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Relationship of Cognitive Level of Instruction To Students' Cognitive Level of Achievement

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Abstract

This pilot study sought to determine instructor's cognitive level of teaching, student's cognitive level of achievement, and factors related to student cognitive achievement in three undergraduate College of Agriculture courses. All student and two instructor variables were assessed by survey instruments. The cognitive level of tests and assignments, cognitive level of teaching, and the cognitive level of achievement were evaluated using the Florida Taxonomy of Cognitive Behavior. All instructors were found to be teaching at a low cognitive level. Student cognitive achievement was most closely related to the cognitive level of tests and assignments.

Introduction

The decade of the 1980's has witnessed mounting concern in society about the quality of education from grade school through college. One of the themes considered by the National Commission on Excellence in Education pertained to students' abilities to function at the higher levels of thinking; the Commission was concerned that students develop expertise in critical thinking and problem solving (National Commission on Excellence in Education, 1983). Boyer reiterated this concern for the college level. "Clear and effective writing and critical thinking, are, we said, the most essential skills both for further education and for work." (Boyer, 1987)

Yet, with rapidly expanding technical knowledge, educators in agricultural fields face a dilemma. Kuhn (1977) summarizes this dilemma:

> . . . the total mass of knowledge is so great that none of it can be learned well. Too often students are required to memorize a body of facts which are much easier to forget than to remember. Teaching for permanent learning must go beyond dissemination of information to the development of student interest and thinking abilities.

However, if agricultural educators are to address students' needs to develop higher level cognitive abilities, they must have information about factors which affect the development of these critical thinking abilities. Several studies regarding the cognitive level of courses in the College of Agriculture have been completed through the Department of Agricultural Education at The Ohio State University. This is a report of a pilot study completed in 1988 which examined the cognitive level of instruction and factors related to student cognitive achievement in three undergraduate courses in the College of Agriculture (Pickford, 1988).

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Purpose of the Study

The purpose of the study was to describe the cognitive level of instruction and explain the cognitive level of student achievement in three undergraduate College of Agriculture courses at The Ohio State University. The specific objectives were to determine:

(1) the cognitive level of instruction at which the selected professors taught;
(2) the cognitive level achieved by students in the selected courses;
(3) the extent to which selected variables were related to students' cognitive level of achievement; major variables included the cognitive level of instruction, the cognitive level of tests and assignments, and instructor's cognitive expectations for the course.

Procedures

Participants in the study were eighty-three students enrolled in three undergraduate courses during Winter quarter, 1988. The classes were purposefully chosen according to instructor willingness to participate.

The cognitive level of teaching was determined by three separate classroom observations for each instructor using the Florida Taxonomy of Cognitive Behavior (FTCB) (Brown, Ober, Soar, and Webb; 1968). The FTCB was developed using the Taxonomy of Educational Objectives (Bloom et al., 1956) and is comprised of seven different cognitive levels, ordered in a cumulative hierarchy. These levels are knowledge, translation, interpretation, application, analysis, synthesis and evaluation. Cognitive weighting factors, ranging from .10 to .50, were utilized to reflect the hierarchy of the cognitive levels, with the lowest weight given to knowledge and the highest weight given to synthesis and evaluation. The cognitive weighting factors allowed the researcher to compare composite level of cognition scores among several different variables.

The cognitive level of achievement was determined using the FTCB based on performance on the final exam. The remaining student and professor

variables were evaluated using either the FTCB or researcher-developed instruments.

Data were analyzed using the Statistical Package for the Social Sciences (SPSSx).

Findings

Characteristics of Students and Instructors

The typical student was completing the sophomore year. All but a few of the students were majoring in agriculture. The typical student reported some familiarity with course content prior to enrolling in the course.

Instructors assessed their cognitive expectations for the course. Using the cognitive weighting factors, a composite cognitive expectations score was derived for each instructor. (Table 1). The composite scores ranged from 20 to 36. These scores could range from 10, reflecting an emphasis on knowledge, to 50, reflecting an emphasis at either the synthesis or evaluation levels. A score of 20 indicated that cognitive expectations were concentrated at the translation level, whereas scores in the 30's indicated cognitive expectations at the level of application.

