# COGNITIVE LEVEL OF INSTRUCTION AND STUDENT PERFORMANCE AMONG SELECTED OHIO PRODUCTION AGRICULTURE PROGRAMS

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Three-quarters of a century of educational literature (Chamberlain & Kelly, 1981; Furst, 1981; Ryan, 1973; Stevens, 1912) suggests that the main emphasis in schools has been teaching students facts, even though teachers and curriculum designers have attested to the importance of teaching students to think (Gall, 1970; Roberts, 1974). Newcomb and Trefz (1987) in a study of college professors of agriculture, stated that professors of agriculture concerned themselves with the subject matter their students learned, but that these same professors were less concerned about the cognitive level of their instruction as well as level of student performance.

The authors of this study were concerned that not only teachers of agriculture at the college level, but teachers of agriculture at all educational levels practice the pattern of teaching suggested by Newcomb, and Trefz (1987). If students are limited to repeating back to the teacher that which was given to them, then not much learning of an enduring nature has occurred. And, if insufficient learning occurs at the higher levels of cognition, then students are not graduated adept at operating at the higher orders of cognition, i.e., analysis, synthesis, and evaluation.

The teacher's lack of concern identified by Newcomb and Trefz (1987) regarding the cognitive level of instruction and student performance may not only lead to a lowered teaching standard, but may well lead to a lowered level of competence on the students' behalf. Given the preceding presumption, it is important to determine at what level of cognition students of vocational agriculture are performing.

Inferentially, the related research cannot be applied to agricultural education programs specifically because the populations studied have not included vocational agriculture students. Furthermore, previous related studies have not acknowledged any differences or similarities among vocational agriculture students and the populations studied. As a result, agricultural educators do not know to what levels of cognition of instruction students in production agriculture classrooms are exposed, or at what levels of cognition the students are capable of performing.

## Purpose and Objectives

The purpose was to determine the cognitive level of planned classroom instruction based upon the written objectives in the courses of study utilized by selected public school production agriculture teachers. This study sought to determine the level of cognition at which students in production agriculture classes were performing.

The following research questions were asked:

1. What proportion of planned instructional time was devoted to instruction (in the subject matter areas of leadership, crop production, animal science, agricultural mechanics, and farm management) by the selected production agriculture teachers during the 1987-1988 academic year?

2. What was the cognitive level (remembering, processing, creating, evaluating) of planned instruction based upon the written objectives in the course of study, utilized by the selected production agriculture teachers during the 1987-1988 academic year?

3. To what extent did the cognitive level of planned instruction based upon the written objectives in the course of study, differ among the grade levels (ninth, tenth, eleventh, and twelfth) and subject areas?

4. What was the level of achievement of the students in the study on a written paper-pencil test at the various levels of cognition?

## Procedures

Population and Sample: The population for this study was production agriculture teachers teaching in Ohio during 1987-1988. Ten production agriculture teachers were purposefully selected by teacher educators and state supervisors to participate in this study based upon having met predetermined criteria such as student SOE, FFA program, course of study, administrative commitment, and overall facilities. The twelfth-grade students enrolled in production agriculture classes in Ohio were the population of students. The twelfth-grade students of the teachers selected constituted the sample of students. Thus, the results are generalizable only to the sample.

Instrumentation: The course of study prepared by each production agriculture teacher who participated in the study was used to determine the level of cognition of planned instruction. The proportion of planned time devoted to instruction in each of the subject areas was also determined from the courses of study. Levels of cognition were assumed following procedures established by Newcomb and Trefz 1987).

A paper-pencil test was developed by the researchers and 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 items were related to the subject matter instructed.

The paper-pencil test had four parts: remembering, processing, creating, and evaluating. Each part consisted of 25 multiple choice questions. Content validity was established by a panel of experts. Reliability was established for each part of the test via pilot test. The reliability scores employing Cronbach's 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 researchers. After receipt of the courses of study, they were carefully reviewed page by page by one of the researchers. Each instructional objective written in each course of study was classified into the appropriate level of cognition as described by Newcomb and Trefz (1987). Levels of cognition were assessed following criteria established by Newcomb and Trefz (1987). In addition, the instructional objectives were categorized into the appropriate subject matter area and the number of class days allotted for the instruction was recorded.

The paper-pencil test and test administration form were mailed to each of the 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 form to the researchers by return mail.

