promote lab safety by color coding equipment, marking safety zones, and posting appropriate safety signs.	2.43	4.051
10. Develop a procedure to insure proper ag mech lab cleanup.	2.43	3.886
11. Develop an accident reporting system.	2.39	3.939
12. Develop a system to document achievement of student competencies.	2.36	3.563
13. Develop objective criteria for evaluation of student activities.	2.35	3.327
14. Develop, maintain, and enforce a student discipline policy.	2.31	3.473
15. Properly install and maintain safety devices and emergency equipment.	2.30	3.355
16. Update agricultural mechanics course offerings.	2.22	3.462
17. Arrange equip. in ag mech lab to enhance safety, efficiency, & learning.	2.17	3.615
18. Develop an identification system to deter tool and equipment theft.	2.02	4.343
19. Develop a maintenance schedule for ag mech lab equipment.	1.92	3.483
20. Develop a rotational plan to move students through skill areas.	1.78	3.317
21. Recognize characteristics of quality tools and equipment.	1.61	3.211
22. Develop educational projects and activities for students.	1.61	3.250
23. Perform routine maintenance of agricultural mechanics lab equipment.	1.58	2.882
24. Develop procedures to facilitate storage, checkout, and security of of tools and equipment.	1.57	3.860
25. Estimate time required for students to complete projects and activities.	1.55	3.464
26. Develop a procedure to bill stud. for materials used in proj. construction.	1.49	4.319
27. Designate and equip work stations for each skill area.	1.46	3.086
28. Identify and select current references and technical manuals.	1.44	3.077
29. Develop and operate within the constraints of a budget.	1.43	3.887
30. Identify tools, equipment, and supplies required to teach mechanics skills.	1.41	3.253

(Table 2, continues)

(Table 2, continued)

31.	Develop a written statement of ag mech lab policies and procedures.	1.27	3.187
32.	Make major equipment repairs.	1.22	3.479
33.	Develop and maintain an adequate inventory of consumable supplies.	1.21	3.196
34.	Develop procedures for safe, efficient storage/distribution of consumables.	1.19	2.788
35.	Inventory shop tools, equipment, and consumable supplies.	1.18	3.599
36.	Modify facilities and/or equipment to accommodate handicapped students.	1.15	3.196
37.	Plan and conduct an agricultural mechanics public relations program.	1.14	3.051
38.	Develop and/or maintain a file of educational projects and activities.	1.12	3.091
39.	Plan and implement stud. recruitment activities for the ag mech program.	1.06	3.153
40.	Develop and/or maintain a file of service and operator's manuals for agricultural mechanics lab equipment.	0.98	3.029
41.	Utilize technical manuals to order replacement parts for lab equipment.	0.75	3.019
42.	Prepare bid specifications and order equipment, tools, and supplies.	0.56	3.354
43.	Arrange for a professional service person to make major equip. repairs.	0.53	3.052
44.	Computerize lab management functions.	0.37	3.977
45.	Silhouette tool and equipment cabinets.	0.41	3.502
46.	Make minor agricultural mechanics lab equipment repairs.	0.25	2.876
47.	Install stationary power equipment.	0.22	3.369
48.	Maintain computerized student academic records.	0.21	3.358
49.	Construct welding booths, work benches, storage areas, etc.	-0.16	3.278
50.	Make minor repairs to the lab facilities.	-1.04	3.699

Five competencies received mean weighted discrepancy scores greater than 3.0. All five of these competencies were safety related. Both of the competencies which received negative mean weighted discrepancy scores were related to facility and equipment repair and improvement.

A rotated factor pattern consisting of five factors was selected as the optimal factor analysis solution. This decision was based upon examination of the scree plot of eigenvalues and the conceptual soundness of the factors (Hair, Anderson, & Tatham, 1987). The five factor solution explained 45.89% of the variance associated with the raw data. Factor loadings for each item in each factor were significant at the .01 alpha level (Hair, Anderson, & Tatham, 1987).

The five factors, the number of items in each factor, and the coefficient alpha reliability estimate for each factor were as follows: Laboratory Safety, 12 items, $\underline{r} = .876$; Program Management, 13 items, $\underline{r} = .837$; Instructional Management and Recordkeeping, 12 items, $\underline{r} = .832$; Inventory Management, 9 items, $\underline{r} = .785$; and Facility and Equipment Repair, 4 items, $\underline{r} = .630$.

The results of stepwise regression analysis indicated that a statistically significant ($\underline{p} < .15$) portion of the variance associated with the weighted discrepancy scores for each of the five competency factors could be explained by a linear combination of respondent demographic characteristics. However, since the largest percentage of variance accounted for was 8.21% (for the Program Management factor), this finding was judged to be of no practical significance.

Conclusions

Missouri secondary agriculture teachers have inservice needs in the area of agricultural mechanics laboratory management. Each of the five competencies which received a mean weighted discrepancy score of greater than 3.0 was safety related. Therefore, in the area of agricultural mechanics laboratory management, Missouri secondary agriculture teachers have the greatest inservice needs in the area of safety.

A high degree of variance was associated with each mean weighted discrepancy score. This indicated that educational needs in the area of agricultural mechanics laboratory management vary among Missouri secondary agriculture teachers. Agricultural mechanics laboratory management inservice needs, as defined in this study, were largely independent of the respondent demographic characteristics investigated.

Recommendations

Inservice programs should be conducted to improve the agricultural mechanics laboratory management abilities of Missouri secondary agriculture teachers. Priority topics should include: (a) administering first aid, (b) storing, handling, and disposing of hazardous materials, (c) providing and documenting safety instruction, (d) conducting safety inspections and correcting hazardous conditions, and (e) selecting, storing, and maintaining student protective equipment.

Agricultural education faculty and state supervisors should be prepared to offer individualized assistance to agriculture instructors who have unique educational needs in the area of agricultural mechanics laboratory management.

Further research should be conducted to identify and validate a common core of laboratory management competencies essential to all phases of laboratory instruction (i.e. horticulture, land, small animal, etc.) in agricultural education. Laboratory instruction is an important component of agricultural mechanics education. Teacher educators should periodically monitor educational needs in the area of agricultural mechanics laboratory management and use the information collected to plan and delivery timely, relevant instruction to present and prospective agriculture teachers.

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