Table 1. Total Weighted Values of Instructor Cognitive Expectations for Student Learning

Instructor 1	Instructor 2	Instructor 3
30.25	20.65	35.75

MEAN = 28.88
Possible Range = 10 - 50
Cognitive Level of Courses

Table 2. Percentage of Cognitive Teaching Behavior by Level of the FTCB and by Instructor

	Percentage of Teaching Behavior			
	Instructor			
FTCB Level of Cognition	1	2	3	Mean
	%	%	%	%
Knowledge	41.86	48.09	47.10	45.68
Translation	14.29	12.84	11.26	12.80
Interpretation	13.30	13.93	17.06	14.76
Application	6.16	9.56	3.75	6.49
Analysis	16.50	11.20	15.02	14.24
Synthesis	2.96	2.19	4.10	3.08
Evaluation	4.93	2.19	1.71	2.94
TOTAL	100	100	100	

Table 3. Total Weighted Cognitive Teaching Scores for Each Instructor

	Weighted Cognitive Teaching Scores			
	Instructor			
	1	2	3	Mean
TOTAL	22.76	20.40	21.26	21.47

Total Score Possible Range = 10 - 50

Two separate measures of the cognitive level of each course were obtained: the cognitive level of teaching and the cognitive level of all classroom evaluation measures. Table 2 reports the percentage of behaviors observed at each level of the FTCB for each instructor and for the three instructors combined.

Table 4. Percentage and Weighted Value of Cognitive Levels of Tests* for each Instructor

	Cognitive Level of Tests					
Level of	Instructor			Instructor		
Cognition	1	2	3	1	2	3
	%	%	%	Weighted Value		
Knowledge	38.50	85.7	4.4	3.85	8.57	.44
Translation	4.25	3.9	0.0	.85	.78	0.0
Interpretation	15.75	5.2	21.8	3.94	1.30	5.45
Application	41.5	5.2	13.0	12.45	1.56	3.9
Analysis	0.0	0.0	39.1	0.0	0.0	15.64
Synthesis	0.0	0.0	0.0	0.0	0.0	0.0
Evaluation	0.0	0.0	21.7	0.0	0.0	10.85
TOTAL	100	100	100	21.09	12.21	36.28
MEAN				23.19		

*Tests included quizzes and mid-term examinations

Slightly less than one-half (46%) of the teaching behaviors were at the knowledge level. The three lowest levels of cognition accounted for 73% of the observed teaching behaviors, whereas each of the two highest cognitive levels comprised approximately 3% of the observations.

Composite cognitive level of teaching scores were derived using the percentages in Table 2 and the cognitive weighting factors. The composite scores are reported in Table 3. The mean score of 21 represents teaching at the level of translation. Note should be made of the tight range of the individual scores, from 20.40 to 22.76.

A score reflecting the cognitive level of tests and assignments was also calculated. Percentage values and weighted values of the cognitive level of tests for each instructor are presented in Table 4. Greater variation was evident in the cognitive levels of tests than in the cognitive levels of teaching. Levels of cognition of tests displayed a wide range, from 12, representing a concentration at the level of knowledge, to 36, representing a concentration at the application level.

Results of the classification of the cognitive level of assignments are reported in Table 5. Assignments included few to no questions at the cognitive levels of knowledge or translation. The cognitive level of assignments ranged from 26, representing the cognitive level of interpretation, to 50, reflecting a concentration at the cognitive level of synthesis or evaluation. Data in Tables 4 and 5 show that higher levels of cognition were required in the assignments than in the tests.

The composite scores of the cognitive level of tests and assignments are reported in Table 6. These scores were calculated according to the proportions each instructor designated to each test or assignment for grading purposes. These scores ranged from 18 to 31, revealing emphasis at the cognitive levels of knowledge, interpretation and application.

