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ABSTRACT

Because of recent educational reform efforts aimed at creating more "educated persons" at the college level, a descriptive-correlational study was made to describe the aspired and the assessed cognitive level of instruction and determine the relationship of these variables to attitude toward teaching at higher cognitive levels among selected faculty members in the College of Agriculture at The Ohio State University. Ten of the 213 faculty members were selected to represent a cross-section of the faculty. Assessment was made by a research assistant using criteria established by a panel of experts. Instruments used included a Likert scale, the Florida Taxonomy of Cognitive Behavior, and Bloom's Taxonomy of Educational Objectives. Data were analyzed using the Statistical Package for the Social Sciences. The study found the following: (1) participants primarily aspired for their discourse and testing to be at the remembering and processing levels of cognition; (2) faculty conducted discourse primarily at the processing level of cognition, but tested at the remembering and processing levels; (3) faculty aspired to teach and test at higher cognitive levels than those at which they were assessed; (4) participants held favorable attitudes toward teaching and testing at higher cognitive levels; and (5) assignments tended to be given at higher cognitive levels than teaching or testing. Recommendations for instruction included the following: provide inservice education to faculty members in teaching at higher-order cognitive skill levels; encourage faculty members to talk to each other about teaching; and encourage faculty members to model higher-level cognitive skills in their classes before presenting material on those levels to students. (Contains 11 references.) (KC)

Summary of Research

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Aspired Cognitive Level of Instruction, Assessed Cognitive Level of Instruction and Attitude Toward Teaching at Higher Cognitive Levels

M. Susie Whittington and L. H. Newcomb

Introduction

America is caught in a sweeping wave of educational reform in higher education that is unprecedented in the history of the country. This intense national concern was sparked by several major national reports sharing a view that undergraduate education in general has become incoherent and ineffective (Reagan et al., 1987). The theme of the ineffectiveness of the undergraduate curriculum has been no different from the criticism of the American education system in general—failure to encourage students to think.

Like many colleges and universities across the country, The Ohio State University is revising undergraduate curricula. The goal of the revision is to expand and enrich the intellectual experience of every undergraduate. To accomplish that goal, educators are encouraged to design courses and programs that produce "educated persons", defined in the *Interim Report of the Special Committee for Undergraduate Curriculum Review* as the ability to write and speak, read and listen, and the ability to engage in careful logical thinking and critical analysis (Reagan et al., 1987).

An "Educated Person" in the College of Agriculture

The Ohio State University adopted a Strategic Plan (Warmbrod et al., 1989) recommending that future "educated persons" in the College of Agriculture complete a total undergraduate curriculum specifically emphasizing science and technology, and analysis and problem solving. However, simply adding science and technology, and analysis and problem solving courses to the curriculum will not develop the primary characteristics of an "educated person". The way in which the curriculum is taught will make the difference.

The Strategic Plan for the College of Agriculture at The Ohio State University addresses the teaching of thinking in the teaching function of the mission for the college:

> To develop the scientific and technical knowledge of students and practitioners, enhance their individual and collective capacity for enlightened thinking and problem solving, and encourage them to value and participate in the lifelong process of education (Warmbrod et al., 1989 p. 2).

Teaching Thinking

The power to think and solve problems should be the student outcome desired by professors. Many educators agree with Meyers (1986) who stated, "It is increasingly important that students master the thinking and reasoning skills they need to

process and use the wealth of information that is readily at hand..." (p. xii).

American educators, however, have not been singled-out as exemplary models for teaching thinking. "Traditionally, instruction in how to think has been a neglected component in American education" (Halpern, 1984, p. ix). McKeachie contends that, "Everyone agrees that students learn in college, but whether they learn to think is more controversial" (Joscelyn, 1988). Thus, in teaching thinking, a discrepancy exists between what theorists believe "is" happening in college classrooms and what Reagan (1987) and others suggest "ought to be" happening in college classrooms.

