THE RELATIONSHIP BETWEEN INSTRUCTION AND STUDENT PERFORMANCE AT THE VARIOUS LEVELS OF COGNITION AMONG SELECTED OHIO PRODUCTION AGRICULTURE PROGRAMS

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Instructional objectives provide a student with a "blueprint" of what is considered important in a given course and create a common understanding between the teacher and student as to what information will be provided by the teacher as well as what is expected of the student. Thus, instructional objectives serve as the basis for a valid and purposeful evaluation of the instructional process and classroom related activities.

Researchers have concluded that a higher proportion of teacher questions (Floyd, 1961; Gall, 1970; Miller, Newcomb, & Whittington, 1989; Newcomb & Trefz, 1987; Pickford, 1988; Ryan, 1974), test questions (Billeh, 1974; Bloom, Englehart, Furst, Hill, & Krathwohl, 1956; Davis & Tinsley, 1967; Miller, Newcomb, & Whittington, 1989; Newcomb & Trefz, 1987), and instructional objectives (Bloom, 1972; Cano, 1988; Davis, Morse, Rogers & Tinsley, 1969; Doak, 1970; Gallagher, 1965) call for a lower level of thinking as opposed to a higher level of thinking on behalf of the students.

An analysis of the literature related to cognitive development of students, indicated a paucity of findings regarding vocational education students' level of cognitive performance. Specifically, research in determining the level of cognitive performance of vocational agriculture students was lacking. However, in a study conducted by Gall (1970), it was concluded that 60% of the teachers' instructional methods required students to merely recall facts (remembering) that had been presented them, about 20% were procedural (processing) in nature, and only 20% required students to actually engage in thought (creating and evaluating) beyond the level of recalling facts.

Relatedly, Gallagher (1965) concluded that the limitation of low level instructional objectives and questions decreased the likelihood of divergent or creative activity on the part of the student. Furthermore, Winne (1979) determined that there was evidence to suggest that a positive relationship existed between the level of the teacher's questioning and student achievement. In addition, Billeh (1974) concluded that the level of instructional objectives or teachers' questions had a direct relationship to the cognitive level which students employed to arrive at satisfactory responses to the questions. Yet in another study, Hunkins (1969) found that students, guided in their study by a preponderance of analysis-evaluation questions, scored significantly higher on a post-test of achievement than those guided by a preponderance of knowledge-type questions written for the same materials.

Purpose and Objectives

The purpose was to determine the cognitive level of planned classroom instruction based upon the written instructional objectives contained within the course of study and students' level of cognitive performance. Furthermore, this study sought to determine the relationship which existed between the cognitive level of planned classroom instruction based upon the written instructional objectives contained within the course of study and the students' level of cognitive performance at the various levels of cognition. The following research questions were investigated:

1. What was the cognitive level of planned classroom instruction based upon the written instructional objectives contained within the course of study taught by vocational agriculture teachers as measured by the Newcomb-Trefz (1987) model?

2. What was the cognitive level of performance by the students as measured by the Newcomb-Trefz (1987) model?

3. What was the relationship between the teachers' cognitive level of planned classroom instruction based upon the written instructional objectives contained within the course of study and the students' cognitive level of performance on a written test?

Procedures

Population and Sample: The population was the production agriculture teachers teaching in Ohio during the 1987-1988academic year. Ten production agriculture teachers were purposefully selected

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by teacher educators and state supervisors to participate in this study. The criteria examined were: student SOE, FFA program, course of study, administrative commitment, and overall facilities. The population selected for this investigation was the twelfth-grade students enrolled in Ohio production agriculture classes. The twelfth-grade students who were taught by the selected production agriculture teachers ($n = 81$) constituted the sample. Thus, the results are generalizable only to the sample.

Design and instrumentation : This was a descriptive-correlational study. The course of study prepared by each production agriculture teacher in the study was used to determine the level of cognition of planned instruction. The written instructional objectives contained within the course of study were used to determine the cognitive level of planned instruction.

A paper-pencil test was developed by the researcher which was administered to the twelfth-grade students enrolled in vocational agriculture programs taught by the selected production agriculture teachers. The paper-pencil test was constructed after analyzing the courses of study to ensure that the paper-pencil test questions were related to the subject matter which had been included in the students' instruction.

The paper-pencil test had four parts, one for each level of cognition as determined by the Newcomb-Trefz (1987) model: Remembering, Processing, Creating, and Evaluating. Each part consisted of 25 multiple-choice questions. Content validity was established by a panel of experts consisting of teacher educators, state supervisors, and former teachers of vocational agriculture. Reliability was established for each part of the test via pilot test. The reliability employing Cronbach's coefficient alpha, were: Remembering, .91; Processing, .90; Creating, .84; and Evaluating, .82.