## Data Analysis

Descriptive statistics (frequencies, percents, standard deviations, and means) were used to describe the proportion of time spent on instruction in the subject matter areas, the level of cognition of instruction, and student level of cognitive performance. Differences between grade levels and subject areas were determined by using one-way analysis of variance using an .05 alpha level I a priori. n those cases where significant differences were noted, the Tukey-HSD post-hoc analysis procedure was employed to determine where the differences occurred.

## Results

Subject Matter Taught: Table 1 indicates that at the ninth-grade level, the greatest amount of planned instructional time is devoted to the animal science subject area. At the tenth-grade, eleventh-grade, and twelfth-grade levels, the greatest amount of instructional time is in the agricultural mechanics subject area.

Table 2 shows that the production agriculture teachers devoted approximately 9% of the planned instructional time to leadership, 16% to crop production, 18% to animal science, 41% to agricultural mechanics, and 17% to farm management.

Cognitive Level of Instruction: The instructional objectives in each course of study were classified according to the level of cognition of instruction by subject area and grade level. These data are presented in Tables 3 through 6.

Tabk 1
Number and Percent of Planned Instructional Days Devoted to Instruction by Subject Area and Grade Level (n = 10)

| Subject | 9 Days | 9 % | 10 Days | 10 % | 11 Days | 11 % | 12 Days | 12 % |
|---|---|---|---|---|---|---|---|---|
| Leadership | 26.20 | 145.5 | 15.80 | 8.78 | 8.80 | 4.89 | 13.30 | 739 |
| | 9.60 | 5.26 | 3.12 | 4.48 | 7.88 | 4.43 | 9.53 | 5.15 |
| Crop Production | 28.70 | 15.94 | 32.80 | 18.22 | 24.50 | 13.61 | 27.50 | 15.28 |
| | 13.83 | 7.67 | 24.46 | 14.00 | 1657 | 9.20 | 19.18 | 10.55 |
| Animal Science | 54.20 | 30.11 | 35.40 | 19.67 | 24.40 | 1356 | 15.00 | 833 |
| | 1154 | 6.20 | 17.04 | 9.35 | 19.39 | 11.80 | 1054 | 5.87 |
| Agriculture Mechanics | 52.00 | 28.89 | 78.60 | 43.66 | 96.50 | 53.61 | 66.00 | 36.67 |
| | 13.99 | 7.77 | 18.76 | 10.31 | 33.67 | 18.64 | 26.12 | 14.48 |
| Farm Management | 18.90 | 10.51 | 17.40 | 9.67 | 25.80 | 14.33 | 58.20 | 32.33 |
| | 12.66 | 7.02 | 15.59 | 8.60 | 21.72 | 11.98 | 29.94 | 16.47 |

Note. State recommendations are: Leadership, 5%; Crop Production, 25%; Animal Science, 25%; Agricultural Mechanics, 30%; Farm Management, 15%. Data reported are means over standard deviations.

Table 2
Number and Percent of Planned Instructional Days Devoted to Instruction by Subject Area (n = 10)

| Subject Area | # of Instructional Days | % of Instructional Days |
|---|---|---|
| Leadership | 64.10 | 8.90 |
| Crop Production | 11350 | 15.76 |
| Animal Science | 129.00 | 17.93 |
| Agricultural Mechanics | 293.10 | 40.71 |
| Farm Management | 120.30 | 16.70 |
| Total | 720.00 | 100.00 |

Note. State recommendations are: Leadership, 5%; Crop Production, 25%; Animal Science, 25%; Agricultural Mechanics, 30%; Farm Management, 15%.

Tabk 3
Distribution of Instructional Objectives Across Levels of Cognition

| Level of Cognition | # of Objectives | % of Objectives |
|---|---|---|
| Remembering | 1045 | 31.00 |
| Processing | 1293 | 38.36 |
| Creating | 626 | 1857 |
| Evaluating | 407 | 12.07 |
| Total | 3371 | 100.00 |

Table 3 indicates that 31% of the instructional objectives were written at the remembering level. Approximately 38% of the instructional objectives were written at the processing level, 1% at the creating level, and 12% at the evaluating level.

Table 4 reveals that in all subject areas, the greatest percentage of the instructional objectives were written at the processing level of cognition. Also, the lowest percentage of the instructional objectives were written at the evaluating level of cognition in all subject matter areas.

