

**ASSESSMENT OF COGNITIVE DISCOURSE:
A STUDY OF THINKING OPPORTUNITIES PROVIDED BY PROFESSORS**

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Abstract

*The American higher education system has been under close scrutiny for more than a decade. The cause is clear: a lack of correspondence between that which is believed to be required for critical thinking in adulthood and that which universities are teaching. The purpose of this study, therefore, was to describe the opportunities given to students to reach higher cognitive levels through professors' classroom discourse. The researchers sought to explore relationships between classroom discourse and class size, course level, and **progression** across the semester. Sixteen College of Agricultural Sciences faculty were purposefully selected. Researchers observed and recorded their teaching four times during the semester. Classroom discourse was presented predominately at lower cognitive levels. No statistically significant relationship existed **between frequency** of opportunities given students to think at higher cognitive levels, class size, course level, **nor** progression across semester. Teacher educators in agricultural education must prepare and present seminars and workshops designed to assist faculty in Colleges of Agriculture in learning techniques for increasing the frequency of opportunities given to students to think at higher cognitive levels, thereby enhancing the cognitive processing skills of students.*

The American higher education system has been under close scrutiny for more than a decade. Reports conveying the message that undergraduate education has become incoherent and ineffective has sparked this intense surveillance (Reagan et al., 1987). Specifically, there exists a lack of correspondence between that which is believed to be required for critical thinking in adulthood and that which universities are teaching (Stemberg, 1985). Are graduates leaving universities without a necessary survival skill: the ability to think critically?

Research on Critical Thinking

“Recently, researchers have begun to investigate how the ability and the propensity to think well are

acquired and maintained” (Resnick, 1987). Resnick reported that, when two or more cognitive abilities were tested, there was almost always a positive correlation between the measures. Thus, people who did well on one ability test were, on the average, likely to do well on the others. She also found that grades were only indirect indicators of changed cognitive abilities. Grades did not reveal the quality of thinking, and offered no indications of transfer beyond purely academic settings.

Simon (1976) wrote, “When cognitive scientists do information-processing analyses of complex skills, they find the same kinds of basic problem-solving processes used in task after task. These “metacognitive skills” have been shown by Brown et. al (1983) to be characteristic of effective

learners, good readers and writers, and strong problem solvers. The researchers found these skills to be relatively absent in younger less intelligent individuals.

Research on teaching critical thinking processes has shown that strategies taught could often be used after just a few lessons, but that people induced to use particular thinking strategies would do so on the immediate occasion but would fail to apply the same strategy on subsequent occasions (Belmont, Butterfield, and Ferretti, 1982).

Ryan (1984b), reported that students who thought at higher levels of cognition (thought critically) scored better on SATs, wrote better research papers, gave better persuasive speeches, and had a better mastery of textbook information. For example, low-level students tended to read textbooks in order to 'recall information in response to study guide questions,' while higher-level students read textbooks in search of 'conceptual relationships and meanings' (p. 252).

Other studies have found similar results. In a study conducted at Harvard by Perry (1970), the relationship between epistemological development in college students and academic skills was examined. It was found that the higher the level of cognition, the better the academic skills. Others have replicated phases of Perry's work (Baxter-Magolda, 1987; Clinchy, Lief, and Young, 1977; Goldberger, 1981; Ring, 1985; Knefelkamp, 1974; Knefelkamp and Slepitz, 1976; Ryan, 1984; Schmidt and Davison, 1983; Stephenson and Hunt, 1977; Touchton, 1977; Widick and Simpson, 1978) and each found similar results; the higher the level of cognition, the better the academic skills.

Research supports the theory that thinking at higher levels of cognition (thinking critically) is an indispensable skill and must be reinforced in schools. Are professors reinforcing this life-long skill, or is the accusation valid -- graduates are

leaving universities void of the ability to think critically.

A Theory for Cognition Research

Bloom's Taxonomy of Educational Objectives: Cognitive Domain (1956) provided the theoretical frame for this research. In his hierarchical theory, Bloom averred that there exists six levels of cognitive complexity through which it is possible to mentally operate: knowledge, comprehension, application, analysis, synthesis, and evaluation (see Figure 1). In order to reach a higher level, Bloom argued that one must first have complete mastery of the preceding level.