A Theory for Cognition Research

The Taxonomy of Educational Objectives: Cognitive Domain, developed by Bloom, Engelhart, Furst, Hill and Krathwohl (1956), was built on a theory of varying levels of complexity (Pickford, 1988) in which cognitive thought and associated behaviors could be classified into six hierarchical levels (Cano, 1988). In the Taxonomy, Bloom argues that accomplishing higher order thinking (application, analysis, synthesis and evaluation) requires some analysis or understanding of the new situation; it requires a background of knowledge of methods which can be readily utilized; and it also requires some facility in discerning the appropriate relations between previous experience and the new situation.

Bloom's Taxonomy was condensed by Newcomb & Trefz (1987) from six levels into four levels (see Table 1). The Newcomb-Trefz model of Bloom's Taxonomy was used in this study.

Teaching Thinking in the College of Agriculture

Using Bloom's Taxonomy, (Bloom et. al., 1956), a research study was conducted in the Department of Agricultural Education at The Ohio State University (Newcomb & Trefz, 1987). The researchers reported that fifteen percent of course activities were found to be assessing students at the highest levels of cognition — creating and evaluating. Later, in a study which considered relationships between student achievement and selected variables (Pickford, 1988), assignments seemed to have had the greatest influence on student achievement across the levels of cognition.

Miller (1989) continued work in the area of cognitive levels of teaching and learning by examining relationships of course experiences, especially instructor discourse, to student cognitive ability. Results of the study revealed that tests, quizzes, and instructor discourse were occurring primarily at the lower levels of cognition. However, assignments challenged students at the higher levels of cognition.

A synthesis of the three studies showed that students in the College of Agriculture at The Ohio State University were challenged to reach beyond rote memorization and comprehension primarily through assignments. However, students were not challenged at the application, analysis, synthesis, and evaluation (Bloom, 1956) levels through instructor discourse — the most concentrated student-professor experience. Nor were students challenged at the higher levels of cognition through tests — the experience which, because of heavy emphasis in grading, tends to motivate students.

Purpose and Objectives

The purpose of this descriptive-correlational study was to describe the aspired cognitive level of instruction and the assessed cognitive level of instruction and determine the relationship of these variables to attitude toward teaching at higher cognitive levels among selected faculty members in the College of Agriculture at The Ohio State University. Specific research questions were:

1. What are the characteristics of faculty members in the College of Agriculture at The Ohio State University who participated in this study in terms of:
   a. general demographics
      -course level taught

-subject matter taught

b. personal demographics
   -age
   -rank

c. teaching demographics
   -years of university teaching experience
   -percent appointment from general funds budget
   -number of courses taught per year
   -amount of time before class devoted to preparing for the class session
   -tenure status

d. extent of familiarity with levels of cognition
   -number of cognition workshops attended
   -extent of prior involvement in cognition studies

2. At what level of cognition do participants aspire to teach with respect to in-class discourse and written test items?
3. At what level of cognition are participants actually teaching as determined by assessment of tests, and assessment of in-class discourse as measured by the Florida Taxonomy of Cognitive Behavior?
4. What is the relationship between cognitive levels of instruction to which participants aspire and actual cognitive level of instruction?
5. Among participants, what is their attitude toward teaching at higher cognitive levels?
6. What is the magnitude of the discrepancy between aspired cognitive level of instruction and actual cognitive level of instruction?
7. What is the relationship between aspired cognitive level of instruction and attitude toward teaching at higher cognitive levels?
8. What is the relationship between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels?
9. What is the relationship between demographic information collected and attitude toward teaching at higher cognitive levels?

Methodology

Population and Sample

The target population for this study was 213 faculty members in the College of Agriculture at The Ohio State University. The accessible population was faculty members in the College of Agriculture at The Ohio State University, Columbus campus, who had a teaching appointment on the general funds budget and who were teaching at least one undergraduate course during Autumn Quarter, 1990 (September 19, 1990 - November 30, 1990).

