

AGRICULTURE GRADUATE PERCEPTIONS OF THE LEVELS OF COGNITION REQUIRED IN UNDERGRADUATE COURSES

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Since 1963, this nation has again recognized public education as a national priority. Politicians at every level have voiced their opinions concerning the strengths and weaknesses of our educational system. Critics have pointed accusing fingers in the direction of teachers, students, families, legislators, and others, blaming each of them for the ills which currently plague education. The renaissance of national attention on education has contributed to widespread debate on improvements needed in the system.

An area of harmony appears to have emerged from the dialogue surrounding education. Persons, to be successful in the future, must be effective problem solvers or decision makers (Blank, 1987). Therefore, graduate of our nation's educational programs should be encouraged to develop the skills needed to solve problems and make effective decisions. Furthermore, future graduates will be expected to continue to learn throughout the remainder of their lives and to be adaptable to constant changes in their environment.

The goal of producing graduates who are capable of life-long learning and adaptation to change has become increasingly important given the rapid rate of change in society. Robert Hilliard (Toffler, 1970) offered a unique perspective on the world awaiting future college graduates when he stated:

At the rate at which knowledge is growing, by the time the child born today (1970) graduates from college, the amount of knowledge in the world will be four times as great. By the time that same child is 50, the amount of knowledge will be 32 times as great, and 97% of everything known in the world will have been learned since his birth (p. 157-158).

In his book *The Third Wave*, Toffler (1980) identified three great advances in the history of civilization. The first wave was characterized by significant gains in agriculture which resulted in increased stability in our society. During this age, education was considered a luxury and limited to those who possessed wealth.

The second wave was characterized by significant improvements in the industrial sector of the economy. The development and utilization of machines and equipment allowed workers to leave farms and rural areas to flock to cities and work in factories. Education for many during this period focused on the basics of reading, writing, and arithmetic in addition to the development of appropriate work habits.

The third wave, which we are now entering, has been designated as the information age. In this new era, the emphasis in the work place will shift from the physical production of products to the manipulation, transmission, and utilization of information. Employees in this environment will need to possess skills which will enable them to collect, interpret, evaluate, and process increasing quantities of new information which will be produced.

The mission of a Land Grant College of Agriculture includes the function "...to teach such branches of learning related to agriculture and mechanic arts..." (Morrill Act, 1962). The University of Missouri-Columbia, College of Agriculture further delineated the mission as it related to resident instruction as follows: "Goals include providing relevant scientific and practical knowledge of the agricultural and food sciences, cultivation of inter-disciplinary problem-solving skills, and a capacity to pursue life-long learning and adaptation to change" (University of Missouri-Columbia, College of Agriculture, 1986).

Agricultural educators have recognized the transient nature of technology. Kellogg and Knapp (1986) stated that "Empirical knowledge of today's problems and methods will be of little use [to graduates] in five to ten years." (p. 94). They further noted that (Kellogg and Knapp, 1986) "...undergraduate education is best directed toward guided practice in the habits and discipline of learning..." (p.94).

Newcomb and Trefz (1987a) also recognized the development of higher level cognitive skills as an important goal of undergraduate education. They reported that the "ability to think and perform independently...[and] ...the ability to evaluate existing products and ideas and create new ones..." (p. 26) were extremely important outcomes of a college education.

There is a growing consensus among educators that memorization has become a less acceptable measure of an education person. Many observers have noted the discrepancy between the realities of the college classroom and the objective of developing students as thinkers. Ruggiero (1987) suggested that teaching students how to think in a classroom situation is important and can be accomplished without comprising academic subject matter. However, accomplishment of this goal may require that college instructors examine the environment for learning which they provide for students. Boyer (1987) noted that "...the lecture method is preferred by professors. With few exceptions, the teacher stood in front of rows of chairs and talked... Information was presented that often students passively received." (p. 149).

Newcomb and Trefz (1987b) studied the cognitive level of tests, quizzes and out-of-class academic activities in 16 College of Agriculture classes at The Ohio State University. They reported that 85 % of all test/quiz items and out-of-class assignments required students to function at low cognitive levels. In follow-up interviews Newcomb and Trefz (1987b) found that 86 percent of the instructors in their study expressed a desire to increase the cognitive level of their tests, quizzes and assignments.

Purpose and Objectives

Wentling (1980) noted that former students were able to provide important information regarding the strengths and weaknesses of an educational program. Therefore, this study was conducted in an effort to identify the levels of cognition required in undergraduate courses at the University of Missouri-Columbia as perceived by recent program graduates.

