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An Assessment of the Level of Cognitive Performance and Critical Thinking Ability of Selected Agricultural Education Students

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Agricultural educators and students are constantly facing a growing body of complex information, knowledge, and skills. The sheer amount of information, knowledge, and skills needed by agriculture students to function in today's highly technological society is overwhelming. The high rate of technological change that is associated with an information society demands that students possess the ability to process increasing amounts of complex information and knowledge in practical and systematic ways.

Moreover, the rate of growth of the information, knowledge, and skills needed by agriculture students is so rapid that many students risk becoming agriculturally obsolete unless they continually learn and update themselves. What is not known, however, is the extent to which agricultural education students are able to process the increasing amounts of information, knowledge, and skills called for by educational reform reports.

In reports advocating educational reform (Adler, 1982; Boyer, 1983; Goodlad, 1984; The National Commission on Excellence in Education, 1983), most of the recommendations forwarded were aimed at students. The quality and quantity of instruction the students received was generally found wanting. One of the concerns identified by the educational reform reports was the lack of skills which students needed to be able to properly cope with everyday life situations. The reports (Adler, 1982; Boyer, Goodlad, 1984; The National Commission on Excellence in Education, 1983) concluded that students do not graduate adept at critical thinking, higher order thinking, or problem-solving.

The development of problem-solving abilities to enhance critical thinking and higher order thinking to solve everyday life situations is probably the single most important basic skill that can be learned (Cowan & Clary, 1978; McTighe & Schollenberger, 1985; Tobin & Capie, 1980; Arter & Salmon, 1987). In spite of the plea for the development of higher order thinking, a dearth of research exists on the cognitive and critical thinking abilities of agricultural education students, including the problem-solving approach to teaching.

The problem-solving approach to teaching has been one of the cornerstones of agricultural education instruction. Although agricultural education instructors may be familiar with and use the problem-solving approach, are agriculture students capable of critically thinking through problem situations? Can agricultural students think at higher levels of cognition to solve problems?

Purpose and Objectives

The purpose of this study was to determine the extent to which students in agricultural education programs were performing at the various levels of cognition utilizing Bloom's

Taxonomy (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). In addition, this study sought to determine the extent to which agricultural education students think critically.

The following research questions were investigated:

What was the cognitive level of performance of agricultural education students as measured by the Developing Cognitive Abilities Test (DCAT)?

What was the critical thinking ability of agricultural education students as measured by the Watson-Glaser Critical Thinking Appraisal (W-GCTA)?

What was the extent to which the cognitive level of performance by the students differed among the grade levels (ninth, tenth, eleventh, and twelfth)?

What was the extent to which the critical thinking level of the students differed among grade levels (ninth, tenth, eleventh, and twelfth)?

Procedures

Population and Sample

The population for this descriptive study was the students enrolled in agricultural education classes in Ohio during 1988-1989. Ten schools were purposefully selected for the study to be teacher educators and state supervisors based upon student SAE, FFA program, administrative commitment, course of study and overall facilities. All students enrolled in agricultural education at the selected schools (n=384) took the DCAT and the W-GCTA. Because the schools were purposefully selected, the findings of this study may not be generalized beyond the sample.

Instrumentation

The DCAT and the W-GCTA were administered to agricultural education students enrolled in agricultural education programs at the selected schools. The DCAT is comprised of three subtests which are based on the hierarchical levels of Bloom's Taxonomy (Bloom et al., 1956).

The DCAT subtests, which include Basic Abilities, is equivalent to knowledge and comprehension from Bloom's Taxonomy. The Application Abilities subtest is equivalent to the application level, and the Critical Thinking Abilities subtest is equivalent to analysis and synthesis of Bloom's Taxonomy.

The W-GCTA is comprised of five subtests which are not hierarchical in nature. The five subtests are: Inference, Recognition of Assumptions, Deduction; Interpretation; and Evaluation of Arguments.

Validity and reliability have been established for both standardized tests which were utilized to collect the data by their respective authors. The reliability coefficient established by the author of the DCAT was .81. For the current study, the post-hoc

reliability coefficient for the DCAT was .90. The W-GCTA had a reliability coefficient of .74 established by its respective author. The current study yielded a post-hoc reliability coefficient of .78 for the W-GCTA.

Data Collection

The DCAT and the W-GCTA were mailed to each agricultural education instructor at each selected school for administration. Each respective test was accompanied by specific instructions for test administration. In addition, the teachers were asked to complete a test administration form for each test to ensure compliance to the directions. The tests were administered on two consecutive days. After administration of the tests, the teachers of agriculture returned the tests and test administration forms to the researcher.

Data Analysis

All data were analyzed using the Statistical Package for the Social Sciences, Personal Computer version (SPSS^{X}PC). Descriptive statistics were used to determine student cognitive level of performance and critical thinking ability. Differences among grade levels within the cognitive levels of performance and critical thinking ability were determined using one-way analysis of variance using an .05 alpha level a priori. In those cases where significant differences were noted, the Tukey-HSD post-hoc analysis procedure was employed to determine where the differences occurred.

