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TIME SERIES ANALYSIS OF AGRICULTURAL EDUCATION STUDENT TEACHERS' PERCEPTIONS OF AGRICULTURAL MECHANICS LAB MANAGEMENT COMPETENCIES

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The student teaching experience has been considered "the single most powerful intervention in a teacher's professional preparation" (Grimmett & Ratzlaff, 1986, p. 41). Few teacher educators question its importance. As such, the influence of the cooperating teacher on the preparation of new teachers is profound. "The selection and preparation of the best cooperating teachers available must receive the attention of educational institutions that require student teaching" (Copas, 1984, p. 49). Yet the role of the cooperating teacher and its practical realities have been largely uncharted (Whaley & Wolf, 1984). According to Hodges, "A need exists for longitudinal studies which take a more in-depth look at teaching variables" (1982, p. 26). In the article "If You Can't Blame the Cooperating Teacher Who Can You Blame?", Hodges reported that topics emphasized in methods courses did not impact the students until they actually experienced those elements.

Much of the secondary agricultural instruction program is devoted to agricultural mechanics instruction. According to Shinn (1987), approximately one-third to two-thirds of this time is devoted to laboratory instruction. Johnson (1989) determined that Missouri secondary agriculture teachers devoted 40% of their instructional time to laboratory instruction in agricultural mechanics. An examination of student teaching follow-up data in North Dakota indicated that the North Dakota student teachers mirrored the percentages discussed by Shinn and Johnson. Data collected by Luft during 1976 - 1989 indicated that North Dakota student teachers devoted approximately 44% of available class time to the teaching of agricultural mechanics (1989).

In light of recent research that suggests (a) some topics emphasized in methods courses did not impact students until they experienced those elements during student teaching (Hodges, 1982), (b) approximately 44% of the student teacher's time was spent teaching agricultural mechanics (Luft, 1989), and (c) the efficient management of the agricultural mechanics laboratory is essential for maximizing student learning (Bear & Hoerner, 1986; Burke, 1986; Gleim, 1982; and Shinn, 1987), the researchers embarked on a study to determine where these laboratory management competencies should be taught during an agricultural mechanics teaching methods class. It was reasoned that the results of this study would provide direction for inservice training of supervising/cooperating teachers and future secondary agriculture teachers.

Purpose

The overall purpose of the investigation was to determine the importance of the competencies needed by high school agriculture teachers as they efficiently manage an agricultural mechanics laboratory. Specific objectives were as follows:

1. To determine student teachers' perceptions of the importance of the agricultural mechanics competencies (a) before these agricultural mechanics competencies were taught in an agricultural mechanics teaching methods course (O_1), (b) just prior to beginning their student teaching experiences (O_2), and (c) after completing their student teaching experiences (O_3).

2. To identify, based on the findings and the conclusions of this investigation, recommendations for (a) supervising teacher inservice training and (b) secondary agricultural teacher education.

Procedures

Population: The population for this investigation included all students enrolled in the agricultural mechanics teaching methods course during winter semester, 1989 ($\underline{N}$ = 19).

Design: The time series research design was selected for the investigation. According to Borg and Gall (1983, p. 660), a "time series design is useful when it is not feasible to form a control group and when the subjects can be measured periodically with the same instrument." Because each student in the class planned to student teach, it was not practical to establish a control group for the investigation.

Instrumentation: The survey instrument designed by Johnson and Schumacher (1988) was used to determine the perceptions of the student teachers. The instrument contained 50 agricultural mechanics laboratory management competency statements. A one-to-five point Likert-type scale was provided so each student teacher could indicate the importance of each competency. The description attached to each point on the scale was as follows: 1 = no importance, 2 = below average importance, 3 = average importance, 4 = above average importance, and 5 = utmost importance.

The competencies identified by Johnson and Schumacher (1988) were developed with input from a panel of nationally recognized agricultural mechanics experts. The 50 competencies were worded exactly as they had been worded in the original instrument. As such, the instrument was judged to be valid.

Cronbach's coefficient alpha was computed each time the instrument was administered. An analysis revealed reliability coefficients of .92, .88, and .94 for O_1, O_2, and O_3 respectively.

Data Analysis: Frequencies, means, and standard deviations were computed. Analysis of variance was used to determine whether significant differences existed among O_1, O_2, and O_3.

Results

The data in Table 1 are organized into four parts. Part 1 included those competencies which were perceived as being more important to the student teacher with each subsequent administration of the instrument. The student teachers perceived the importance of these competencies to be above average. The mean values observed for O_3 were 4.1 or higher using the one-to-five point Likert-type scale. The competency, maintain healthy environmental conditions in the laboratory, was perceived as the most important competency by the student teachers (O_3, X = 4.76).