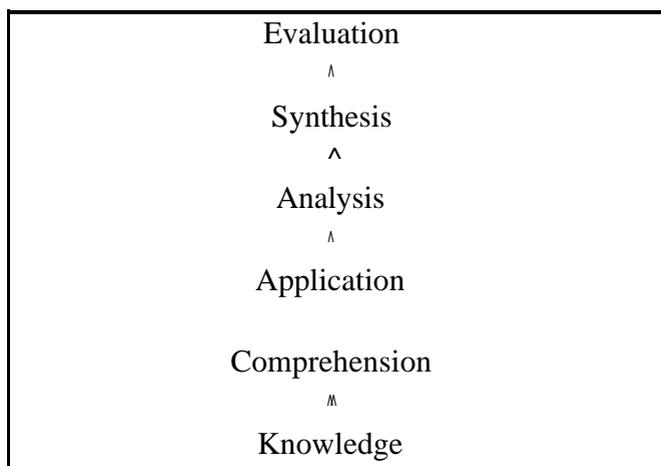


Figure 1. Bloom's Taxonomy -- A Hierarchy of Thought Processes

Purpose and Objectives of Study

The purpose of this descriptive-correlational study was to describe the opportunities given to students to reach higher cognitive levels through professors' classroom discourse. The researchers sought to determine the relationship between opportunities given by professors for students to think at higher cognitive levels through classroom discourse, class size, course level, and progression across the semester. Sixteen case studies were compiled and examined.

The dependent variable in the study was opportunities given to students to think at higher cognitive levels (as measured by the Florida Taxonomy of Cognitive Behavior). The independent variables of the study were assessed cognitive level of classroom discourse, class size, course level, and progression across the semester. Specific research questions were:

1. At what level of cognition are participants actually teaching?
2. What is the degree of relationship between opportunities provided for students to think at higher cognitive levels, class size, course level, and progression across the semester?

Methodology

Population and Sample

The target population for this study was 390 faculty members in the College of Agricultural Sciences at the Pennsylvania State University. The accessible population was faculty members at the University Park campus who held a teaching appointment on the general funds budget and who were teaching at least one undergraduate course during Spring Semester, 1996 (January 8, 1996-May 11, 1996).

In an attempt to hold numerous variables constant, interviews were conducted with department chairs to determine faculty members who were “good teachers” as evidenced by interest in improving teaching, exit interview comments by students, attendance at teaching seminars, and student evaluations of teaching. Of those nominated, sixteen faculty members from nine departments/schools in the College of Agricultural Sciences (horticulture, entomology, agronomy, dairy science, animal and veterinary science, forestry, soils, environmental resource management, agricultural economics, and plant

pathology), who taught freshman through senior level courses, agreed to participate.

Instrumentation

In 1970, Bloom’s Taxonomy was used by Webb to create the Florida Taxonomy of Cognitive Behavior (FTCB), an instrument that can be used to assess the cognitive level of classroom discourse (the formal speech or conversation delivered during class) professors are using when they teach. The FTCB utilized 55 observable behaviors indicative of the various cognitive levels identified by Bloom’s Taxonomy. In the “knowledge” category, 17 observable behaviors are listed on the instrument; for “comprehension”, 12 observable behaviors are listed; for “application”, four observable behaviors are listed; for “analysis”, 11 observable behaviors are listed; for “synthesis”, nine observable behaviors are listed; and for “evaluation”, two observable behaviors are listed.

Validity for the FTCB 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 audio-tapes of lectures and establishing Spearman Rho reliability coefficients. Intra-rater reliability was approximately $r = .96$. Inter-rater reliability between previous researchers and the researchers in this study was approximately $r = .98$.

Data Collection

Sixteen participants were observed and audio-taped during four randomly selected 50-minute class sessions, approximately every two weeks, but avoiding the first ten days and the final ten days of the semester. Participants were aware of the days the researchers would be in attendance. The observations were split evenly between two raters.

During observations, raters were seated among the students as frequencies of observable behaviors were recorded in six-minute intervals. Examples of observable behaviors at each level of Bloom's hierarchy include: "Defines meaning of a term" (knowledge level); "Shows cause and effect relationship" (comprehension level); "Applies previous learning to new situations" (application level); "Shows interaction or relation of elements" (analysis level); "Formulates hypothesis" (synthesis level); and "Evaluates something from evidence" (evaluation level).

