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Effects of Two I. structional Techniques Used with the Fo. J Power Train Simulator on the Perfo1 ·nance of Mississippi Vocational A. iculture Students

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In recent years, the power train unit has been considered a means of simulating the service and repair of agricultural tractors. Jacobs (1974) indicated some 1,767 units had been distributed to high schools, vocational schools, and community colleges. He further indicated that many of the units were not being used to their potential. A recent survey by the State Department of Education in Mississippi (1980) indicated that of the 40 power train units in vocational agriculture departments in Mississippi, many were not being used. This lack of use raises the question of the power train's importance as an instructional aid; if implemented into the teaching process, what instructional technique will improve its effectiveness?

Objectives of the Study

The purpose of this study was to compare the effects of two instructional techniques using the Ford power train unit as an instructional aid. The instructional techniques used in the study were traditional lecture-demonstration and small group self-study. Instruction in this study was focused on valve train-cylinder head service and repair. Specifically, the study attempted to answer the following questions:

1. What are the short and long-term effects of an instructional technique on cognitive performance scores?

2. What are the effects of an instructional technique on motor skill performance scores?

3. What are the effects of an instructional technique on student attitude?

4. Will there be an aptitude treatment interaction between the instructional technique and student mechanical apitude level?

Definition of Terms

Power train unit. The power train unit is an instructional simulator which consists of the engine and its auxiliary components, the transmission, and final drive of an agricultural tractor.

Trac-Com System. The Trac-Com System is an audiovisual instructional system developed by the Ford Tractor Company to train persons employed as mechanics and service people in Ford tractor dealerships. Filmstrip audio tape presentations have been developed for all major systems on the Ford tractor.

Methods and Procedures

Research Design

This study was conducted during 1981 as a posttest-only control group experiment utilizing a 2 x 2 factorial design as described by Campbell and Stanley (1963). The study was expanded to test for effects extended in time by adding a second cognitive posttest three weeks following the treatments. The experimental independent variables manipulated by the researcher were (a) the type of instruction and (b) mechanical aptitude level. Dependent variables for the experiment were cognitive, psychomotor, and attitude posttest scores.

Population

The population of this study consisted of students in 33 vocational agriculture departments in Mississippi whose laboratory facilities included a Ford power train unit readily available for use as an instructional aid. Eight schools were randomly selected from the population to participate in the experiment. Three schools with 10 students from each school were randomly selected and assigned to Treatment A, traditional lecture-demonstration. Six schools with five students from each school were randomly selected and assigned to Treatment B, small group self-study. Treatment A served as the control group for the experiment. One school which had a farm power machinery class and a general agricultural mechanics class participated in both treatment groups.

Pilot Study

A pilot study was conducted in one school which was included in the population but not randomly selected as part of the experiment. The principal investigator directed and analyzed the instructional procedures, instrumentation, and results. Minor revisions were made in the procedures and test instruments as a result of the pilot study.

Treatments

Two sets of data were collected from the students prior to the treatments. First, a self-reported overall grade point average was collected for use as a covariate in the statistical analysis. Second, students in both groups were given the Science Research Associates *Test of Mechanical Concepts*, developed by Standard and Bode (1976). These scores were used to determine student mechanical aptitude level.

Students in both treatment groups were given identical criterion-referenced objectives at the beginning of the treatments. Students in Treatment A then received approximately four hours of classroom instruction on valve train-cylinder head service and repair through a lecture-demonstration technique. Instructional materials used to teach theory, service, and repair of the valve train system were selected from *Pre-employment Laboratory Training in Agricultural Machinery Service and Repair*, Texas Vocational Instructional Service (1979).

In the laboratory, students received approximately six hours of demonstration and practice in valve train-cylinder head disassembly, inspection, repair, and reassembly. Students completed a laboratory exercise sheet which outlined procedures, specifications, and recommendations for parts analysis. All instruction in Treatment A was directed by the vocational agriculture teacher in each school.

Students in Treatment B received approximately four hours of instruction via a small group self-study technique. At the beginning of the treatment, students were given an instructional packet outlining the learning process. Following an explanation of the instructions, students viewed the Ford Trac-Com Audiovisual System film entitled *Valve Train*. Classroom worksheets reinforcing concepts established in the presentation were completed by each student.

In the laboratory, students completed a six hour exercise identical to that used with Treatment A. In Treatment B, however, students worked in a small group, independent of direct teacher demonstration and supervision. The teacher served only as a resource person in both classroom and laboratory instruction.

Instrumentation

A 30 item cognitive posttest was developed by the researcher to measure cognitive performance immediately following the treatments. A panel of experts examined the test instrument for content validity. A parallel form of the cognitive posttest was also given three weeks following the treatments to test for effects extended in time. The cognitive posttest, which consisted of 30 multiple-choice items, was field tested with three individual groups to establish item reliability. An alpha coefficient item reliability of .65 was established for the instrument.

A psychomotor posttest and scoresheet were developed by the researcher to measure motor skill performance in the area of valve train-cylinder head service and repair. The Ford 4000 repair manual was used to establish criteria for adjustment of intake and exhaust valve lash. A panel of experts examined the instrument for content validity. Students were allowed 10 minutes to complete the test.

A semantic differential attitude scale was used to measure student attitude toward the instructional technique in each of the treatments. An alpha coefficient instrument reliability of .94 was established by Stone (1977).