Two faculty members from each of five subject matter areas in the College of Agriculture were purposefully selected. Engineering and Food Sciences participants were selected from the Department of Food Science and Technology and the Department of Agricultural Engineering. Those selected from animal sciences included a participant from the Department of Animal

TABLE 1
COMPARISON OF BLOOM'S TAXONOMY AND THE NEWCOMB-TREFZ MODEL

Bloom's Taxonomy	Newcomb-Trefz Model
Knowledge	Remembering
Comprehension	Processing
Application	Processing
Analysis	Processing
Synthesis	Creating
Evaluation	Evaluating

Science and one from the Department of Poultry Science. The social sciences constituent group was represented by a faculty member from the Department of Agricultural Economics and Rural Sociology and one from the Department of Agricultural Education. The plant sciences group was represented by a participant from the Department of Agronomy and the Department of Horticulture. Finally, natural resources was represented by two participants from The School of Natural Resources.

Instrumentation

The nature of the variables involved in this study required that a variety of instruments be used. A panel of experts consisting of researchers in the area of cognitive levels of teaching and learning, and experts in instrumentation validated each instrument used in the study. Reliability was established using data from a pilot study of 25 college of agriculture faculty members, not included in the research. Appropriate reliability coefficients are reported as each instrument is addressed.

Aspired Cognitive Level

Aspired cognitive level of instruction was measured by a research assistant the first week of Autumn Quarter, 1990. After individually reviewing the Newcomb-Trefz model, the research assistant asked participants to place 10 chips, in proportion to their aspired cognitive level of instruction, on each of four quadrants on a posterboard marked remembering, processing, creating, and evaluating. The proportion of chips placed on each quadrant was recorded as a portion of one hundred, thus revealing the aspired level, in percentages, at each level of cognition. The process was repeated for discourse, and written test items. A test/retest procedure was adopted to establish the reliability of this methodology. The test/retest coefficient indicated the methodology was reliable.

Attitude Toward Teaching at Higher Cognitive Levels

Attitude toward teaching at higher cognitive levels was measured during the first week of Autumn Quarter, 1990, using a 50-item six-point Likert scale instrument developed by the researcher. Reliability was calculated at r = .86 using Cronbach's Alpha.

Assessed Cognitive Level

The Florida Taxonomy of Cognitive Behavior (FTCB) (Webb, 1970) was used to assess cognitive level of discourse. This instrument is based upon Bloom's Taxonomy and is designed to identify specific cognitive behaviors. Each participant's in-class discourse was audio-taped and assessed three times (the third, fifth, and eighth weeks) during Autumn Quarter, 1990. Validity for this instrument was based upon its direct development from Bloom's Taxonomy and the support generally given to this hierarchy of cognitive behaviors. Reliability for this instrument was established by coding videotapes of lectures and establishing Spearman Rho reliability coefficients. Intra-rater reliability was approximately p = .96. Inter-rater reliability between previous researchers was approximately p = .98.

For written tests, each item was assessed using Bloom's Taxonomy of Educational Objectives (Bloom, 1956) and the categories on the Florida Taxonomy of Cognitive Behavior instrument. After assessment the researcher met one-on-one with participants to confer on each item since cognitive level assessment is dependent upon the context in which the information was delivered.

Data Analysis

The Statistical Package for the Social Sciences (SPSSx/PC+) computer package was used to analyze the data. For each variable in the study, measures of central tendency and frequency distributions were generated and then used to describe the sample in the study. Pearson Product Moment Coefficients of the Correlation were calculated between aspired and assessed cognitive level of instruction, attitude toward teaching at higher cognitive levels, and demographic information.

Findings

Characteristics of Participants

The ten purposefully selected professors in the College of Agriculture at The Ohio State University who participated in this study taught freshmen level through senior level undergraduate courses in ten different subject matter areas. Their average age was 48 years. One-half of the participants were Professors; three were assistant professors while two were associate professors.

The participants had an average of 14 years of university teaching experience. Their percentage of appointment from the general funds budget ranged from 50% - 100% with a mode of 50%. Faculty members in the study taught an average of five courses per year.

