A Three Year Study of Student Achievement and Factors Related to Achievement in a State FFA Agricultural Mechanics Contest

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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 (Newcomb, McCracken and Warmbrod, 1986; Phipps and Osborne, 1988).

Contests are an integral part of the FFA at the local, state, and national levels (Binkley and Byers, 1982). According to the National FFA Organization (1991). "FFA contests make classroom instruction come alive as students use their skills in competitive settings. Contests help develop technical knowledge, judgement. reasoning, and sportsmanship" (p. 50).

Smith and Kahler (1987) estimated that approximately 87,000 students participate in state and local FFA contests each year. According to Smith and Kahler (1987), these contests ". . . have a broad impact on the educational experience of some 468,953 students enrolled in vocational agriculture and participating in the FFA organization" (p. 45).

FFA contests are intended to be educational experiences for the participants (Binkley and Byers. 1982). According to Smith and Kahler (1987), "In order for the national FFA contests to provide truly educational experiences, these contests must be continuously evaluated and revised" (p. 45). This statement is just as valid for FFA contests conducted at the chapter, district, and state levels.

Buriak. Harper, and Gliem (1985) performed an internal evaluation of the National FFA Agricultural Mechanics Contest using contest scores and selected contestant demographic variables. According to Buriak et al. (1985):

> This investigation demonstrates the utility of contest score evaluation and the need for further evaluation. Investigations of the prediction value of selected variables could prove useful in the development and enhancement of the contests. The use of trend analysis could explore the progress of contestants' scores in the various areas of a contest and may indicate areas needing particular attention (p. 32).

Previous research (Brozozowski, 1988; Chapman, 1988; and Johnson, 1991) 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.

Johnson (1991) examined factors related to achievement in the 1990 Mississippi State FFA Agricultural Mechanics Contest. Using descriptors established by Davis (1971). low to moderate positive relationships were found between the students' total

contest scores and the variables of age, grade level, average grade in agriculture courses, years of mathematics completed, average grade in mathematics courses, and farm work experience.

The results of Johnson's (1991) study were limited by the small population (N=27) size and by the fact that data were collected for only the 1990 contest. The present study incorporates data from two additional contest years (1991 and 1992) in an attempt to provide more in-depth information on student achievement and factors related to achievement in a state FFA agricultural mechanics contest. The findings of this study should provide further information with which to evaluate and improve the state FFA agricultural mechanics contest.

Purpose and Objectives

The purpose of this study was to examine student achievement and factors related to achievement in the 1990-1992 Mississippi State FFA Agricultural Mechanics Contests. Specific objectives were to:

Describe students participating in the 1990-1992 state FFA agricultural mechanics contests on the variables of: age. gender, grade level, number of years of agricultural education completed, average grade in agriculture classes, number of years of mathematics completed, average grade in mathematics courses, farm work experience, previous contest experience, and use of a calculator during the contest.

Describe student achievement in the 1990-1992 state FFA agricultural mechanics contests as indicated by contest scores.

Determine the relationship between student achievement in the 1990-1992 state FFA agricultural mechanics contests and selected student demographic variables.

Determine if a linear combination of student demographic variables could explain a significant portion of the variance associated with achievement in the 1990-1992 state FFA agricultural mechanics contests.

Procedures

This study employed a descriptive-correlational design. The population was composed of all students competing in the 1990-1992 Mississippi State FFA Agricultural Mechanics Contests (N=73). Contest score data were obtained for all 73 participants; demographic information was available for 68 (93%) of the contest participants.

The Mississippi State FFA Agricultural Mechanics Contest is divided into the following subject matter areas: agricultural structures and electrification, agricultural power and machinery, and agricultural construction and soil and water conservation.

During the contest each participant completes two skill activities and one problem solving activity in each of the three contest areas. In addition. each contestant completes a 30-item multiple choice examination which includes IO items from each of the three subject matter areas.

The Mississippi State Agricultural Mechanics Contest is an open-entry contest; any team can compete in the state contest without participating or placing in the district contest. 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 are developed based on the validated list of competencies suggested for the national contest (National FFA Organization, 1990).

