STUDENT ACHIEVEMENT AND FACTORS RELATED TO ACHIEVEMENT IN A STATE FFA AGRICULTURAL MECHANICS CONTEST

Donald M. Johnson, Assistant Professor
Mississippi State University

Agricultural educators profess that a total secondary agricultural education program consists of three essential and interdependent components. These components are classroom and laboratory instruction, supervised agricultural experience, and the FFA (Phipps and Osborne, 1988).

FFA contests are designed to complement classroom and laboratory instruction. According to the 1989 Official FFA Manual (National FFA Supply Service, p. 44), "All FFA Contests are to be a natural outgrowth of the instructional program. The contests help make classes more interesting and encourage the development of special skills."

Smith and Kahler (1987, p.45) stated that "In order for the national FFA contests to provide truly educational activities, these contests must be continuously evaluated and revised." This statement is also true for FFA contests at the chapter, district, and state levels.

Buriak, Harper and Gliem (1985) analyzed contestant scores on the National FFA Agricultural Mechanics Contest. The researchers found that undetermined contestant variables accounted for a majority of the variance in the total contest scores. Buriak, Harper and Gliem (1985, p.32) concluded that "Investigations of the prediction value of selected variables could prove useful in the development and enhancement of the contest."

Research has indicated that several student characteristics are associated with achievement in agricultural mechanics. These characteristics include: gender, number of mathematics courses completed, average grade in mathematics courses, average grade in agriculture courses, and farm work experience (Chapman, 1988; Brozozowski, 1988; and Birkenholz, Stewart, McCaskey, Ogle, and Linhardt, 1989).

Agricultural educators in Mississippi determined that a need existed to assess student achievement and factors related to achievement in the Mississippi State FFA Agricultural Mechanics Contest. It was reasoned that the findings of this study could be used to evaluate and improve the state agricultural mechanics contest.

Purpose and Objectives

The purpose of this study was to examine student achievement and factors related to achievement in the 1990 Mississippi FFA Agricultural Mechanics Contest. Specific objectives were as follows:

1. To describe students participating in the 1990 Mississippi FFA Agricultural Mechanics Contest on the characteristics of (a) age, (b) gender, (c) grade level, (d) number of years of agricultural education completed, (e) average grade in agriculture classes, (f) number of years of mathematics completed, (g) average grade in mathematics classes, and (h) farm residence and/or work experience.

2. To describe student achievement in the 1990 Mississippi FFA Agricultural Mechanics Contest as indicated by contest scores.

3. To determine the relationship between student achievement in the 1990 Mississippi FFA Agricultural Mechanics Contest and selected student demographic characteristics.

4. To determine if a linear combination of student demographic characteristics could explain a significant portion of the variance associated with achievement in the 1990 Mississippi FFA Agricultural Mechanics Contest.

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Procedures

This study employed a descriptive-correlational research design. The population was composed of all students competing in the 1990 Mississippi FFA Agricultural Mechanics Contest (N=27). All members of the population were included in the study and provided useable data.

The Mississippi FFA Agricultural Mechanics Contest is divided into the following subject matter areas: (a) agricultural power and machinery, (b) agricultural structures and electrification, and (c) agricultural construction and soil and water conservation. Each contestant completes two skill activities and one problem solving activity for each of the three subject matter areas. In addition, each contestant completes a 30-item multiple choice examination which includes 10 items from each subject matter area. The maximum total individual score which can be achieved is 150 points (six skill activities at 15 points each, three problem solving activities at 10 points each, and one written examination worth 30 points).

The Mississippi state contest follows the same format and rotation schedule as the National FFA Agricultural Mechanics Contest. All state contest activities and test items were developed based on the validated list of competencies suggested for the national contest (National FFA Contest Bulletin #4, National FFA Organization, 1988).

In order to meet the research objectives, student scores were analyzed for each contest activity and for the total contest. In addition, an eight item instrument was developed and administered to each student to determine relevant demographic characteristics. Demographic items were selected based on a review of previous research concerning characteristics related to achievement in agricultural mechanics (Chapman, 1988; Brozozowski, 1988; and Birkenholtz, et al., 1989).