Analysis of Data

Subjects within each of the two treatment groups were assigned to subgroups on the basis of the Science Research Associates *Test of Mechanical Concepts* scores. Subjects scoring below the mean were classified as low mechanical aptitude. Subjects scoring at the mean or above were classified as high mechanical aptitude. Refer to Table 1 for a diagram of the two-way statistical matrix.

A two-way analysis of covariance was used to analyze the data collected in the posttests. *F* values were calculated for the following: the main effects (instructional technique and mechanical aptitude level), the covariate (grade point average), and the two-way interaction between the instructional technique and mechanical aptitude level. A .10 alpha level was set a priori as the significance level by the researcher.

A Duncan's Multiple Range post-hoc test was used when a significant difference was found within the four subgroups. Cochrans C and Bartlett-Box F tests were used to determine if the homogeneity of variance assumption for analysis of variance was satisfied.

Table 1

Two-Way Statistical Matrix Showing Instructional Technique and Mechanical Aptitude Level

	Mechanical aptitude level	
Instructional technique	Low	High
A (Traditional)	X_{AL}@	X_{AH}@
B (Self-Study)	X_{BL}	X_{BH}

@AL = low, AH = high

Results

Statistical analysis indicated that cognitive and psychomotor posttest scores were not significantly different when performance was measured immediately following the treatments. However, mean scores from a delayed cognitive posttest indicated a significant difference at the .01 alpha level. The alpha level for evaluation of the second cognitive posttest was raised from .10 to .01 after a homogeneity of variance test indicated a violation of this assumption for analysis of covariance (Kennedy, 1978).

A Duncan's post-hoc analysis indicated that students with high mechanical aptitude assigned to Treatment B scored significantly higher than students with low mechanical aptitude assigned to Treatment A. Table 2 presents adjusted mean scores for the delayed cognitive posttest.

The Semantic Differential Attitude Scale indicated that student attitudes toward the instructional techniques did not differ significantly. Even though attitudes did not differ significantly, the *F* value for the two-way interaction resulted in a significant interaction between the main effect variables, instructional technique and mechanical aptitude level. Students in Treatment A with high mechanical aptitude had the most positive attitude while students in Treatment B with high aptitude had the most negative attitude. Figure 1 presents a graph of the interaction of the main effect variables, instructional technique, and mechanical aptitude level.

Table 2

Adjusted Mean Scores of Two-Way Analysis for Cognitive Posttest Two

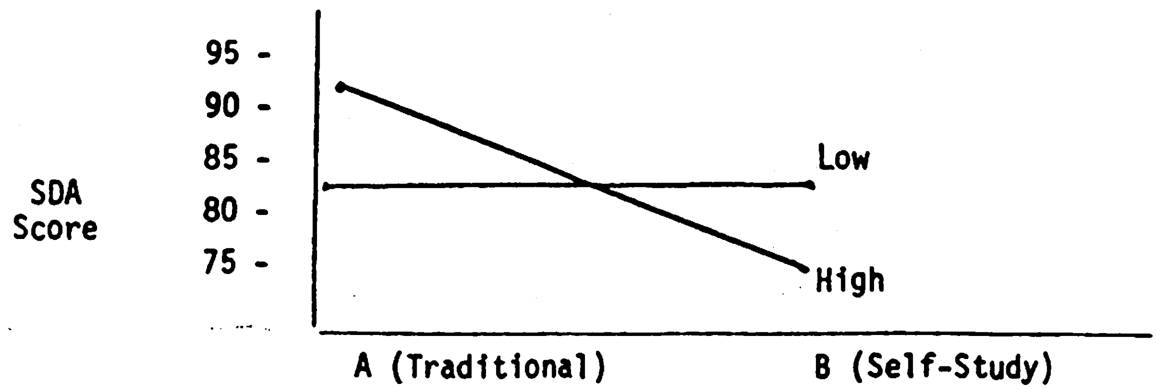
	Mechanical aptitude level	
Instructional technique	Low	High
A (Traditional)	32.47	37.67
B (Self-Study)	44.14	48.59

Implications and Recommendations

Differences between the two treatment groups were not statistically significant when student performance was measured immediately following the treatments. Based on these findings, instruction in valve train-cylinder head service and repair may be implemented to meet the needs of the multidimensional learning situation, either small group self-study or traditional, without significantly affecting immediate student performance. The use of the Trac-Com System in small

Figure 1

Significant Interaction of Instructional Technique and Mechanical Aptitude Level on Semantic Differential Attitude Scale



group self-study may provide a practical means of alleviating problems caused by large classes. Small groups using the power train simulator and the Fort Trac-Com System may independently study the valve train-cylinder head assembly or other tractor systems leaving the instructor more options for large class management.

It was found that students in Treatment B, small group self-study, scored significantly higher on a delayed cognitive posttest than did Treatment A students. Because long-term retention is of major importance, it is recommended that the use of small group self-study be considered for use teaching other systems on the agricultural tractor as well as valve train-cylinder head service and repair.

Attitude scores indicated a significant aptitude-treatment interaction. Students scored higher with self-study but had a negative attitude toward it. High mechanical aptitude students were most negative toward small group self-study and most positive toward traditional lecture-demonstration technique. Through an extensive review of related literature and the results of this study, the researcher analyzed the reasons for the negative attitude toward self-study in the following statements:

1. Self-study is hard work and requires self-motivation.

2. Self-study lacks positive teacher reinforcement.

3. Self-study is somewhat impersonal.

The researcher recommends that teachers using the small group self-study:

1. use an interest approach to properly motivate students to learn;

2. reinforce student success on an individual basis; and

3. scrutinize student performance by insisting on high quality work.

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