In order to meet the research objectives, student scores were analyzed in the following contest areas: agricultural structures and electrification skills, agricultural power and machinery skills, agricultural construction and soil and water conservation skills, problem solving activities, written examination and total contest score. A maximum score of 30 points was possible in each of the five contest areas. One-hundred and fifty points was the maximum total contest score (5 areas at 30 points each).

Information about student demographic characteristics was collected using a researcher designed instrument. The eight-item instrument used in 1990 (Johnson, 1991) had been developed based on a review of research concerning characteristics related to achievement in agricultural mechanics (Brozozowski, 1988; Chapman, 1988). Based on informal observations and discussions with coaches and contestants following the 1990 contest, two additional items (previous district or state agricultural mechanics contest participation and use of a calculator during the contest) were added to the instrument for the 1991 and 1992 contest years.

Data for objectives one and two were analyzed using descriptive statistics. Bivariate correlation coefficients were used to analyze data for objective three. Stepwise multiple regression was used to analyze data for objective four. The .10 level of probability was selected **a priori** as the decision standard for the exploratory regression analysis.

Results

The typical contestant in the 1990-1992 Mississippi State FFA Agricultural Mechanics Contests was **male** (100%). approximately 17 years of age, and, by a narrow margin, did not live or work on a farm (53.5%). Slightly fewer than one-half of the participants in the 1991 and 1992 contests had either used a calculator during the contest (41.9%) or competed in a previous district or state FFA agricultural mechanics contest (46.5%). Table 1 presents descriptive statistics for the contestant demographic characteristics of interest in this study.

Overall, students tended to score highest in the agricultural power and machinery skills area (15.07/30; 50.2%). and lowest in the problem solving area 7.04/30; 23.5%). However, there was variation between contest years, with students scoring highest on the written examination in 1991 and on the agricultural construction and soil and water conservation skills area in 1992. Conversely, students scored lowest on the agricultural construction and soil water conservation skills area in 1991. Total contest scores ranged from 47.32 (31.5%) in 1991 to 72.50 (48.3%) in 1992. The mean total contest score for the three year period was 59.15 (39.4%). Table 2 summarizes student achievement in the 1990-1992 contests by year, contest area, and overall.

Table 1. Summary of Selected Contestant Demographic Characteristics, 1990-1992.

Contestant Characteristic	Year 1990 Mean SD	1991 Mean SD	1992 Mean SD	Combined Mean SD
Age	16.88 1.24	17.10 1.29	16.83 1.37	16.93 1.29
Grade	11.32 0.75	10.95 0.82	10.83 0.94	11.04 0.85
Years of Agriculture	2.84 0.94	2.74 1.09	2.44 1.08	2.67 1.04
Average Grade in Agriculture*	3.68 0.48	3.56 0.62	3.55 0.61	3.60 0.56
Years of Mathematics	2.88 0.78	2.30 0.57	2.47 0.95	2.57 0.82
Average Grade in Mathematics*	2.50 0.86	2.74 0.87	2.25 0.91	2.49 0.89

*Note: A="4", B="3", C="2", D="1 ", F="0".

Table 2. Student Achievement in the Mississippi State FFA Agricultural Mechanics Contest, 1990-1992.

Contest Area (Possible Points	Year 1990 Mean SD	1991 Mean SD	1992 Mean SD	Overall Mean SD
	n=27	n=22	n=24	n=73
Agricultural Structures and Electrification Skills (30 pts.)	14.22 5.34	9.91 6.32	9.54 6.01	11.38 6.19
Agricultural Power and Machinery Skills (30 pts.)	14.70 5.36	10.23 3.61	19.92 5.11	15.07 6.13
Agricultural Construction and Soil and Water Skills (30 pts.)	9.19 4.65	6.05 5.49	22.75 5.84	12.70 8.91
Problem Solving Activities (30 pts.)	5.63 3.53	9.45 4.75	6.42 4.05	7.04 4.36
Written Examination (30 pts.)	13.19 3.00	11.73 2.57	13.92 3.32	12.99 3.08
Total Contest Score (150 pts.)	56.93 13.66	47.32 17.25	72.50 14.77	59.15 18.11

Using descriptors suggested by Davis (1971). the relationships between total contest score and the student characteristics of age. grade level, years of agricultural education completed, and average grade in mathematics courses were negligible. Average grade in agriculture and farm work experience had low, positive relationships with total contest score. Moderate, positive relationships existed between total contest score and years of mathematics completed, previous contest experience, and use of a calculator. Table 3 presents the correlation coefficient and the coefficient of determination for the relationship between total contest *score* and each of the demographic characteristics investigated.