The purpose of this study was to ascertain the perceptions of College of Agriculture graduates concerning the levels of cognition required to complete assignments, quizzes, tests and projects in agriculture and general education courses at the University of Missouri-Columbia. A secondary purpose was to ascertain the perceptions of College of Agriculture graduates concerning selected characteristics of their undergraduate agriculture and general education coursework. The following objectives were investigated as part of this study.

1. To ascertain the perceptions of College of Agriculture graduates concerning the extent to which undergraduate agriculture and general education courses required students to perform skills at each level of cognition.
2. To ascertain the perceptions of College of Agriculture graduates concerning the: quality, difficulty, personal development benefits, career development benefits, faculty competence, and expansion of credit hour requirements in agriculture and general education courses.
3. To assess the relationship between respondent characteristics of age and GPA, and their perception of the extent to which various levels of cognition are required in undergraduate courses.

Procedures

A three-part survey instrument was developed to collect information needed to fulfill the objectives of this study. Six hierarchical levels of cognitive skills; knowledge, comprehension, application, analysis, synthesis and evaluation (Bloom, Englehart, Furst, Hill, and Krathwohl, 1956); formed the basis for the items incorporated into part one of the instrument. Six performance statements were developed for each level of cognition. Therefore, 36 performance statements were included in the data collection instrument to which graduates were asked to respond.

Each statement was developed to solicit the perceptions of College of Agriculture graduates concerning the extent to which assignments, quizzes, tests and projects in undergraduate agriculture and general education courses required specific cognitive skills. A five-point, Likert-type response scale was provided which allowed graduates to respond never = 1, seldom = 2, sometimes = 3, usually = 4, or always = 5.

The second section of the instrument was designed to assess the perceptions of College of Agriculture graduates concerning the: quality, difficulty, personal development benefits, career development benefits, faculty competence and need to increase credit hour graduation requirements in agriculture and general education coursework. A Likert-type scale was provided which allowed the graduates to respond strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4.

The third section of the instrument was designed to elicit the following demographic information: academic major, academic minor, age, grade point average (GPA) at graduation, semester of graduation, and occupation. A panel of graduate students, teacher educators and state supervisors examined the instrument and judged it to be valid for the purposes of this investigation. Instrument reliability was estimated following data collection using the Cronbach's Alpha procedure. This procedure produced a reliability coefficient of 0.90 for the overall instrument. Subscale reliabilities for each level of cognition ranged from .78 for the knowledge level to .85 for the evaluation level.

Instruments and cover letters were mailed to each student who graduated from the University of Missouri-Columbia, College of Agriculture during the 1987-88 academic year (N = 289). Two weeks following the initial mailing a reminder postcard was sent to those persons who had not responded. After another two-week period, a second letter and survey instrument were sent to graduates who had not yet returned completed survey forms.

Responses were received from 137 graduates for a 47 percent return rate. Early and late respondents were compared on their perceptions of the extent to which agriculture and general education courses required each of the six levels of cognition. The results of *t* tests indicated that one level of cognition was rated significantly different by early and late respondents. Late respondents rated the general education category of evaluation significantly higher ($X = 3.11$, $X = 2.82$; $p < .05$) than did early respondents. Significant differences were not found among the other cognitive levels examined. These findings, together with the similarity between the mean GPA and relative frequency of majors among the respondents and the population supported the assumption that the results of this study were generalizable to the population.

Results

The average respondent was 23.44 years of age and reported an undergraduate GPA of 2.89 on a 4.0 scale. Animal Science majors accounted for the majority (31.3%) of those responding while Atmospheric Science, Agricultural Journalism, and the "other" category comprised the smallest (0.7%) respondent groups when categorized by academic major. The distribution of respondents by academic major is presented in Table 1.

Table 1
Frequency of Respondents by Academic Major

Major	N	Percent
Animal Science	42	31.3
Agricultural Economics	30	22.4
Food Science & Nutrition	20	14.9
General Agriculture	11	8.2
Biochemistry	9	6.7
Agricultural Education	7	5.2
Agricultural Engineering	6	4.5
Agronomy	4	3.0
Horticulture	2	1.5
Atmospheric Science	1	0.7
Agricultural Journalism	1	0.7
Other	1	0.7
Not reported	3	2.2
Total	137	99.9

An analysis of variance (ANOVA) procedure followed by the Duncan's multiple range test was used to identify significantly ($p < .05$) different mean cognitive level scores for College of Agriculture (Table 2) and general education (Table 3) courses, respectively. Inferential statistics were utilized based on the assumption that the respondents comprised a time and place sample which is representative of past, present and to a limited degree, future graduates of the University of Missouri-Columbia, College of Agriculture.