Cognitive Level of Achievement

Student's cognitive level of achievement was based on performance on the final examination. Each student's cognitive level of achievement was deter-

mined by both the cognitive level of each question on the exam and actual performance on each question. However, the final examinations were instructor-written exams and they did not test at similar levels. Table 7 reports the cognitive level of the final exams. The cognitive level of exams for instructors 1 and 2 were similar (16.1 and 14.4) and both reflected a concentration at the cognitive level of knowledge. However, the cognitive level of the exam for instructor 3 was markedly different. The weighted cognitive value of 44.0 reflected an emphasis at the cognitive level of synthesis or evaluation. The different emphases of these exams implied that students in classes with instructors 1 and 2 were not challenged to perform at levels comparable to those students of instructor 3.

Correlations between selected student and instructor variables and student cognitive level of achievement were calculated. A few of these correlations are reported in Table 8. These results should be viewed with caution since controls were not present in the study which would have equalized the exams in terms of cognitive levels tested, difficulty of questions, and other posible intervening factors.

Surprisingly, there was a substantial negative relationship between the amount of instructor's previous experience and student cognitive level of achievement. Cognitive expectations for the course, that is, the cognitive level at which instructors thought students would be learning, were very highly correlated with students' cognitive level of achievement scores. The cognitive level of tests and assignments was found to be highly correlated with students' cognitive level of achievement. However, a low correlation was found between the cognitive level of teaching and students' cognitive level of achievement.

Conclusions

The cognitive level of teaching in the three College of Agriculture courses was found to be concentrated at the level of translation for all three courses. The cognitive level of tests and assignments reflected cognitive emphasis at the knowledge, interpretation, and application levels. However, the overall cognitive level of assignments was found to be higher than the cognitive level of tests.

The research was able to obtain a measure of the cognitive level of achievement reflecting the hierarchy of the levels of cognition using final examination performance. Due to differences in exams in the three classes, comparisons of students among the classes did not yield incontrovertible results. It was found that instructors' level of cognitive expectations was strongly related to student cognitive achievement; the same was true for cognitive level of tests and assignments. Extent of previous experience of instructor, though, was negatively related to student cognitive achievement.

Recommendations

This study suggets several areas of pursuit for instructors interested in providing students with increased opportunities to develop higher level cognitive skills and abilities. The following recommendations would contribute to an increase in the use of the higher cognitive levels. In placing greater emphasis at the higher levels of cognition it is assumed that students will not only have the opportunity to become more skilled at higher levels but they will also learn to place value on achievement at the higher cognitive levels.

Table 5. Percentage and Weighted Value of Cognitive Level of Assignments* for Each Instructor

Level of Cognition	Cognitive Level of Assignments					
	Instructor			Instructor		
	1	2	3	1	2	3
	%	%	%	Weighted Value		
Knowledge	0.0	0.0	0.0	0.0	0.0	0.0
Translation	5.7	0.0	0.0	1.14	0.0	0.0
Interpretation	12.6	0.0	78.6	3.15	0.0	19.65
Application	42.7	0.0	21.4	12.80	0.0	6.42
Analysis	26.0	0.0	0.0	10.4	0.0	0.0
Synthesis	0.0	100.0	0.0	0.0	50.0	0.0
Evaluation	13.0	0.0	0.0	6.5	0.0	0.0
TOTAL	100	100	100	33.99	50.0	26.07
MEAN					36.69	

*Assignments consisted of out-of-class work such as laboratory assignments, homework, and projects

Table 6. Total Weighted Cognitive Scores of Tests and Assignments for Each Instructor

Instructor	Tests and Assignments Total Weighted Scores
1	27.54
2	18.51
3	31.18

Possible Range = 10 - 50

Table 7. Percentages and Weighted Values of Cognitive Levels on the Final Exams by Instructor