One-half of the participants (5) in this study devoted one hour prior to each class preparing for the class session. Eighty percent (8) of the participants were tenured.

With respect to knowledge of the levels of cognition, faculty members had participated in 0 to 6 previous cognition workshops (mean = 2.7). Two participants had been involved in two previous cognition studies in the College of Agriculture.

Aspired Cognitive Level of Instruction

Participants aspired to have approximately 70% of their discourse at the remembering and processing levels (see means in Table 2). Aspirations for discourse at the creating and evaluating levels ranged from 0 to 30% with a mean of approximately 15%. Participants in this study aspired to write 75% of their test items at the remembering and processing levels.

Assessed Cognitive Level of Instruction

As can be seen in Table 2, the discourse of participants in this study was assessed to be approximately 95% at the remembering and processing levels. Approximately 80% of the test items were found to be at the remembering and processing levels.

The majority of the participants in this study (6) wrote 30% - 40% of their test items at the remembering level. With the exception of one participant, all wrote 35% or more of their test items at the processing level. One participant wrote 100% of the test items at the creating level while all other participants wrote fewer than 10% of

Table 2
Aspired and Assessed Cognitive Level of Discourse and Tests

	Aspired percent			Assessed percent	
Level of cognition	Mode	Mean	Range	Mean	Range
Cognitive level of discourse					
Remembering	40	39	10-80	42	34-57
Processing	30	32	10-50	53	38-61
Creating	0, 20	14	0-30	5	2-9
Evaluating	10, 20	15	0-30	<1	<1-1
Cognitive level of tests					
Remembering	50	38	10-60	39	0-62
Processing	30	36	20-50	41	0-57
Creating	0, 10	12	0-30	13	0-100
Evaluating	10	14	0-30	7	0-19

their items at the creating level. The maximum percentage of test items written at the evaluating level was nineteen percent.

Discrepancy Between Aspired Levels and Assessed Levels

Regardless of the aspired level of discourse at the remembering level, between 34%-57% of the participants' discourse occurred at the remembering level. All participants achieved a higher percentage of discourse at the processing level than the proportion to which they aspired. No one was assessed as having greater than 10% of their discourse at the creating level, no matter the aspiration. Participants failed to reach their aspiration for discourse at the evaluating level by as much as 30%.

Relationship Between Aspiration and Assessment

Correlation coefficients between aspired cognitive level of instruction and assessed cognitive level of instruction revealed that as participants aspired to write more test items at the processing and creating levels, they were successful (see Table 3). Very little association was found between aspired cognitive level of instruction and in-class discourse.

Attitude Toward Teaching at Higher Cognitive Levels

Participants completed a 50-item Likert scale instrument designed to measure their attitude toward teaching at higher cognitive levels. The mean score on the attitude instrument (238 on a scale of 50 - 300) indicated that participants in the study had attitudes which favored teaching at higher cognitive levels.

Relationships: Aspiration and Attitude

Table 4 shows, as attitude toward teaching at higher cognitive levels increased, proportion of discourse and number of test items written at the remembering level decreased. As attitude toward teaching at higher cognitive levels increased, extent of discourse and number of test items written at the creating and evaluating levels also increased.

Relationships: Assessment and Attitude

The strongest relationships between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels were in the area of testing. As

Table 3
RELATIONSHIP BETWEEN ASPIRED AND ASSESSED COGNITIVE LEVEL OF INSTRUCTION

Level of cognition	Association
Cognitive level of discourse	
Remembering	r = -.0168
Processing	r = .0913
Creating	r = .2341
Evaluating	r = .1226
Cognitive level of tests	
Remembering	r = .2271
Processing	r = .4232
Creating	r = .5945
Evaluating	r = -.1216

attitude toward teaching at higher cognitive levels increased, the number of test items written at the remembering, processing, and evaluating levels decreased (strongest relationship at the processing level). As attitude toward teaching at higher cognitive levels increased, the number of test items written at the creating level increased.