Part 2 of Table 1 included those items which were perceived as being more important just prior to student teaching than they were after the student teaching experience. Again, the student teachers perceived these competencies as having above average importance. The mean values observed for O_2 and O_3 were 3.8 and higher. Many of these competencies were related to safety. For example, the mean value for, provide and document safety instruction, dropped from 4.83 (O_2) to 4.76 (O_3); the mean value for, conduct regular safety inspections and correct hazardous conditions, decreased from 4.78 (O_2) to 4.65 (O_3).

Several competencies in Part 3 were perceived to be less important just prior to student teaching (O_2) than they were perceived to be after the student teaching experience (O_3). Student teachers perceived these competencies as having above average importance. The mean values observed for O_3 were 3.6 and higher. The greatest increase in mean values between O_2 and O_3 occurred for the competencies, plan and implement student recruitment activities for the agricultural mechanics program, and, develop and/or maintain a file of educational projects and activities.

Part 4 of Table 1 includes those competencies which were perceived as being less important each time the instrument was administered. Many of these competencies focused on documentation procedures such as utilizing computerized inventory and billing procedures, documenting the mastery of student competencies, and developing a maintenance schedule for agricultural mechanics lab equipment. The mean values observed for Part 4 were 3.4 and higher. The competency that decreased in importance the most was, develop a written statement of agricultural mechanics lab policies.

Analysis of variance was used to identify five competencies that were statistically significant at the .10 level of probability. The .10 level of probability was selected due to the exploratory nature of the study (Borg & Gall, 1983). The five statistically different competencies included the following: develop an identification system to deter tool/equipment theft; make minor repairs to the agricultural mechanics lab facility; maintain healthy environmental conditions; identify tools, equipment, and supplies required to teach agricultural mechanics skills; and develop educational projects/activities.

Table 1
Importance of Agricultural Mechanics Laboratory Management Competencies Perceived by Students Before and After Student Teaching (N = 19)

Competency	(O_1) Before Methods Course (N = 16)	(O_2) After Methods Course (N = 16)	(O_3) After Student Teaching (N = 16)
Part I: Competencies perceived by student teachers as having more importance each time the instrument was administered.			
1. Maintain healthy environmental conditions	4.38	4.50	4.76
in lab.	.62	.51	.44
2. Develop ID system to deter tool/equipment	4.00	4.28	4.53
theft.	.63	.67	.51
3. Develop procedures for storage/distribu-	4.19	4.28	4.29
tion of consumable supplies.	.66	.67	.59
4. Develop procedure to ensure proper ag.	4.06	4.22	4.29
mech lab cleanup.	.68	.55	.59
5. Identify/select current references/tech.	4.00	4.17	4.24
manuals.	.63	.38	.66
6. Develop ed. projects and activities for	3.86	4.00	4.24
students.	.62	.59	.56
7. Develop/maintain a file of service operator's	3.81	4.06	4.18
manuals for ag. mech. lab equipment.	.54	.54	.53
8. Use technical manuals to order replacement/	3.88	4.11	4.18
repair parts for ag. mech. lab equipment	.50	.47	.64
9. Develop procedures for storage checkout/	4.00	4.00	4.18
security of tools and equipment.	.82	.49	.64
10. Make minor repairs to the ag. mech. lab	3.75	3.78	4.06
facility.	.58	.43	.56
Part II. Competencies perceived by student teachers as having more importance prior to student teaching and less importance after student teaching.			
11. Provide and document safety instruction.	4.69	4.83	4.76
	.60	.38	.44
12. Properly install and maintain safety devices	4.69	4.73	4.65
and emergency equipment.	.60	.58	.31
13. Conduct regular safety inspections and	4.50	4.78	4.65
correct hazardous conditions.	.63	.43	.49
14. Develop/maintain/enforce a student	4.63	4.72	4.65
discipline policy.	.62	.46	.49
15. Store/handle/dispose of hazardous	4.75	4.83	4.59
materials safely.	.58	.38	.71
16. Select/store/maintain protective equipment	4.63	4.67	4.59
for student use.	.62	.49	.62
17. Perform routine maintenance of ag. mech. lab	4.44	4.50	4.41
equipment.	.63	.51	.51
18. Maintain ag. mech. lab in compliance with	4.44	4.50	4.35
OSHA standards.	.81	.62	.70
19. Promote lab safety by color coding equip., by	4.31	4.39	4.29
marking safety zones, and by posting warnings.	.70	.78	.59
20. Arrange equipment in lab to enhance safety/	4.38	4.39	4.29
efficiency/learning.	.50	.50	.47
21. Make minor lab equipment repairs.	4.38	4.39	4.24
	.62	.50	.66
22. Diagnose malfunctioning ag. mech. equipment.	4.44	4.44	4.24
	.63	.71	.56