The SAS/PC computer program (SAS Institute, 1988) was used for data analysis. Data for objectives one and two were analyzed by calculating means, standard deviations, and percentages. Pearson product-moment and point-biserial correlation coefficients were calculated, as appropriate, to meet objective three. An alpha level of .05 was established a priori to evaluate the statistical significance of all bivariate correlation coefficients. Data for objective four were analyzed using stepwise multiple regression. Based upon recommendations in the SAS User's Guide: Statistics (SAS Institute, 1985), the .10 alpha level was selected as the critical standard for exploratory regression analysis.

Results

The typical contestant in the 1990 Mississippi FFA Agricultural Mechanics Contest was male (100%), 18 years old (36%), and did not live or work on a farm (56%). Table 1 presents descriptive statistics for the contestant demographic characteristics of interest in this study.

Table 1
Summary of Selected Contestant Demographic Characteristics

Characteristic	X	SD
Age	16.88	1.24
Grade level	11.32	.75
Years of agricultural education	2.84	.94
Average grade in agriculture	3.64	.49
Years of mathematics	2.88	.78
Average grade in mathematics	2.50	.86

Note: Calculated on the basis of A = 4, B = 3, C = 2, D = 1, and F = 0.

The mean total contest score was 56.93 points (37.95%) out of the 150 points possible. Total contest scores ranged from a low of 32 (21.33%) to a high of 78 (52.0%). Contestants scored highest on the skill activity of setting a clock timer (11.67/15; 77.8%) while scoring lowest on the problem solving activity of calculating concrete yardage (.52/10; 5.2%). Table 2 presents a summary of scores for each contest area as well as for the total contest.

Table 2
Summary of Contestant Scores for the 1990 Mississippi FFA Agricultural Mechanics Contest

Contest activity	Points Possible	X	SD	Percent Score
Ag. Structures & Electrification				
Lay out a brace+	15	2.56	2.64	17.06
Set a clock timer+	15	11.67	4.60	77.80
Calculate concrete yardage•	10	0.52	1.34	5.20
Ag. Power & Machinery				
Assemble small engine ignition system+	15	8.22	4.85	54.80
Identify A.S.A.E. hand signals+	15	6.48	2.58	43.20
Locate info. in service manual•	10	3.30	1.81	33.00
Ag. Construction & Soil & Water				
Horizontal SMAW fillet weld+	15	4.63	3.09	30.87
Lay out and drill metal+	15	4.56	4.29	30.40
Calculate tap drill size and drill press rpm•	10	1.81	1.82	18.10
Written Examination	30	13.19	3.00	43.97
Total Contest Score	150	56.93	13.66	37.95

Note. + = skill activity
• = problem solving activity

Five of eight student demographic characteristics (grade level, average grade in agriculture, number of years math completed, average grade in math, and farm residence and/or work experience) had a significant ($p < .05$) positive correlation with total contest score. Two characteristics, age and number of years of agricultural education completed, were not significantly related to total contest score. There was no variation in gender of the contestants (100% male). Table 3 shows correlation coefficients for the relationship between each of the seven characteristics and the total contest score.

Table 3
Relationship Between Contestant Demographic Characteristics and Total Contest Score

Characteristic	Total Contest Score r	r^2
Age	.26•	.07
Grade level	.50•	.25
Years of agricultural education	.07	.00
Average grade in agriculture	.57•	.32
Years of math	.57•	.32
Average grade in math	.46•	.21
Farm residence and/or work experience	.41•	.17

Note: $p < .05$.

The five contestant demographic characteristics which were found to be significantly related to the total contest score (Table 3) were further analyzed to determine if a model could be constructed which would explain a significant portion of the variance associated with the total contest scores. The first step in this process was to determine the inter-correlation between each pair of potential predictor variables (Ferguson, 1981). These correlation coefficients are presented in Table 4.

Table 4
Inter-correlations Between Potential Predictor Variables

	GRADE	LWFARM	GRDAG	YRMTH	GRDMTH
GRADE	1.00				
LWFARM	-.17	1.00			
GRDAG	.60	.00	1.00		
YRMTH	.64	.03	.51	1.00	
GRDMTH	.15	.11	.48	.25	1.00

Note: GRADE = Grade level, LWFARM = Farm residence and/or work experience, GRDAG = Average grade in agriculture classes, YRMTH = Number of years of mathematics completed, GRDMTH = Average grade in mathematics classes.