Relationships to Characteristics

Attitude toward teaching at higher cognitive levels was positively related to increased age, rank, and tenure status. Also, extent of participation in cognition workshops was positively related to attitude toward teaching at higher cognitive levels.

Conclusions

The following conclusions are based upon the researcher's interpretation of the results of this study.

1. Participants in this study primarily aspired for their discourse and testing to be at the remembering and processing levels of cognition. There was much less aspiration among participants to conduct discourse or write test items at the creating and evaluating levels. This was the case for all participants no matter what the subject matter or course level.
2. The faculty members in this study conducted discourse primarily at the processing level of cognition, but tested at the remembering and processing levels. They tested very little at the creating and evaluating levels and taught even less at those levels.
3. The participants in this study aspired to teach and test at cognitive levels higher than those at which they were assessed.
4. Regardless of the cognitive level to which faculty members in this study aspired to conduct discourse, they conducted discourse at about the same level. There was little discourse at the creating and evaluating levels.
5. Generally, participants in this study who aspired to write test items at the processing and creating levels wrote more test items at the processing and creating levels. This was less true at the remembering level and was not the case at the evaluating level.
6. Participants in this study held favorable attitudes toward teaching at higher cognitive levels.
7. Faculty members in this study who possessed more favorable attitudes toward teaching at higher cognitive levels wanted their discourse and testing to be less at the remembering level and more at the creating and evaluating levels.
8. Participants who held a more favorable attitude toward teaching at higher cognitive levels tested less at the processing and evaluating level

Table 4
RELATIONSHIP BETWEEN ASPIRED COGNITIVE LEVEL OF INSTRUCTION AND ATTITUDE TOWARD TEACHING AT HIGHER COGNITIVE LEVELS

Level of cognition	Association
Cognitive level of discourse	
Remembering	r = -.6157
Processing	r = .2167
Creating	r = .5375
Evaluating	r = .3732
Cognitive level of tests	
Remembering	r = -.7879
Processing	r = -.1317
Creating	r = .8043
Evaluating	r = .5155

Table 5
RELATIONSHIP BETWEEN ASSESSED COGNITIVE LEVEL OF INSTRUCTION AND ATTITUDE TOWARD TEACHING AT HIGHER COGNITIVE LEVELS

Level of cognition	Association
Cognitive level of discourse	
Remembering	r = .1442
Processing	r = -.1695
Creating	r = .0937
Evaluating	r = .0461
Cognitive level of tests	
Remembering	r = -.1893
Processing	r = -.7154
Creating	r = .5441
Evaluating	r = -.3108

and more at the creating level. However, the cognitive level of discourse was not strongly associated with attitude toward teaching at higher cognitive levels.

9. More experienced professors had more favorable attitudes toward teaching at higher cognitive levels.

Discussion of Findings

If students are to graduate from institutions of higher education equipped with the ability to think at higher cognitive levels, professors must take an active role in assisting students to develop higher level thinking skills through effective instruction. This discussion section is designed to further unveil knowledge revealed in this study regarding effective instruction — instruction at higher cognitive levels.

Cognitive Level of Discourse

This study was grounded in Bloom's theory of educational objectives in the cognitive domain (Bloom, 1956) which emphasizes the importance of offering lower level (remembering and processing) information to students as a basis on which to move to the upper levels of cognition (creating and evaluating). However, professors may be presenting a greater proportion of lower level information than is necessary or desired.

The data from this study show that professors conduct discourse at lower levels of cognition (remembering and processing) 98% of the time. These data are consistent with the findings of previous studies (Pickford, 1988; Miller, 1989).

High percentages of lower level discourse were found consistently across three studies involving a total of 17 professors, who taught a wide variety of subject matter to students at various course levels. This comparison of studies provides further evidence that agricultural professors are conducting discourse primarily at the lower levels of cognition and thus limiting students' opportunities to observe and practice higher level thinking.

Why instructors are conducting such a high proportion of discourse at the lower levels is not known. One could speculate that this is "normal" and cannot be changed. More than likely, this is not the case.