Competency		(O$_1$) Before Methods Course (N = 16)	(O$_2$) After Methods Course (N = 16)	(O$_3$) After Student Teaching (N = 16)
23.	Construct/maintain welding booths, work benches, storage areas.	4.13	4.22	4.12
		.72	.55	.70
24.	Update ag. mech. course offerings, policy.	3.86	4.06	3.88
		.62	.54	.60
25.	Estimate time required for students to complete projects/activities.	3.94	4.00	3.82
		.68	.69	.53
26.	Prepare bid specifications and order equipment, tools, and supplies.	3.93	4.00	3.77
		.68	.49	.66
Part III.	Competencies perceived by student teachers as having less importance prior to student teaching but more importance after student teaching.			
27.	Administer first aid.	4.69	4.44	4.59
		.60	.62	.71
28.	Develop an accident reporting system.	4.75	4.50	4.59
		.58	.71	.51
29.	Identify tools, equipment, and supplies required to teach ag. mech. skills.	4.19	4.17	4.41
		.54	.57	.51
30.	Inventory shop tools, equipment, and consumable supplies.	4.31	4.28	4.29
		.60	.67	.59
31.	Develop procedure to bill students for project construction materials.	4.19	4.12	4.29
		.75	.60	.59
32.	Recognize characteristics of quality tools and equipment	4.31	4.06	4.24
		.61	.69	.53
33.	Develop objective criteria for evaluation student projects/activities.	4.31	4.00	4.18
		.61	.69	.53
34.	Develop/maintain an adequate inventory of consumable supplies.	4.19	4.11	4.18
		.54	.58	.39
35.	Arrange for professional service person to make major equipment repairs.	4.06	3.83	4.06
		.85	.92	.90
36.	Develop/maintain a file of educational projects and activities.	4.13	3.98	4.06
		.62	.43	.66
37.	Modify facilities/equipment to accommodate handicapped students.	3.88	3.78	4.06
		.89	.88	.83
38.	Designate equipment work stations for each skill area (cold metal, arc welding, elect., etc.) reporting system.	4.13	3.94	4.06
		.50	.64	.56
39.	Plan/implement student recruitment activities for ag. mech. program.	3.75	3.67	4.00
		.77	.49	.50
40.	Develop/operate within constraints of budget.	4.19	3.83	3.94
		.54	.92	.66
41.	Develop rotational plan to move students through ag. mech. skill areas.	4.00	3.83	3.94
		.73	.92	.56
42.	Install stationary power equipment.	3.88	3.56	3.94
		.62	.98	.56
43.	Plan and conduct an ag. mechanics public relations program.	4.13	3.72	3.88
		.50	.58	.60
44.	Silhouette tool/equipment cabinets.	3.69	3.22	3.59
		.70	.73	.94
Part IV:	Competencies which were perceived as being less important both prior to and following student teaching.			
45.	Develop written statement of ag. mech. lab policies.	4.50	4.50	4.18
		.52	.62	.64

Competency	(O_1) Before Methods Course (N = 16)	(O_2) After Methods Course (N = 16)	(O_3) After Student Teaching (N = 16)
46. Develop a maintenance schedule for ag. mech. lab equipment.	4.19 .40	4.11 .68	4.00 .61
47. Develop a system to document achievement of student competencies.	4.19 .66	4.06 .54	3.82 .81
48. Make major ag. mech. lab equipment repairs.	4.00 .89	3.94 .80	3.82 .73
49. Computerize lab management functions (inventory, billing, accounting, etc.)	3.63 .62	3.61 .78	3.53 .51
50. Maintain computerized student academic records.	3.56 .73	3.44 .71	3.35 .86

Note. O_1 was administered after one week of the agricultural mechanics teaching methods course.
O_2 was administered just prior to the student teaching experience.
O_3 was administered just after the students had completed both the agricultural mechanics teaching methods course and the student teaching experience.

The student teachers perceived these competencies as being more important after completing their student teaching experience. The means, standard deviations, F values, and probabilities are presented in Table 2.

