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

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The power to think and solve problems should be the student outcome desired by professors. 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). Many educators agree with Meyers (1986) who wrote, "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). 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 and Trefz (1987) from six levels into four levels (see Table 1). The Newcomb-Trefz model of Bloom's Taxonomy was used in this study.

Table 1. Comparison of Bloom's Taxonomy and the Newcomb-Trefz Model

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

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 of selected professors in a College of Agriculture, and determine the relationship of these variables to attitude toward teaching at higher cognitive levels. Specific research questions were:

At what level of cognition do participants aspire to teach?

At what level of cognition are participants actually teaching?

What is the relationship between cognitive levels of instruction to which participants aspire and actual cognitive level of instruction?

Among participants, what is their attitude toward teaching at higher cognitive levels?

What is the relationship between aspired cognitive level of instruction and attitude toward teaching at higher cognitive levels?

What is the relationship between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels?

Methodology

Population and Sample

The target population for this study was 213 faculty members in a College of Agriculture. The accessible population was faculty members on the local campus who had a teaching appointment on the general funds budget and who were teaching at least one undergraduate course during Autumn Quarter, 1990.

The departments in the College of Agriculture are divided into five constituent groups consisting of Animal Sciences, Engineering and Food Sciences, Plant Sciences, Social Sciences, and the School of Natural Resources. Two faculty members from each of the five areas were purposefully selected to represent a cross-section of departments in the college. The findings of this study cannot be generalized beyond the ten participants.

Instrumentation

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 of the 50-item, six-point Likert-type instrument used to measure attitude toward teaching at higher cognitive levels was established at $r = .86$ using Cronbach's Alpha. These data were gathered from a pilot study of 25 College of Agriculture faculty members not included in the research (68% return rate after two mailings).

Additionally, the cognitive level of classroom discourse was described by analyzing in-class discourse and written test items using the Florida Taxonomy of Cognitive Behavior (FTCB) (Webb, 1970), an instrument based on Bloom's Taxonomy (1956). Validity for this instrument was based upon its direct development from Bloom's Taxonomy. Intra-rater reliability (.98) was established by coding videotapes of professors of agriculture which were on file in the departmental library.

Collection

One week prior to Autumn Quarter 1990, a research assistant met individually with each participant to review the Newcomb-Trefz model, collect demographic information, deliver the attitude toward teaching at higher cognitive levels instrument for completion by the faculty member, and determine the aspired cognitive level of instruction for each participant. To determine aspired cognitive level of instruction, participants placed 10 chips, in proportion to their aspired cognitive level of in-class discourse, on four quadrants drawn on a posterboard marked remembering, processing, creating, and evaluating (the levels of cognition in the Newcomb-Trefz model). The proportion of chips placed on each quadrant was recorded as a portion of one hundred, revealing the aspired level, in percentages, at each level of cognition. The process was repeated for written test items. A test/retest procedure was adopted to establish the reliability of this methodology.

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, and attitude toward teaching at higher cognitive levels.

Findings

Characteristics of Participants

The ten purposefully selected professors 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 full 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 to 100 percent with a mode of 50 percent. Faculty members in the study taught an average of five courses per year. Participants devoted 30 minutes to 1 1/2 hours prior to each class preparing for the class session, with one-half of the participants (5) devoting one hour. Eighty percent (8) of the participants were tenured.

With respect to knowledge of the levels of cognition, the ten faculty members in this study had participated in 0 to 65 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 percent 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 percent with a mean of approximately 15 percent. Participants in this study aspired to write 75 percent 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 percent at the remembering and processing levels. Approximately 80 percent 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 to 40 percent of their test items at the remembering level. With the exception of one participant, all wrote 35 percent or more of their test items at the processing level. One participant wrote 100 percent of the test items at the creating level while all other participants wrote fewer than 10 percent of their items at the creating level. The maximum percentage of test items written at the evaluating level was nineteen percent.

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
Processing	30	32	10-50	53	38-60
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	0-10
Evaluating	10	14	0-30	7	0-19

Discrepancy Between Aspired Levels and Assessed Levels

Regardless of the aspired level of discourse at the remembering level, between 34 and 57 percent 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 percent 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 assessed in-class discourse.

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

Participants completed a 50-item Likert-type 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 to 300) indicated that participants in the study had attitudes which favored teaching at higher cognitive levels.

Relationships: Aspiration and Attitude

As revealed in Table 4, 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 increased.

Table 4. Relationship Between Attitude Toward Teaching at Higher Cognitive Levels and Aspired and Assessed Cognitive Level of Instruction

	Association with attitude	
Level of cognition	Aspiration	Assessment
Cognitive level of discourse		
Remembering	r = -.6157	r = .1442
Processing	r = .2167	r = -.1695
Creating	r = .5375	r = .0937
Evaluating	r = .3732	r = .0461
Cognitive level of tests		
Remembering	r = -.7879	r = -.1893
Processing	r = -.1317	r = -.7154
Creating	r = .8043	r = .5441
Evaluating	r = .5155	r = -.3108

Relationships: Assessment and Attitude

As can be seen in Table 4, the strongest relationships between assessed cognitive level of instruction and attitude toward teaching at higher cognitive levels were in the area of

testing. As 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.

Conclusions

The participants in this study aspired to teach and test at cognitive levels higher than those at which they were assessed.

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.

Regardless of the cognitive level to which faculty members in this study aspired to conduct discourse, they conducted discourse at about the same cognitive level.

Participants in this study had favorable attitudes toward teaching athigher cognitive levels.

Faculty members in this study who had a more favorable attitude 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.

Participants who had a more favorable attitude toward teaching at higher cognitive levels tested less at the processing and evaluating level and more at the creating level.

Discussion

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 in this study may be presenting a greater porportion of lower level information than is necessary or desired.

High percentages of lower level discourse were found consistently across three studies (Pickford, 1988; Miller, 1989; Whittington, 1991) 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 in this study are conducting discourse primarily at the lower levels of cognition and limiting students' opportunities to observe and practice higher level thinking.

Perhaps this is the case because professors do not know how to reach creating and evaluating levels of cognition in their discourse. It is also possible that professors believe they lack the amount of time required 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 of perseverance that may be necessary 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.

There is more to teaching than discourse. There are additional possibilities for providing higher cognitive levels of instruction. In addition to higher level discourse, professors can provide learning experiences in the classroom and outside of the classroom, but one must first plan and prepare for experiences at the upper levels of cognition.

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 this 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 the 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. Professors can work to model higher levels of cognition in their classrooms. Professors can then plan to assess student performance at higher cognitive levels by writing tests with less remembering level items and more creating and evaluating level items. Professors can also require assignments written at higher cognitive levels.

Recommendations

For Instruction

It is recommended that:

Professors test less at the remembering level.

Students be tested at the upper levels of cognition only after higher order thinking has been modeled for the students in the classroom.

Professors make conscientious changes in their current teaching methodology to reach the cognitive levels to which they aspire for their instruction.

For Further Research

Study 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.

Develop a regression model for establishing contributions of professor variables and student variables to acquire higher cognitive level processes.

Determine the retention rate of information in relation to the cognitive level at which the information was delivered.

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