Each level of cognition for College of Agriculture courses received a mean rating of 3.18 or greater. Table 2 summarizes respondent perception of the extent to which courses in the College of Agriculture emphasized learning at each of the six level of cognition. Respondents indicated that agriculture coursework placed significantly ($p < .05$) more emphasis on the lower cognitive levels of knowledge and application and less emphasis on the synthesis level.

Table 2
Means, Standard Deviations, and Significantly Different Levels of Cognition Required in Agriculture Courses

Cognitive level	X	SD	Sig. Diff. levels ^a
Knowledge	3.66	.49	A
Application	3.54	.49	A
Analysis	3.35	.59	B
Comprehension	3.31	.51	B C
Evaluation	3.23	.62	B C
Synthesis	3.18	.59	C

^a Means followed by different letters were found to be significantly different ($p < .05$) by the Duncan's Multiple Range Test.

Each level of the cognitive domain for general education courses received a mean rating of 2.88 or greater. Table 3 summarizes the respondent perceptions of the degree to which general education coursework required the use of each level of cognition. Respondents reported that general education courses placed significantly more emphasis on knowledge-level skills than the five remaining levels of cognition. The higher-order cognitive levels of evaluation and synthesis were also rated significantly lower than the other four levels of cognition.

Table 3
Means, Standard Deviations, and Significantly Different Levels of Cognition Required in General Education Courses

Cognitive level	X	SD	Sig. Diff. levels ^a
Knowledge	3.46	.57	A
Application	3.09	.52	B
Analysis	3.09	.52	B
Comprehension	3.16	.51	B
Evaluation	2.89	.60	C
Synthesis	2.88	.55	C

^a Means followed by different letters were found to be significantly different ($p < .05$) by the Duncan's Multiple Range Test.

Table 4 summarizes the perceptions of respondents concerning selected characteristics of undergraduate agriculture and general education courses. Respondents rated agriculture courses significantly ($p < .05$) higher than general education courses in the areas of quality, personal development benefits, career development benefits and faculty competence. Respondents were somewhat mixed regarding the need to increase the number of credit hours required for graduation. However, they were significantly ($p < .05$) more positive toward expanding agriculture course

requirements than general education courses. Respondents did not perceive agriculture courses to be more difficult than general education courses or vice versa.

Table 4
Perceptions of Graduates Concerning Selected Aspects of Agriculture and General Education Courses

Statement	Agriculture	Gen. Ed.	t
	X SD	X SD	
Courses were of high quality	3.05 0.55	2.71 0.63	4.94*
Courses beneficial for personal development	3.15 0.58	2.82 0.72	4.03*
Courses beneficial for career development	3.30 0.67	2.80 0.71	5.77*
Courses taught by competent faculty	3.09 0.72	2.65 0.65	5.00*
Credit hour requirements increased	2.50 0.88	1.91 0.83	5.49*
Courses were more difficult	2.34 0.66	2.38 0.73	-0.40

Note. Responses were coded 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.
* Significantly different at the .05 level.

Pearson product-moment correlation coefficients were calculated to determine if a significant relationship existed between respondent age and undergraduate GPA, and their perception of the degree to which each level of cognition was utilized in agriculture and general education coursework. Table 5 presents the correlation coefficients for the relationship between the variables of respondent age and GPA and the six level of cognition. The largest correlation coefficient ($r = -0.28$) was computed for the relationship between undergraduate GPA and the respondents' perception of the extent to which the synthesis level of cognition was required in agriculture courses. Although the

Table 5
Relationship Between Age and GPA, and Graduate Perceptions of the Levels of Cognition Required in Agriculture and General Education Courses

Level of cognition	r Age	r GPA
Agriculture		
Knowledge	.075	-.105
Comprehension	-.028	-.039
Application	.032	-.047
Analysis	.005	-.199*
Synthesis	-.039	-.277*
Evaluation	-.095	-.166
General Education		
Knowledge	-.024	.030
Comprehension	-.041	-.033
Application	.001	.012
Analysis	-.063	-.074
Synthesis	-.023	-.117
Evaluation	-.060	-.112

* $p < .05$.

correlation coefficient was statistically significant, the R-square of .077 indicated that GPA explained less than 8% of the variance associated with the dependent variable (i.e., synthesis level of cognition in College of Agriculture courses). A similar relationship was identified between GPA and the analysis level of cognition in College of Agriculture courses. Other correlation coefficients were not found to be statistically significant for either agriculture or general education coursework.