Data Collection: The teachers selected were asked to personally deliver or mail their courses of study to the researcher. The courses of study were then carefully reviewed page by page by the researcher. Each instructional objective written in each course of study was classified into the appropriate level of cognition following criteria developed by Newcomb and Trefz (1987). The Newcomb-Trefz (1987) model consisted of four (Remembering, Processing, Creating, and Evaluation) cognitive levels rather than six cognitive levels (Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation) as identified by Bloom's (1956) taxonomy.

The paper-pencil test and test administration form were mailed to each of the production agriculture teachers with specific instructions for administration. All tests were administered on May 23 and 24, 1988. After administration of the tests, the teachers returned the tests and test administration forms to the researcher.

Data Analysis: Descriptive statistics (frequencies, percents, standard deviations, and means) were used to determine the level of cognition of instruction and student level of cognitive performance. Canonical correlation analysis was used to determine the relationship between the cognitive level of instruction and student level of cognitive performance.

Results

Cognitive Level of Instruction : As classified by the researcher, approximately 31% of the instructional objectives written by the production agriculture teachers were written at the remembering level of cognition (Table 1). Approximately 38% of the instructional objectives were written at the processing level, 19% at the creating level, and 12% at the evaluating level (Table 1).

Table 1
Distribution of Instructional Objectives Across Levels of Cognition

Level of Cognition	Number of Objectives	Percent of Objectives
Remembering	1045	31.00
Processing	1293	38.36
Creating	626	18.57
Evaluating	407	12.07
Total	3371	100.00

Cognitive Level of Student Performance: Cognitive level of student performance was measured by the mean percent score of correctly answered questions at each level of cognition. The students correctly answered approximately 64% of the remembering-level questions, 55% of the processing-level questions, 40% of the creating-level questions, and 28% of the evaluating questions.

Relationship Between Cognitive Level of Instruction and Cognitive Level of Student Performance: The relationship between the teachers' level of cognitive instruction based upon the written objectives in the course of study and students' level of cognitive performance was calculated using the canonical correlation procedure. Table 3 presents the correlation matrix depicting the relationship between the independent (predictor) and dependent (criterion) variables.

Of the intercorrelations among the criterion variable set, Remembering had a low negative correlation (Davis, 1971) with Creating. Processing had a low correlation (Davis, 1971) with the other variables in the criterion variable set. Creating had low correlations (Davis, 1971) with Remembering (negatively) and Evaluating (positively). Evaluating had a low correlation (Davis, 1971) with Creating.

Among the predictor variable set, relatively strong and positive intercorrelations (Davis, 1971) exist. The correlation was very strong (Davis, 1971) between Remembering and Processing, and between Creating and Evaluating. Substantial correlations (Davis, 1971) between Processing and both Creating and Evaluating were evident. Low correlations (Davis, 1971) existed between Remembering and both Creating and Evaluating.

The correlations between the individual predictor and individual criterion variables resulted in 10 negative coefficients. The coefficients ranged from negligible to moderate (Davis, 1971). Table 3 indicates that of the direct pairs (teacher remembering vs. student remembering, teacher processing vs. student processing, teacher creating vs. student creating, and teacher evaluating vs. student evaluating), two out of four were negatively correlated (Creating and Evaluating) and only one pair (Creating) was moderately correlated (Davis, 1971), but negative.

Table 3
Canonical Correlation Analysis

Function	Eigen Value	Canon Corr.	Canon Corr ^{2}	F	P
1	.453	.557	.312	2.059	.011
2	.033	.178	.032	0.381	.943
3	.009	.092	.008	0.256	.905
4	.005	.071	.005	0.386	.536

Wilks Lambda = .657, F = 2.059, (df 16, 224), p = .01.

Table 4 indicates four functions (four pairs of variates) were derived yielding various canonical correlation scores.

The null hypothesis tested was that all squared canonical correlations ($R^2c(s)$) equaled zero. The Wilks Lambda test was significant at p = .01. The null hypothesis was rejected, indicating that the first squared canonical correlation ($R^2c(1)$) was statistically significant. Following the 10% rule of thumb (Thompson, 1984; Warmbrod, 1987), the remaining squared canonical correlation coefficients ($R^2c(1) = .032$; $R^2c(3) = .008$; and $R^2c(4) = .005$) were less than .10 and were not considered meaningful. In addition, the F statistic revealed that $R^2c(2)$, $R^2c(3)$, and $R^2c(4)$ were not statistically significant and thus were not interpreted.

Standardized Canonical Coefficients: Canonical weights (standardized canonical coefficients) were used as indices of the relative importance of a variable to the canonical variate (function). The researcher selected the variables which indicated a relatively high coefficient in relation to the other variables within a given function. Table 5 indicates that for the criterion variable set, student creating was most important for Canonical Variate 1. For the predictor variable set, teacher remembering, teacher processing, and teacher creating was relatively important for Function 1.