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) on the mainframe at the Pennsylvania State University. More specifically, frequencies of behaviors observed across all cognitive levels were totaled. Then frequencies within each cognitive level were divided by the overall total to acquire percentages of classroom discourse at each cognitive level. Cross-tabulations, frequencies, and means were calculated.

Results

Assessed Cognitive Level of Classroom Discourse

The discourse of participants in this study was assessed to be: knowledge = 47%, comprehension = 33%, application = 8%, analysis = 10%. Participants' discourse was approximately 1.5% at the synthesis level with a range of 0 to 6%. Evaluating level discourse was assessed at less than 1%.

Opportunities for Higher Level Thinking and Progression Across Semester

Although periodic increases and decreases were assessed in opportunities for higher level thinking in classes, in one-half of the classes the percentage of discourse at lower levels decreased while the

percentage of discourse at higher levels increased by the end of the semester. However, in the remaining one-half, the percentage of discourse at lower levels increased while the percentage of discourse at higher levels increased by the end of the semester. For example, one professor was assessed as using 47% knowledge level, 41% comprehension level, and 0% evaluation level discourse at the beginning of the semester. At the end of the semester, the same professor was assessed at 42% knowledge, 39% comprehension, and 1% evaluation, a statistically significant increase at the .05 level. At the same time, another professor was assessed as using 30% knowledge level, 32% comprehension level, and 4% evaluation level discourse at the beginning of the semester. At the end of the semester, the same professor was assessed at 39% knowledge, 45% comprehension, and 1% evaluation, a statistically significant decrease at the .05 level.

Opportunities for Higher Level Thinking: and Course Level

During a 100 level (n = 1) course, 41% of the discourse was presented at the knowledge level and 32% was presented at the comprehension level (lowest two cognitive levels) while 1% of the discourse was presented at the synthesis level and 0% was presented at the evaluation level (highest two cognitive levels). As can be seen in Table 1, during 200 level courses (n = 3), 35% of the discourse was presented at the knowledge level, and 25% was presented at the comprehension level while 8% of the discourse was presented at the synthesis level and 3% was presented at the evaluation level. Discourse presented at the synthesis level 8% of the time was the highest of all course levels.

For a 300 level course (n = 1), 57% of the discourse was presented at the knowledge level, 31% was presented at the comprehension level while 1% of discourse was presented at the synthesis and evaluation levels. Discourse

Table 1. Percent of Discourse at Each Cognitive Level by Course Level

Percent of discourse by level						
Level	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
100 Level (n= 1)	41% (26%-53%)	32% (23%-42%)	13% (4%-24%)	13% (0%-22%)	1% (0%-3%)	0% (0%)
200 Level (n = 3)	35% (14%-58%)	25% (14%-47%)	13% (9%-28%)	16% (2%-35%)	8% (2%-10%)	3% (0%-5%)
300 Level (n = 1)	57% (51%-61%)	31% (18%-38%)	;;-6%)	7% (0%-14%)	1% (0%-3%)	1% (0%-1%)
400 Level (n = 11)	36% (21%-56%)	31% (14%-49%)		17% (2%-35%)	5% (0%-9%)	2% (0%-6%)

Note: Numbers within parentheses indicate a range.

Table 2. Percent of Discourse at Each Cognitive Level by Class Size

Percent of discourse by size						
Size	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
10-15 (n = 4)	34% (19%-46%)	28% (17%-48%)	13% (2%-27%)	17% (3% - 35%)	6% (1%-9%)	2% (1%-7%)
16-20 (n= 1)	32% (26%-39%)	33% (19%-45%)	10% (5%-13%)	18% (12%-21%)	6% (3%-10%)	2% (1%-6%)
21-30 (n = 4)	37% (14%-58%)	28% (9% - 57%)	10% (1%-34%)	12% (2% - 26%)	9% (2%- 10%)	4% (1%-6%)
31-50 (n = 5)	36% (26%-49%)	29% (18%-42%)	9% (2%-14%)	18% (2% - 35%)	6% (1%-8%)	2% (1%-4%)
51-60 (n= 1)	34% (21%-56%)	32% (19%-51%)	11% (4%-35%)	14% (2% - 32%)	3% (2%-7%)	2% (1%-4%)
300+ (n= 1)	39% (26%-51%)	30% (22%-40%)	12% (4%-23%)	16% (13%-21%)	3% (2%-3%)	0% (0%)

Note: Numbers within parentheses indicate a range.

presented at both of these cognitive levels ranged from 0%-3% of the total discourse presented. At the knowledge level of discourse, in 400 level courses (n = 1), the amount of discourse was 36%. The range for knowledge level discourse presented in 400 level courses was 21%-56%. Thirty-one percent of discourse was presented at the comprehension level while 17% (the most of any other course level) was presented at the analysis level. Five percent of the discourse was presented

at the synthesis level and 2% was presented at the evaluation level.