Discussion and Conclusions

Although only 1987-88 College of Agriculture graduates were surveyed, the findings of this investigation may have implications for future College of Agriculture students, teachers, and courses at the University of Missouri-Columbia and other institutions with similar characteristics. The following conclusions were formulated as a result of this study.

Students reported that both agriculture and general education coursework at the University of Missouri-Columbia placed greater emphasis on lower-level cognitive skills and less emphasis on higher levels of cognition. College of Agriculture courses were perceived to have placed significantly more emphasis on the cognitive levels of knowledge and application, while the synthesis level of cognition received the lowest mean rating for agriculture coursework. This indicates that graduates perceive the College of Agriculture courses less often require students to synthesize information from a variety of sources when completing assignments, quizzes, tests, and projects.

General education courses were also perceived to place significantly more emphasis on the knowledge level skills than on higher levels of cognition. The comprehension, application, and analysis levels received mean scores which were lower than the knowledge level, but higher than the evaluation and synthesis level.

Graduates responded more favorably to several characteristics associated with coursework in the College of Agriculture as compared to general education courses. Respondent ratings indicate that College of Agriculture courses were of higher quality, more beneficial for both personal and professional development, and were more likely to be taught by competent faculty.

Graduates reported no difference in the level of difficulty for agriculture and general education courses. However, if credit hour requirements for graduation were to be increased, respondents were more likely to recommend that the increase be allocated to agriculture courses rather than general education courses.

An examination of the relationship between the respondent characteristics of age and GPA, and the respondents' perception of the extent to which cognitive skills were required, produced only two significant correlations. Statistically significant, negative correlation coefficients were computed for the synthesis and analysis levels of cognition in College of Agriculture courses and respondent GPA. This relationship suggests that students with higher GPA's tend to have lower perceptions of the extent to which analysis and synthesis skills were required in College of Agriculture courses.

As a result of these findings it may be concluded that the more academically talented College of Agriculture students are not being sufficiently challenged in their courses. Instructors should be encouraged to examine the assignments, quizzes, tests, and projects in their courses to determine the extent to which they require students to develop skills and demonstrate proficiencies at each level of cognition.

Recommendations

Undergraduate College of Agriculture instructors should develop assignments, quizzes, tests, and projects which enable students to learn to synthesize information from a variety of sources, while also challenging academically talented students.

Instructors of general education courses should develop assignments, quizzes, tests, and projects which require students to further utilize cognitive skills at the evaluation and synthesis levels. General education instructors should examine their courses to identify ways to improve the quality, benefits, and instruction of general education courses.

Additional studies in this areas are strongly encouraged. Further research is needed to determine the levels of cognition which are in greatest demand by employers of College of Agriculture graduates. Also, research to determine the appropriate mix of cognitive skill development at the

primary, secondary and postsecondary levels of education should be a priority. After determining the desired emphasis on each level of cognition, program planners should make an effort to articulate educational programs for students. Development and validation of a matrix of cognitive skills to be enhanced at each educational level would be a significant step toward improving agricultural education in the United States.

References

- Blank, S.C. (1987). Comparing faculty and alumni expectations of future agribusiness curriculum content. NACTA Journal, 31(2), 30-32.
- Bloom, B.S., ed., Englehart, M.D., Furst, E.J., Hill, W.H., and Krathwohl, D.R. (1956). A taxonomy of education objectives: Handbook 1, The cognitive domain. New York: David McKay Co.
- Boyer, E.L. (1987). College: The undergraduate experience in America. New York: Harper and Row.
- Kellogg, C.E. and Knapp, D.C. (1966). The college of agriculture: Science in the public service. New York: McGraw-Hill.
- Morrill Act (1862). United States Statutes at Large, Volume 12, Chapter 314, p. 503, 37th Congress.
- Newcomb, L.H. and Trefz, M.K. (1987a). Toward teaching at higher levels of cognition. NACTA Journal, 31(2), 26-30.
- Newcomb, L.H. and Trefz, M.K. (1987b). Levels of cognition of tests and assignments in agriculture courses at the Ohio State University. Proceedings of the 14th Annual National Agricultural Education Research Meeting. Las Vegas, NV.
- Ruggiero, V.R. (1987). Teaching thinking across the curriculum. New York: Harper and Row.
- Toffler, A. (1970). Future shock. New York: Random House.
- Toffler, A. (1980). The Third Wave. New York: William Morrow.
- University of Missouri-Columbia, College of Agriculture (1986). Mission statement: Columbia, MO: author.
- Wentling, T.L. (1980). Evaluating occupational education and training programs. Boston, MA: Allyn and Bacon.