Perhaps professors do not know how to reach creating and evaluating levels of cognition in their discourse. It is also possible that they believe they have no time to re-evaluate and re-write lesson plans to prepare for evaluating and creating level discourse. It may be too frustrating for them to try to teach at higher cognitive levels. It is also possible that professors feel apprehensive about making vast changes toward

teaching at higher cognitive levels when the theory is still being developed.

Professors may not fully understand the long term effects which teaching at higher cognitive levels can provide for students. They may not be aware of the number of weeks, months, years that it might take to persevere in order to change the cognitive level of their teaching. It is also possible that professors do not appreciate the challenge that teaching at higher cognitive levels can provide for professors and for students.

However, there is more to teaching than discourse. In addition to providing students opportunities for higher level thinking through higher level discourse, professors can provide learning experiences inside the classroom and outside the classroom that encourage higher level thinking. In all cases, though, planning and preparing for experiences at the upper levels of cognition are the initial steps. Such planning and preparing are the focus of the following sections.

Raising Cognitive Level of Instruction

Prior to Teaching

It is speculated that with knowledge of teaching methods and with time, professors can provide a greater portion of their instruction at higher cognitive levels. Professors should be taught to use the principles of teaching and learning, primary and secondary principles of interest, a greater variety of group and individual teaching techniques, and the categories on the FTCB to plan to more readily teach at the higher levels of cognition. Using the listed materials, professors can purposefully plan the words, methods, and visuals needed to reach the creating and evaluating levels of cognition in the classroom.

Professors must then learn to evaluate their own lesson plans or be willing to share their lesson plans with peers who can assist them with planning for classroom opportunities to model higher level thinking. Professors should also plan to regularly observe other professors as they teach. Much can be learned from colleagues who have a reputation for good teaching.

In-class learning experiences

Professors in this study were proficient at using words to reach the application level (part of the processing level). Many times, however, spoken examples desperately needed to be supplemented with a case study, a demonstration, or an experiment; these techniques require students to utilize higher level thought processes.

Testing

Once professors have modeled higher order thinking in classrooms, testing students at the upper levels of cognition can be a means for adding rigor to courses. However, testing at the higher cognitive levels without first writing objectives which require higher level thinking, and then demonstrating higher level thought processes for students, adds frustration rather than rigor.

One participant in this study wrote 100% of test items at the creating level. Before implementing 100% creating level testing, professors should answer the following questions: How will I model the creating level of cognition during lecture, prior to expecting students to operate at the creating level on tests? How will I grade the creating level tests? Is it beneficial to my students to offer only one option for measuring performance or should other forms of measurement be available for students who do not excel at writing?

The participant who wrote 100% creating level tests was an exception. Professors in this study most often used two midterm examinations and one final examination consisting of a combination of objective and subjective items written primarily at the remembering and processing levels of cognition.

Out-of-class Learning Experiences

Professors can provide opportunities for students to reach higher cognitive levels outside of the classroom. Experiences such as outside reading from the chosen text and other sources, laboratory experiments and projects, field trips, and discussion groups can be designed to increase the cognitive level of the course. Table 6 portrays a comparison of the level of discourse between one participant's observed lectures (n = 3) and the participant's discussion group (n = 1). As can be seen in the table, this participant's discourse during the discussion group was less at the remembering level, more at the processing level and more at the creating level than was the case for the participant's lectures.

Summary of Discussion

Upon considering this study and the previous cognition research of Newcomb and Trefz (1987), Pickford (1988), and Miller (1989), one can speculate that students entering a college of agriculture today could expect to be taught by discourse delivered primarily at the processing level. They could expect very little, if any, in-class discourse at the creating and evaluating levels.

Students could expect to be tested using two midterms and one final, all written predominantly at the remembering and processing levels with occasional items written at the evaluating level. Occasionally, students might take a class that requires assignments; the assignments would be written at the creating level. Previous research indicates that regardless of the subject matter, course level, or experience of the professor, this would be the scenario.