Table 4
Number and Percent of Instructional Objectives Across Levels of Cognition by Subject Area (n = 10)

| Subject | Level of Cognition R # | R % | P # | P % | C # | C % | E # | E % |
|---|---|---|---|---|---|---|---|---|
| Leadership | 18.70 | 33.63 | 21.00 | 37.77 | 11.40 | 2050 | 4.50 | 7.26 |
| | 6.85 | 8.77 | 8.63 | 8.74 | 8.77 | 12.27 | 4.25 | 6.33 |
| Crop Production | 21.80 | 33.38 | 26.70 | 41.14 | 9.90 | 15.25 | 6.50 | 10.92 |
| | 15.35 | 15.27 | 10.55 | 7.25 | 6.19 | 9.83 | 4.03 | 6.11 |
| Animal Science | 18.40 | 31.13 | 24.40 | 41.29 | 8.60 | 15.55 | 7.70 | 13.03 |
| | 11.75 | 13.63 | 11.25 | 6.77 | 5.74 | 10.25 | 4.24 | 757 |
| Agriculture Mechanics | 29.70 | 29.67 | 34.60 | 34.57 | 20.80 | 20.78 | 15.00 | 14.98 |
| | 15.73 | 13.18 | 16.47 | 11.64 | 13.12 | 14.12 | 8.30 | 6.54 |
| Farm Management | 15.90 | 27.71 | 22.69 | 39.37 | 11.99 | 29.73 | 7.00 | 12.10 |
| | 7.74 | 18.16 | 10.00 | 13.65 | 958 | 11.13 | 2.75 | 3.59 |

Note. R = Remembering, P = Processing, C = Creating, E = Evaluating. Data reported are means over standard deviations.

Table 5 shows that approximately 16% of the instructional objectives were written in the subject areas of leadership, 19% in crop production, 18% in animal science, 39% in agricultural mechanics, and 17% in farm management.

Table 5
Number and Percent of Instructional Objectives by Subject Area (n = 10)

| Subject Area | # of Instr. Objectives | % of Instr. Objectives |
|---|---|---|
| Leadership | 55.60 | 16.49 |
| Crop Production | 64.90 | 19.25 |
| Animal Science | 59.10 | 1753 |
| Agricultural Mechanics | 100.10 | 29.70 |
| Farm Management | 57.40 | 17.03 |
| Total | 337.10 | 100.00 |

The majority (68% to 72%) of the instructional objectives written in the courses of study by the production agriculture teachers at all grade levels were written at the lower (remembering and processing) levels of cognition (Table 6) as described by Newcomb and Trefz (1987).

Table 6
Percentages of Instructional Objectives Across Levels of Cognition by Grade Level

| Grade | % Remembering | Level of Cognition % Processing | % Creating | % Evaluating |
|---|---|---|---|---|
| 9 | 33.00 | 39.02 | 18.28 | 9.70 |
| 10 | 30.29 | 38.48 | 17.31 | 13.92 |
| 11 | 28.87 | 38.87 | 19.75 | 12.51 |
| 12 | 31.18 | 37.18 | 18.88 | 12.07 |
| Mean Percent | 31.00 | 38.36 | 1857 | 12.07 |

**Student Performance**: The mean percentage score of correctly answered questions at each level of cognition was approximately 64% for the remembering level questions, 55% for processing level questions, 40% for creating level questions, and 28% for evaluating level questions (Table 7).

Tabk 7
Distribution of Student Mean Percentage Scores Across Levels of Cognition (n = 81)

| Level of Cognition | Mean Score (% Correct) |
|---|---|
| Remembering | 63.91 |
| Processing | 55.41 |
| Creating | 40.02 |
| Evaluating | 28.20 |

Differences in Levels of Cognition of Instruction by Grade Level and Subject Area: Table 8 indicates that two out of the five subject areas at the remembering level of cognition were found to have significant differences among grade levels. At the cognitive level of processing, four of the five subject areas had significant differences among grade levels. Only one subject area was found to have a significant difference at the creating and evaluating level of cognition among the grade levels.