Opportunities for Higher Level Thinking and Class Size

As can be seen in Table 2, approximately two-thirds of classroom discourse was presented in the lower cognitive levels of knowledge and comprehension, regardless of class size: 62% in classes of 10-15 (n = 4), 65% in a class of 16-20 (n

= 1), 65% in classes of 21-30 (n = 4), 65% in classes of 31-50 (n = 5), 66% in a class of 51-60 (n = 1), and 69% in a class of 300+ (n = 1). In class sizes of 10- 15, students had the opportunity to think at the application level of cognition 13% of the time (more than any other class size). The frequency of this occurrence ranged from 2%-27%. The greatest amount of discourse at the synthesis level (9%) and the evaluation level (4%), was presented in a class size of 21-30. However in a class size of 21-30 the range of discourse at the knowledge level was 14%-58%. Conversely, it was found that during a class of 300+, the least amount of discourse, 0%, was presented at the evaluation level.

Conclusions

1. Regardless of progression across semester, class size, or course level, low levels of cognition, namely knowledge and comprehension, dominated the classroom discourse of professors.
2. Students in class sizes of 51 or more were given the fewest opportunities to think at the highest cognitive levels.
3. Four-hundred level courses offered the greatest number of opportunities for students to think at the analysis level.
4. Students in a 100 level course were offered the least number of opportunities to think at the highest cognitive levels.

Discussion

At the beginning of this project the researchers thought that students would be given more opportunities to think at higher cognitive levels when the course level was higher, the class size was smaller, and as the course progressed across the semester. Courses taught at upper levels, it was

rationalized, would tend to challenge students to apply and analyze concepts learned in earlier coursework. A similar pattern of presentation, it seemed, would exist from the beginning of the semester to the end; facts, concepts, and theories presented at the beginning of the semester would be built upon such that students would be applying, analyzing, synthesizing, and evaluating by the end of the semester. Also, smaller class sizes would enhance interaction, thus potentially encouraging more in-depth questioning which would lend itself to use of higher cognitive processes.

Participants in this study taught freshman through senior level courses, were observed at steady intervals across an entire semester, and taught in classes where a range of 12 to 344 students were enrolled,. It was puzzling that none of these variables held a relationship to thinking opportunities provided by professors.

In each case, it appeared that the factor most affecting the frequency of opportunities given to students to think at higher cognitive levels was the professor. Is it possible that by the time new professors become comfortable with teaching they have developed "habits" that will remain with them for the extent of their career? Professors, after their first year or so, are not likely to have the time nor the knowledge and expertise in pedagogy needed to write new lessons designed to increase cognitive levels at which students operate in the classroom.

Yet, students in college need to be expected to think at higher levels of cognition in order to challenge themselves, master topics, and gain knowledge. Only through thoughtful classroom preparation can professors change their comfortable routine, thereby, potentially increasing the frequency of opportunities given to students to think at higher cognitive levels.

Recommendations

1. Since students enrolled in classes of 51 or more were given fewer opportunities to think at higher cognitive levels, a conscious effort should be made on college campuses to design educational activities for smaller groups of students to interact with the professor.
2. Faculty teaching 400 level courses need to read the results of this study and be commended for engaging students at the analysis level; their techniques should be shared with others. These faculty should also understand the role they play in "capstoning" the thinking processes of the students' college careers and thus the need to also use techniques which reach the synthesis and evaluation levels.
3. Faculty teaching 100 level courses need to read the results of this study and decide if their course is simply delivering information. If so, is that the purpose of the course? If not, they need access to resources which can provide teaching tips and techniques for enhancing students' cognitive processes.
4. Teacher educators in agricultural education need to develop and present seminars and workshops designed to assist faculty in Colleges of Agriculture in learning techniques for increasing the frequency of opportunities given to students to think at higher cognitive levels.
5. Professors should be encouraged to attend workshops and seminars aimed specifically at teaching techniques which have been found to increase opportunities to enhance thinking.

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