Level of Cognition	Cognitive Level of Final Exams					
	Instructor			Instructor		
	1	2	3	1	2	3
	%	z*	%	Weighted Value		
Knowledge	66.0	77.4	0.0	6.6	7.7	
Translation	2.0	0.0	0.0	0.4	0.0	0.0
Interpretation	14.0	2.6	0.0	3.5	0.7	0.0
Application	16.0	20.0	0.0	4.8	6.0	0.0
Analysis	2.0	0.0	60.0	0.8	0.0	24.0
Synthesis	0.0	0.0	0.0	0.0	0.0	0.0
Evaluation	0.0	0.0	40.0	0.0	0.0	20.0
TOTAL	100	100	100	16.1	14.4	44.0

Table 8. Pearson-Product Correlations Between Students' Cognitive Level of Achievement Scores and Selected Instructor Variables N = 76

Selected Instructor and Course Variables	Correlations with Students' Cognitive Level of Achievement Scores
Previous Experience	-.62
Cognitive Expectations for the Course	.72
Cognitive Level of Teaching	.17
Cognitive Level of Tests and Assignments	.67

1. Instructors should consider placing a greater emphasis on assignments. Assignments will almost automatically move the student away from recall into the higher levels of cognition.

2. Instructors need to place a greater emphasis on the higher cognitive levels in their classroom discourse. Although this is not likely to be easily accomplished, several factors could help instructors with this task. First, instructors need increased knowledge about the cognitive levels at which they teach. Second, instructors could examine their courses with several questions in mind.

a. What facts or understandings are essential knowledge within the course?
b. What do you, the instructor, expect students to be able to do upon completion of the course? The answer or answers to this question should provide a guide to the cognitive levels which must be incorporated into the classroom instruction and evaluation procedures.
c. What teaching methods are most appropriate for the skills and abilities you hope students will develop as a result of the course?

3. Instructors need to design in-class testing instruments which incorporate higher cognitive level questions. Tests will almost certainly continue to be heavily used in classrooms. Exams provide an excellent method for testing recall; thus questions at the knowledge level on exams may continue to be represented disproportionate to the emphasis given knowledge in the course. However, other levels can be tested on exams, even though they are sometimes more difficult to evaluate. Instructor training in the construction of test questions at the various levels of cognition may be necessary.

Finally, further research which seeks to explain student cognitive achievement in the short term is needed. Additionally, longer term studies which would describe and explain the development of cognitive skills is necessary for both instructors and curriculum planners.

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ASSESSING

Experiential Learning

Dennis C. Scanlon

Abstract

The Penn State Experiential Assessment Model was developed to assess the background and agricultural experiences of students entering the Department of Agricultural and Extension Education. The model employs two techniques for assessing student knowledge: self assessment and the faculty interview. Students deficient in technical agriculture and leadership skills are remediated through a variety of approaches that include but are not limited to credit courses, student organizations and advising. Preliminary indications are that the task of monitoring and making recommendations for additional skill development are working. Students are becoming more confident in their ability to perform and are entering the classroom with greater credibility and self esteem.

Introduction

The assessment of undergraduate experiential learning is pre-requisite to the development of a functional undergraduate curriculum. Because learning is comprised of a series of cognitive experiences that collectively impact an individual's role in society, education should supplement real life experiences in ways that contribute to the development of the whole individual.

In this regard, Odell (1984) found that 82% of students entering the College of Agriculture at The Pennsylvania State University had no experience in agriculture, agribusiness, or education. Odell indicated that the "typical" College of Agriculture freshman had completed an academic high school program and was an 18-year-old male from a town or rural, non-farm area. This profile led faculty in the Department of Agricultural and Extension Education at Penn State to conclude that a valid and reliable procedure was needed to assess the backgrounds and agricultural experiences of students entering the department.

The Assessment Model

A model was developed for the Department to use in assessing prior learning in two domains: leadership and technical agriculture. Successful experiences comprising the leadership domain are indicated by basic skills in the areas of communication, speaking, and organization. These skills are fundamental to successful teaching and correlate strongly with effective teaching (Cruickshank, 1978).

Technical agriculture knowledge encompasses the second domain upon which the vocational agriculture curriculum is built. Unlike mathematics, science, and

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