

Levels of Cognition Required In Undergraduate Agriculture Courses

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American agriculture is an increasingly complex and technologically sophisticated enterprise. Colleges of agriculture have a major responsibility for preparing students for professional careers in this rapidly changing industry (Beits and Newcomb, 1986).

Recognizing this responsibility, the University of Missouri-Columbia, College of Agriculture established the following objectives for resident instruction: "Goals include providing relevant scientific and practical knowledge of the agricultural and food sciences, cultivation of interdisciplinary problem-solving skills, and a capacity to pursue life-long learning and adaptation to change" (University of Missouri-Columbia, College of Agriculture, 1986). Accomplishment of these objectives would require students to develop and utilize higher level cognitive skills.

Ruggiero (1987) suggested that teaching students how to think is an important educational goal that can be accomplished by designing learning activities which require students to operate at the higher levels of cognition (i.e. analysis, synthesis, and evaluation). However, research has indicated that college coursework generally places the greatest emphasis on lower level cognitive skills (Boyer, 1987; Newcomb and Trefz, 1986).

University of Missouri-Columbia, College of Agriculture administrators and faculty determined that a need existed to examine faculty and graduate perceptions of the cognitive skills being enhanced in undergraduate agriculture courses. Therefore, this study was conducted to provide baseline data from which recommendations for instructional improvement could be made.

Purposes and Objectives

The purpose of this study was to assess the perceptions of University of Missouri-Columbia College of Agriculture faculty and graduates concerning the cognitive level of undergraduate agriculture coursework. Specific objectives were as follows:

1. To ascertain faculty perceptions of the extent to which undergraduate agriculture course assignments, tests, quizzes, and projects required students to operate at each level of cognition.
2. To ascertain graduates' perceptions of the extent to which undergraduate agriculture course assignments, tests, quizzes, and projects required students to operate at each level of cognition.

3. To ascertain the relationship between faculty and graduate perceptions of the extent to which undergraduate agriculture course assignments, tests, quizzes, and projects required students to operate at each level of cognition.

Procedures

The population of faculty members included the instructors of all resident, undergraduate courses taught during the fall and winter semesters of the 1987-1988 academic year. Course schedules for the two semesters revealed that 268 on campus undergraduate courses were offered during the period (exclusive of courses identified as Problems, Readings, and Research). The entire population of course instructors was surveyed.

The population of graduates included all individuals who received undergraduate agriculture degrees from the University of Missouri-Columbia during the 1987-1988 academic year (N=289). The entire population of graduates was surveyed.

Two versions of the same instrument were developed to collect data from the two groups. The six hierarchical categories of cognition; knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, et al. 1956); formed the basis for the 36 items included in both versions of the instrument. Six representative performance statements were included for each of the six levels of cognition. The stem statement and instructions in the instrument mailed to faculty members directed respondents to rate the extent to which the specific course identified required students to engage in each of the 36 cognitive behaviors. The stem statement and instructions in the instrument mailed to the graduates directed respondents to rate the extent to which undergraduate agriculture classes as a whole had required students to engage in each of the 36 cognitive behaviors. Responses for both versions of the instrument were coded: 1 = never, 2 = seldom, 3 = sometimes, 4 = usually, and 5 = always.

A panel of experts in agricultural education examined both instrument versions and judged them to be valid. Coefficient alpha reliability estimates of .98 (faculty) and .90 (graduate) were calculated following data collection.

Responses were received from 224 (83.6%) faculty members and 137 (47%) graduates for an overall response rate of 64.8%. Comparison of early and late respondents within each group revealed no significant differences. Therefore, the data collected from each group were assumed to be representative of each population (Miller and Smith, 1983).

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Analysis of Data

Means and standard deviations were computed for the perceptions of the two groups (faculty and graduates) concerning the extent to which each of the six levels of cognition were utilized in undergraduate agriculture courses. Analysis of variance and Duncan's post hoc tests were used to identify significant differences ($p < .05$) in the extent to which each of the levels of cognition were utilized as perceived by faculty and graduates. The use of inferential statistics was based on the assumption that both groups of respondents represented time and place samples which were representative of past and future agriculture faculty and graduates. Spearman's rank-order correlation coefficient was computed to determine the relationship between faculty and graduate perceptions of the relative extent to which each level of cognition was used in undergraduate agriculture courses.

Results

Analysis of variance indicated that significant differences existed in the degree to which agriculture courses required operation at the various levels of cognition as perceived by faculty members ($F = 7.98$; $df = 5, 195$; $p < .0001$). Faculty respondents perceived that agriculture courses required knowledge level skills to the greatest extent while requiring synthesis level cognitive skills the least. Table 1 presents a summary of faculty perceptions concerning the extent to which each level of cognition was required in undergraduate agriculture courses.

A second analysis of variance procedure revealed that

Table 1: Faculty perceptions of the extent to which each level of cognition was required in agriculture courses.

Cognitive level	\bar{X}	SD
Knowledge	3.36 A*	.72
Application	3.31 A B	.76
Analysis	3.24 A B C	.68
Evaluation	3.19 B C	.79
Comprehension	3.14 C	.72
Synthesis	2.94 D	.78

* Letters in common were not significantly different ($\alpha=.05$).

significant differences also existed in graduate perceptions of the extent to which agriculture courses required students to operate at the six levels of cognition ($F = 14.79$; $df = 5, 124$; $p < .0001$). Graduate respondents indicated that agriculture courses required knowledge and application level skills to the greatest extent while requiring synthesis level cognitive skills the least. Table 2 presents a summary of graduate perceptions concerning the extent to which each level of cognition was required in undergraduate agriculture courses.

A Spearman's rank-order correlation coefficient of .93 was calculated for the relationship between faculty and graduate perceptions of the relative extent to which agriculture coursework required students to operate at each level of cognition. The faculty respondent group produced higher mean rankings. For the evaluation category than for the comprehension category. However, the student group reversed the rankings for the evaluation and comprehension categories. The four remaining categories held the same relative position (i.e. rank) for both groups.

Table 2: Graduate perceptions of the extent to which each level of cognition was required in agriculture courses.

Cognitive level	\bar{X}	SD
Knowledge	3.66 A*	.49
Application	3.54 A	.49
Analysis	3.35 B	.59
Evaluation	3.31 B C	.51
Comprehension	3.23 B C	.62
Synthesis	3.18 C	.59

* Letters in common were not significantly different ($\alpha=.05$).

Conclusions and Recommendations

The following conclusions, concerning faculty and graduate perceptions of the extent to which undergraduate agriculture coursework at the University of Missouri-Columbia required students to use each level of cognition, are based on the results of this study.

1. Faculty and graduate respondents perceive that College of Agriculture coursework requires students to utilize skills at relatively low levels of cognition (i.e. knowledge and application) to a greater extent than higher level cognitive skills.
2. Faculty and graduate respondents perceive that College of Agriculture coursework requires students to utilize skills at the synthesis level of cognition to a lesser extent than the remaining five levels of cognition.
3. Both faculty and graduate respondents have very similar perceptions of the relative extent to which undergraduate agriculture courses require students to operate at each level of cognition.

The following recommendations are based on the results of this study.

1. Instructors of undergraduate agriculture courses should be encouraged to develop assignments, quizzes, tests, and projects which require students to synthesize information.
2. Upper division "capstone" courses should be developed which require students to synthesize information from a variety of sources, including previous coursework, in order to solve agricultural problems.
3. Faculty development programs should be initiated to assist instructors in upgrading existing courses and developing new courses which emphasize higher order cognitive skills.

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