Table 2
Relationship [a] Between Teachers Level of Cognitive Instruction and Students Level of Cognitive Performance (n = 81)

	Criterion Variable Set (% Items Correct) Student Level of Cognitive Performance				Predictor Variable Set (% Instr. Objectives) Teacher Level of Cognitive Instruction			
	R	P	C	E	R	P	C	E
Criterion Variable Set								
Student Remembering	1.000							
Student Processing	.0580	1.000						
Student Creating	-.234	.019	1.000					
Student Evaluating	-.003	-.011	.252	1.000				
Predictor Variable Set								
Teacher Remembering	.225	.017	-.261	-.216	1.000			
Teacher Processing	.194	.013	-.402	-.260	.873	1.000		
Teacher Creating	.272	-.104	-.463	-.176	.144	.557	1.000	
Teacher Evaluating	.292	-.080	-.464	-.220	.285	.647	.911	1.000

Note. R = Remembering; P = Processing; C = Creating; E = Evaluating.
[a] Pearson's Product Moment Correlation Coefficients.

Table 4
Summary of Canonical Correlation Analysis

Variable	Canonical Variate 1 b	Canonical Variate 1 s	Canonical Variate 2 b	Canonical Variate 2 s	Canonical Variate 3 b	Canonical Variate 3 s	Canonical Variate 4 b	Canonical Variate 4 s
Criterion Variable Set								
Student Remembering	.367	.541	.223	.216	.935	.811	-.096	.051
Student Processing	-.108	-.099	-.653	-.651	.200	.266	.726	.704
Student Creating	-.760	-.908	-.144	-.023	.574	.336	-.457	-.249
Student Evaluating	-.236	-.428	.738	.709	-.083	.056	.681	.558
Proportion of Variance		.327		.243		.211		.218
Predictor Variable Set								
Teacher Remembering	.889	.507	.146	-.822	2.071	-.094	3.127	.241
Teacher Processing	-.702	.781	-1.042	-.561	-3.074	-.270	-3.269	-.041
Teacher Creating	.794	.903	1.304	.364	-.787	.184	2.467	-.136
Teacher Evaluating	.409	.931	-.397	.119	2.215	.099	-1.352	-.331
Proportion of Variance		.637		.284		.031		.041
Redundancy		.102		.008		.002		.001
		$R_{c(1)}^2 = .312$		$R_{c(2)}^2 = .032$		$R_{c(3)}^2 = .009$		$R_{c(4)}^2 = .005$

Note. b = Standardized Canonical Coefficient; s = Structure Coefficient

Structure Coefficients: The structure coefficients which can be interpreted as factor loading, are a product-moment correlation between the original variables in each set and the canonical variate scores for a given canonical variate (functions). The rule of thumb (Thompson, 1984; Warmbrod, 1987) is to treat as meaningful structure coefficients which are equal to or greater than .30. The magnitude of the structure coefficients were interpreted following guidelines established by Chuatong (1987). The interpretations were: .25 or lower, Low; .25 to .64, Moderate; and, .65 or greater, High.

On the criterion variable set, student creating ((0.908) loaded highest on Canonical Variate 1. Of the predictor variable set, teacher creating (.903), teacher evaluating (.931), and teacher processing (.781) loaded highest on Canonical Variate 1.

Conclusions and Recommendations

There was a significant relationship between the level of cognition of instruction (measured by percent of instructional objectives) and the student level of cognitive performance (measured by percent of correctly answered text questions). The magnitude of this relationship indicates that the level of instruction students are perceived to receive is congruent to their performance level.

Higher percentages of teachers' instructional objectives were accompanied by lower test scores by students on creating and evaluating test items and higher test scores on remembering test items. Higher values of teacher remembering, processing, creating, and evaluating were associated with higher values on student performance.

The vocational agriculture teachers were writing a higher percentage of instructional objectives at the higher levels of cognition than suggested by the literature (Bloom, 1972; Gallagher, 1965). Conversely, fewer instructional objectives were being written at the lower cognitive levels than the literature would suggest (Bloom, 1972; Gallagher, 1965). The students performed at higher percentages at the various levels of cognition as compared to the findings in previous studies (Gall, 1970; Ryan, 1973).

Teachers of agriculture should further develop a curriculum which appropriately challenges the students at all levels of cognition.

Further research should be conducted; in the level of cognition of instruction and student performance in other vocational areas, in the level of cognition of instruction and student performance in agricultural education on a broader, more comprehensive scale, and to determine why agriculture students are perceived to perform at higher percentages at the various levels of cognition as compared to the findings in previous studies.

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