Table 2
Analysis of Variance Tests Among Respondents by Time of Measurement and the Laboratory Management Competency

Competency	(O_1) Before Methods Course	(O_2) After Methods Course	(O_3) After Student Teaching	F	p	SiD
1. Develop ID system to deter tool/ equipment theft.	4.00 .62	4.28 .67	4.53 .51	2.79	.0779	1=3
2. Make minor repairs to the ag. mech. lab facility.	3.75 .57	3.77 .43	4.06 .56	3.16	.0572	2=3 1=3
3. Maintain healthy environ. conditions.	4.38 .62	4.50 .51	4.76 .44	3.51	.0432*	1=3
4. Identify tools, equip. and supplies required to teach ag. mech. skills.	4.19 .54	4.17 .57	4.41 .51	2.66	.0873	1=3 2=3
5. Develop educational projects/activities.	3.88 .62	4.00 .59	4.24 .56	2.91	.0706	1=3

Note. O_1 was administered after one week of the agricultural mechanics teaching methods course.
O_2 was administered just prior to the student teaching experience.
O_3 was administered after the students had completed both the agricultural mechanics teaching course and the student teaching experience.

Discussion

Analysis of Table 1 - Part 1 indicated that 10 of the 50 competencies were reinforced by the agricultural mechanics teaching methods course. It also appeared that the student teaching experience reinforced the perceptual importance of these competencies.

The 16 competencies reported in Table 1 - Part 2 appeared to be reinforced by instruction during the teaching methods course. The student teaching experience, however, failed to reinforce the student teacher's perceptual importance of these competencies. This was unfortunate because approximately 50% of the competencies in that category related to safety.

Ten of the 18 competencies in Table 1 - Part 3 specifically related to projects and tools/equipment. Although the competencies were taught as a part of the agricultural mechanics teaching methods course, their perceptual importance declined immediately prior to the student teaching experience. Fortunately, the student teaching experience reinforced the perceptual importance of these competencies.

Table 1 - Part 4 included the six competencies which declined in perceptual importance each time the instrument was administered. A comparison of the mean values reported by student teachers and the mean values provided by agricultural mechanics experts (Johnson & Schumacher, 1988) suggest that normal regression had occurred.

All of the competencies which were statistically different at the .10 level of probability differed between O_1 and O_3. Because only two of these competencies were statistically significant between O_2 and O_3, the researchers inductively reasoned that the combined effect of the agricultural mechanics methods instruction and the student teaching experience impacted the students' perceptions of these competencies.

Conclusions

Student teachers recognized the importance of laboratory management when teaching agricultural mechanics. Thirty-eight of the 50 competencies were observed to have mean values of 4.00 or higher. The mean values observed were as high and higher than those reported by Johnson (1989).

The student teaching experience reinforced competencies relating to tools/equipment, project construction, and agricultural mechanics public relations. Agricultural mechanics methods coursework failed to increase the perceptual importance of these competencies. This supports the conclusions suggested by Hodges (1982).

It should be noted that many of the differences observed were not statistically significant; however, an overview of the data clearly suggested that the perceptual importance for several of the safety-related competencies decreased during the student teaching experience.

Recommendations

The importance of safety-related competencies should be stressed during supervising teacher workshops and student teacher visits. A trend clearly existed within the data indicating that the student teacher placed less importance on safety-related competencies after having student taught. The trend was not surprising because an analysis of Johnson's (1989) data indicated that the average agriculture teacher in the state placed less perceptual importance on safety-related competencies than did the student teachers.

Teacher educators should ascertain criteria for identifying student teaching centers that promote the development of these laboratory management competencies. An overview of the data suggested that some of the competencies may not have been strongly reinforced during the student teaching experience. The statistically different competencies appeared to be positively reinforced both by methods instruction and by the student teaching experience.

Data collection should be continued from successive groups of Missouri student teachers and should be pooled in order to allow more rigorous statistical analysis. Such analysis may indicate further changes needed in agricultural mechanics methods instruction.

Implications

Much work has been conducted in an effort to determine and validate competencies needed by secondary agriculture students. Johnson and Schumacher (1988) identified and validated the laboratory management competencies required of secondary agriculture teachers. These competencies serve as a guide for teacher educators and, as such, help ensure that student teachers are taught these competencies.

This research identified competencies that (a) were reinforced by both the teaching methods course and the student teaching experience, (b) were reinforced more strongly by the student teaching experience than by the teaching methods course, (c) were reinforced more strongly by the teaching methods course than by the student teaching experience, and (d) declined in importance after both experiences.

Although the number of participants in this study was small and although further research must be conducted to substantiate the findings of the investigation, implications for teacher preparation and inservice instruction for supervising teachers are evident. Items that were positively reinforced during methods instruction and the student teaching experience must continue to be emphasized. Competencies that appeared to be positively reinforced by the student teaching experience but not reinforced during the methods instruction might best be taught in greater depth after the student has student taught. Competencies taught that were not reinforced during student teaching but were reinforced during methods instruction should be carefully examined and discussed with supervising teachers during supervisory visits and during supervising teacher inservice education. Lastly, competencies that were perceived as less important after both the teaching methods course and student teaching should be analyzed closely by both teacher educators and supervising teachers.

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