In order for a variable to serve as a good predictor in a regression model, the variable should possess two characteristics: a high correlation with the variable to be predicted and little or no correlation with other potential predictor variables (Borg and Gall, 1983; Pedhazur, 1982). Based upon examination of Table 3 and Table 4, two variables were selected which most closely met these requirements. These variables were average grade in agriculture classes and farm residence and/or work experience (dummy coded, No = O; Yes = 1).

Table 5 presents the results of the stepwise regression procedure. Both variables entered into the prediction equation.

Table 5
Stepwise Regression of Total Contest Score on Selected Student Characteristics

Characteristic	Partial R	Model R^2	F	P
GRADEAG	.297	.297	8.465	.0087
LWFARM	.121	.418	3.961	.0611

Note: GRADEAG = Average grade in agriculture classes
LWFARM = Farm residence and/or work experience

Average grade in agriculture classes (GRDAG) entered first, accounting for 29.7% of total contest score variance. Whether the student lived and/or worked on a farm (LWFARM) entered second and accounted for an additional 12.1% of the unique variance. Together, these two variables were capable of explaining approximately 42% of total contest score variance.

Conclusions

This study sought to examine student achievement and factors related to achievement in the 1990 Mississippi FFA Agricultural Mechanics Contest. Although data were collected for the 1990 contest only, the findings of this investigation may have implications for planning, conducting and evaluating future agricultural mechanics contests in Mississippi and other states with similar programs and contests. The following conclusions were formulated as a result of this study.

Female students did not participate in the state FFA agricultural mechanics contest. This is consistent with research by Cole (1985) which indicated that agricultural mechanics was the only area of agricultural education where sex-equity had not been achieved.

The overall level of student achievement in the state FFA agricultural mechanics contest was low as evidenced by a mean total contest score of 56.93 points out of a possible 150 points. Student achievement was especially low for the two problem solving activities of calculating concrete yardage (5.20%) and calculating tap drillsize and drill press rpm (18.10%). These scores indicated that the contestants possessed a low level of mathematical problem solving ability. This finding is consistent with research by Gliem and Warmbrod (1985) which found that secondary agriculture students perform poorly when solving mathematical word problems related to agricultural mechanics.

Contestants who had completed more years of mathematics, received higher grades in mathematics and agriculture classes, were in higher grade levels, and lived and/or worked on a farm tended to achieve higher total contest scores. This finding is consistent with research on agricultural mechanics achievement in the general secondary school population (Brozozwski,1988; Chapman, 1988).

The contestant characteristics of age and number of years of agricultural education completed were not significantly related to overall contest achievement. This finding is also consistent with research on agricultural mechanics achievement in the general secondary school population (Brozozowski, 1988; Chapman, 1988).

The best predictor of overall contest achievement was a linear combination of average grade in agriculture classes and farm residence and/or work experience. Together, these two characteristics were capable of explaining approximately 42% of the total contest score variance. Again, this finding is consistent with the results of previous research on agricultural mechanics achievement (Brozozowski, 1988; Chapman, 1988).

Recommendations

Research should be conducted to determine why females are under-represented in the state FFA agricultural mechanics contest. If barriers to participation exist, efforts should be made to eliminate them.

Agricultural educators in Mississippi should examine the degree of congruence between the agricultural mechanics competencies listed in the state standardized curriculum, those competencies actually taught by agricultural education instructors, and those competencies listed in the National FFA Contests Bulletin #4 (National FFA Organization, 1988). Possible discrepancies between these three areas might yield additional insight concerning student performance on the 1990 state contest.

Further research should be conducted to examine the mathematical problem solving abilities of Mississippi secondary agriculture students. If results similar to those reported in this study are found, instructional programs should be designed to improve mathematical problem solving ability. Research should be conducted to determine additional characteristics related to achievement in agricultural mechanics. Data should be collected from successive groups of Mississippi FFA Agricultural Mechanics Contest participants. Such data would provide additional information for contest refinement and improvement.

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