Table 8
Analysis of Variance of Percentages of Instructional Objectives for the Level of Cognition by Grade Level (n = 10; df 3, 36)

| Level of Cognition | Mean Score by Grade Level 9 | 10 | 11 | 12 | F | Prob. |
|---|---|---|---|---|---|---|
| Remembering | | | | | | |
| Leadership | 25.11[a] | 26.44[a] | 23.34[a] | 17.72[a] | 0.49 | .60 |
| Crop Production | 23.28[a] | 20.77[a] | 15.52[a] | 16.24[a] | 0.83 | .49 |
| Animal Science | 19.39[a] | 20.72[a] | 10.68[a] | 10.84[a] | 3.12 | .06 |
| Ag Mechanics | 18.42[a] | 23.89[a] | 41.38[b] | 25.05[a] | 4.68 | .01 |
| Farm Mangement | 13.80[a] | 8.18[a] | 9.07[a] | 32.15[a] | 654 | .01 |
| Processing | | | | | | |
| Leadership | 20.59[a] | 15.09[a] | 14.16[a] | 13.15[a] | 1.42 | .25 |
| Crop Production | 24.95[ab] | 30.01[a] | 14.20[b] | 11.54[b] | 8.61 | .01 |
| Animal Science | 25.58[a] | 19.03[ab] | 17.60[ab] | 8.50[b] | 4.75 | .01 |
| Ag Mechanics | 15.73[a] | 21.73[ab] | 40.09[b] | 28.78[ab] | 4.63 | .01 |
| Farm Mangement | 13.16[a] | 14.14[a] | 13.95[a] | 38.12[b] | 9.08 | .01 |
| Creating | | | | | | |
| Leadership | 25.82[a] | 16.84[a] | 1.47[a] | 13.56[a] | 2.34 | .09 |
| Crop Production | 17.11[a] | 15.38[a] | 17.82[a] | 16.35[a] | 0.05 | .98 |
| Animal Science | 15.61[ab] | 9.54[ab] | 21.84[b] | 8.59[a] | 359 | .02 |
| Ag Mechanics | 3.30[a] | 6.10[a] | 6.20[a] | 5.20[a] | 0.88 | .47 |
| Farm Mangement | 17.43[a] | 24.79[a] | 11.76[a] | 28.70[a] | 1.62 | .20 |
| Evaluating | | | | | | |
| Leadership | 15.58[a] | 7.86[a] | 9.43[a] | 7.29[a] | 1.09 | .37 |
| Crop Production | 15.38[a] | 16.09[a] | 19.44[a] | 13.43[a] | 0.37 | .77 |
| Animal Science | 23.82[a] | 21.55[a] | 17.72[a] | 10.84[a] | 1.69 | .19 |
| Ag Mechanics | 26.79[a] | 41.51[a] | 43.30[a] | 34.77[a] | 1.45 | .25 |
| Farm Mangement | 18.43[ab] | 12.99[a] | 10.11[a] | 33.67[b] | 4.72 | .01 |

Note. Means with the same superscript do not differ significantly when alpha = .05 utilizing the Tukey - HSD post hoc analysis procedure.

## Conclusions and Recommendations

Teachers of agriculture are writing more instructional objectives at higher cognitive levels than that suggested by the literature. Gall (1970), and Kirts and Stewart (1983) indicated that approximately 20% of the instructional objectives were written at the higher levels of cognition. Students also performed at higher levels of cognition than previous studies (Gall, 1970; Ryan, 1973) had suggested. Gall (1970) and Ryan (1973) concluded that students generally were able to successfully complete approximately 20% of the test questions written at the higher levels of Bloom's (1956) taxonomy.

As grade level increased, one could assume that teachers of agriculture are raising the cognitive level of the instructional objectives in some subject areas but not in others. The results of this objective are in contrast to the findings of Billeh (1974) who concluded that instructors objectives were not cognitively elevated as grade levels increased.

The teachers are devoting a greater percentage of time to some subject matter areas than is recommended by State of Ohio guidelines and spending less time in other areas.

Teachers of agriculture in the public schools should assess the level of cognition of instruction being delivered to their students and if found to be unacceptable, by some predetermined standard, corrective action should be taken to develop a curriculum which appropriately challenges the students at all levels of cognition. In addition, pre-service teachers should be provided a unit of instruction on recognizing and writing instructional objectives at the various levels of cognition.

As students progress to higher grade levels, the teachers of agriculture should make a concerted effort to elevate the cognitive level of instruction. These teachers should purposefully create learning situations which assist in the development of higher cognitive abilities in students.

Further research should be conducted to determine if the results of this study are generalizable for the population of Ohio production agriculture teachers and students. Research should be conducted to determine the extent to which differences occur in levels of cognition of instructional objectives as indicated by the courses of study and actual classroom cognitive level of instruction, and to determine the extent to which differences occur in proportion of planned instructional time based upon courses of study and actual teaching time in the selected subject areas.

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