The scenario could change as professors work to model higher levels of cognition in their classrooms and then assess student performance at those levels by writing tests with less remembering level items and more creating and evaluating level items, and by requiring assignments written at the higher cognitive levels.

Recommendations

Recommendations for Instruction

1. More cognition workshops should be offered to faculty members by those studying cognitive levels of teaching and learning. Faculty members, especially young faculty members, should be encouraged to attend.
2. It is recommended that professors devote more time to talking with one another about teaching. Professors need to encourage peers and colleagues to give attention to teaching at higher cognitive levels.
3. It is recommended that students be tested at the upper levels of cognition only after higher order thinking has been modeled for the students in the classroom.
4. It is recommended that professors test less at the remembering level.

Table 6
COMPARISON OF COGNITIVE LEVEL OF DISCUSSION GROUP VERSUS LECTURE

	Teaching method	
Level of cognition	Percent of lecture	Percent of discussion
Remembering	57	34
Processing	38	51
Creating	5	13
Evaluating	0	0

Note: Percent of lecture represents the mean of the data from three observations. Percent of discussion represents data from one discussion.

5. Participants in this study primarily used tests to assess student performance. It is recommended that professors use assignments to challenge students to reach higher levels of cognition and to measure student performance at higher levels of cognition.
6. It is recommended that professors make changes in their current teaching style to reach the cognitive levels to which they aspire for their instruction.

Recommendations for Further Research

1. Develop an instrument for assessing classroom discourse that provides the researcher with equal opportunities to record behaviors across all levels of cognition.
2. Compare item analysis of examinations with the assessment of items at each level of cognition. Compare the cognitive level of items to percentage of discourse across the levels of cognition. Examine student performance at various levels of cognition. Compare student performance across the levels of cognition with professor discourse across the levels of cognition to student variables such as ACT scores, class rank, high school track, learning style and other student variables.
3. Additional study is needed to determine the extent to which laboratories, discussion groups, field trips and other activities provided by the professor outside of the classroom situation contribute to higher cognitive levels of instruction.
4. A future study should develop a regression model for establishing contributions of professor variables and student variables to higher cognitive levels.
5. Continue research which will lead to developing recommendations for appropriate percentage of discourse at each level of cognition, sufficient number of written test items at each level of cognition, and necessary cognitive level of assignments for various subjects and course levels.
6. Select professors who are teaching undergraduate and graduate courses during the same quarter and assess their teaching level between the courses.
7. Determine the retention rate of information in relation to the cognitive level at which the information was delivered. An example might be to readminister final course examinations to students one year after completion of the course and then assess the cognitive level of items retained by the students.
8. A study should be conducted to examine the difference in cognitive level of instruction following an intensive intervention program on cognitive levels of teaching and learning.

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SUMMARY OF RESEARCH SERIES

The power to think and solve problems should be the student outcome desired by professors. This can be achieved by teaching at higher cognitive levels that encourage higher order thinking (application, analysis, synthesis, and evaluation). This study describes agriculture faculty members' aspired cognitive level of instruction, the assessed level of instruction, and the higher cognitive levels. It should be of interest to college faculty members who are striving to develop thinking skills in their students.

This summary is based on a dissertation by M. Susie Whittington under the direction of L. H. Newcomb. M. Susie Whittington was a graduate student in the Department of Agricultural Education at The Ohio State University. She is currently Assistant Professor, Department of Agricultural and Extension Education, University of Idaho. Dr. Newcomb is Associate Dean for Academic Affairs, College of Agriculture, The Ohio State University. Special appreciation is due to David E. Cox, University of Arizona; Carl L. Reynolds, University of Wyoming; and N. L. McCaslin, The Ohio State University for their critical review of the manuscript prior to publication.

Research has been an important function of the Department of Agricultural Education since it was established in 1917. Research conducted by the Department has generally been in the form of graduate theses, staff studies, and funded research. It is the purpose of this series to make useful knowledge from such research available to practitioners in the profession. Individuals desiring additional information on this topic should examine the references cited.

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