Results

Developing Cognitive Abilities Subtests

Results indicated that students scored higher on questions based on the lower levels of Bloom's Cognitive Domain (Table 1). The scores ranged as follows: 67% correct at Basic level (Knowledge/comprehension levels of Bloom's Taxonomy), 59% correct at Application level (application level of Bloom's Taxonomy), and 48% correct at Critical Thinking level (analysis/synthesis levels of Bloom's Taxonomy). The overall mean score for the DCAT was 58%.

Table 1. Mean Percent Correct for All Students on Cognitive Subtests of the Developing Cognitive Abilities Test (n=384)

Subtest	Percent Correct
Basic	67%
Application	59%
Critical Thinking	48%
DCAT Overall	58%

Watson-Glaser Critical Thinking Abilities Subtests

The mean scores of students on the various subtests of the W-GCTA are presented in Table 2. With the exception of Inference, the mean scores did not vary much among the subtest scores. For each subtest, the following mean scores were obtained: Inference, 38%; Recognition of Assumptions, 63%; Deduction, 56%; Interpretation, 56%; and

Evaluation of Arguments, 56%. The overall mean score for the W-GCTA was 53%.

Table 2. Mean Percent Correct for All Students on Subtests of the Watson-Glaser Critical Thinking Appraisal (n=384)

Subtest	Percent Correct
Inference	38%
Recognition of Assumptions	63%
Deduction	56%
Interpretation	56%
Evaluation of Argument	56%
Watson-Glaser Overall	53%

Differences Among Grade Levels on Subtests of the Developing Cognitive Abilities Test and Watson-Glaser Critical Thinking Appraisal

Using one-way analysis of variance, significant differences were found in the test scores on the DCAT among the grade levels. The Tukey-HSD post-hoc analysis was used to determine where the differences occurred. For the measure at the Application level of the DCAT, significant differences among scores were noted between ninth-grade students and twelfth-grade students (Table 3). Significant differences were also noted among total DCAT scores (Table 3) between ninth-grade students and twelfth-grade students. Student performance on the W-GCTA revealed no significant differences among the grade levels (Table 4).

Table 3. Analysis of Variance for the Developing Cognitive Abilities Subtests by Grade Level

Subtest	Mean Score by Grade Level					
Score	9	10	11	12	F	Prob.
Basic	17.17a	18.23a	17.23a	18.14a	1.72	.163
Application	14.88a	16.35ab	16.31ab	17.01b	4.06	.007
Critical thinking	11.94a	12.91a	13.09a	13.58a	2.15	.094
DCAT Total	43.81a	47.45a	46.81ab	48.71b	3.06	.028

Note: Means with the same subscript do not differ significantly. Subtest maximum score = 27. DCAT Total maximum = 81.

Table 4. Analysis of Variance for Watson-Glaser Subtests by Grade Level

Subtest	Mean Score by Grade Level					
Score	9	10	11	12	F	Prob.
Inference	5.71a	5.69a	5.75a	6.34a	1.28	.282
Recognition of Assumptions	9.02a	9.44a	9.61a	10.07a	1.94	.123
Deductions	8.95a	8.68a	8.75a	9.14a	0.65	.585
Interpretations	8.89a	9.33a	8.77a	8.60a	1.25	.290
Evaluation of Arguments	9.14a	9.22a	8.75a	9.65a	1.47	.222
W-G Total	41.73a	42.27a	41.66a	43.85a	1.22	.301

Note: Means with the same subscript did not differ significantly. Subtest maximum score = 16. W-G Total maximum score = 80.

The findings of this study support the findings of previous studies (Newcomb & Trefz, 1987; Cano, 1988; Pickford, 1988; Rollins, Miller, & Kahler, 1988). Students of agriculture tend to score at higher percentages at the higher levels of cognition than students in other disciplines such as science (Billeh, 1974), English (Purves, 1971), and social studies (Hunkins, 1969). Although agricultural educators profess that problem-solving instruction is the cornerstone of agricultural instruction, is the problem-solving approach to teaching the variable which increases the agricultural students' cognitive ability? Further research is recommended to answer the aforementioned question.

In regard to the critical thinking abilities of agricultural students, the research basis is shallow. Rollins, Miller, and Kahler (1988) concluded that agriculture students were able to think critically through problem situations using another form of measurement. Utilizing the Watson-Glaser Critical Thinking Appraisal, the findings support the conclusion that agriculture students are able to think critically at the various levels (measured by percent correct). Again, is the problem-solving approach to teaching the catalyst which serves to increase the agriculture students' critical thinking ability? Further research is recommended to determine if the problem-solving approach to teaching is the catalyst which influences agriculture students to think critically.

It was concluded by the current study that ninth-grade students scored significantly different than twelfth-grade students on the Developing Cognitive Abilities Test. This finding is supported by research which was conducted by Cano (1988). However, there were not any significant differences among the critical thinking abilities of the high school students by grade level. Why not? Could it be concluded that students reach their critical thinking ability level prior to the ninth-grade? Further research is necessary to determine why the critical thinking ability of agricultural students does not significantly increase (as measured by percent correct) as the student progresses to higher grade levels.

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