Table 3. Relationship Between Contestant Demographic Characteristics and Total Contest Score

Characteristic	Total Contest Score r	r^2
Age	-.06	.oo
Grade Level	.08	.01
Years of Agricultural Education Completed	.oo	.oo
Average Grade in Agriculture Courses	.14*	.02
Years of Mathematics Completed	.32**	.10
Average Grade in Mathematics Courses	.06	.oo
Farm Work Experience	.21*	.04
Previous Contest Experience	.34**	.12
Use of Calculator	.47**	.22

Note: * = low relationship; ** = moderate relationship (Davis, 1971).

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 (Pedhauzer, 1982). After examination of the intercorrelation matrix (Table 4), three variables were selected which most closely met these requirements: farm work experience, years of mathematics completed, and use of a calculator during the contest.

Table 4. Intercorrelations Between Potential Predictor Variables

Variable	Xl	X2	X3	X4	X5
Average Grade in Agriculture Classes (Xl)	1.00				
Years of Mathematics Completed (X2)	.31	1.00			
Farm Work Experience (X3)	.00	.05	1.00		
Previous Contest Experience (X4)	-.04	.12	.25	1.00	
Use of Calculator (X5)	-.12	-.13	.15	.44	1.00

Table 5 presents the results of the stepwise regression procedure. Two variables, use of a calculator during the contest and years of mathematics completed, entered into the regression model. Together, these two variables were capable of explaining approximately 35% of the variance in total contest scores for the 1991 and 1992 contests. (Note: since information on use of a calculator and previous contest experience was not collected for 1990 contest participants, the 1990 contest group was excluded from the regression analysis).

Table 5. StepwiseRegression of Total Contest Score on Selected Student Characteristics

Characteristic	Partial R^2	Model R^2	F	prob
Use of a Calculator	.244	.244	11.83	.001
Years of Mathematics	**.130**	.354	8.02	.007

Note: df = 1,41

Conclusions and Recommendations

The overall level of student achievement in the state FFA agricultural mechanics contest was low. However, interpretation of this finding must be tempered with the realization that contests represent a rather unique form of student evaluation. Since contests are intended to discriminate among individuals, contest activities include items that represent a wide range of difficulty. Therefore, by definition and design, some contest activities will be too difficult for almost every contestant to complete with 100 percent accuracy. However, the results of this study do indicate that future contest planners should attempt to develop activities which are more within the capabilities of contest participants. Such activities should be challenging and discriminate among contestants while still providing participants with the opportunity to achieve higher levels of success.

Average grade in agriculture courses. years of mathematics completed, and farm work experience were all positively related to achievement in the agricultural mechanics contest. These three variables were also found to be positively related to achievement in the 1990 contest study (Johnson, 1991).

Age and number of years of agricultural education completed were not related to contest achievement. This is consistent with previous research (Brozozowski. 1988; Chapman, 1988) and with Johnson's study of the 1990 contest (Johnson, 1991). The lack of a relationship between achievement and number of years of agricultural education completed should be examined further. Future research efforts should seek to determine the relationship between the quality and quantity of agricultural mechanics instruction provided at the local level and student achievement in the state FFA agricultural mechanics contest.

Additionally, this study found that use of a calculator during the contest and previous contest experience were positively related to contest achievement. Although this does not prove a causal relationship, agriculture teachers should be encouraged to enter their agricultural mechanics teams in the district contest and to ensure that each participant brings a calculator for use during the contest.

Use of a calculator during the contest and years of mathematics courses completed combined to explain approximately 35 percent of the variance in contest achievement. This underscores the importance of mathematics to achievement in agricultural mechanics. This finding is supported by Gliem and Warmbrod (1986). Further research should be conducted in this area to develop a greater understanding of the relationship between mathematical and mechanical abilities.

The results of this study will be used to improve future Mississippi State FFA Agricultural Mechanics Contests. In addition, the results have substantiated previous research concerning student characteristics which are (and are not) related to achievement in agricultural mechanics. Future studies should seek to expand on this base in an effort to both enhance knowledge and improve practice.

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