

## Teaching Techniques Used by Professors in a College of Agriculture and Their Relationship to Cognitive Levels of Discourse

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### Abstract

*Nordvall and Braxton (1996) recommended examining course-level academics to identify institutional quality, and advocated Bloom's Taxonomy for assessing level of understanding related to course content. Therefore, the purpose of this study was to examine the teaching techniques used in selected college of agriculture courses and their relationship to professor cognition scores. The objectives of the study were to use Newcomb, McCracken, Warmbrod, and Whittington (2004) to record the frequency of group and individualized teaching techniques used by professors, to use Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) to describe the cognitive level of classroom discourse of professors, and to describe the relationship between professor cognition score and percent of lecture versus non-lecture used by professors. Twenty-one undergraduate class sessions were videotaped in 12 professors' class sessions. A researcher-developed instrument was used to determine frequency and cognitive level of professor teaching techniques.*

*Professors' discourse was mostly (62%) at the two lowest levels of cognition, knowledge and comprehension. Teaching technique results showed that lecture and discussion were the most often used group teaching techniques, and that individualized teaching techniques were seldom used. A relationship existed between professor cognition score and lecture technique.*

### Introduction

#### *The University Context*

Several reports in the 1980s questioned the quality of undergraduate education and identified the need for instructional improvement (Paulsen & Feldman, 1995). Kerr (2001) noted that teaching at many research institutions had generally deteriorated. Boyer (1990) echoed the allegation that research competes with teaching for professors' time. He further noted that research often "wins" at large research institutions, and at some smaller liberal arts universities (Tom, 1997), because of the need to publish for promotion and tenure. Bess (1998) noted that stakeholders in higher education want to see quality from their institution.

#### *Teaching Thinking*

"The task of higher education has never been more complex and challenging", wrote Kuh

(2001, p. 289). Professors are expected to prepare graduates who possess the ability to problem-solve and use higher order thinking skills (Lewis & Smith, 1993). However, students rarely arrive at postsecondary institutions with the ability to use these higher cognitive abilities (Weimer, 2003).

Whittington (2003) argued, that the higher the level of cognition at which a student performs, the more the learning experience will be enhanced. Palmer (2003) believed that educators do not teach pure content; rather, they teach students how to learn the content. However, for there to be improved student cognitive performance, teachers must understand the ways in which students learn (Presseisen, 1989). The most important classroom outcome for professors should be the ability of students to think and solve problems (Whittington, 1995).

### *Improving Teaching*

Faculty members at the university level have often been prepared to perform the role of researcher, but have not been prepared as experts in pedagogy, delivery, and evaluation; requirements to be successful in teaching (Bess, 1998). “Pedagogy is the forgotten subject in higher education” (Stevens, 2001, p. 373). “Few teachers feel that they have either the intellectual or professional grasp of teaching that they have of the curriculum” (Gregory, 2001, p. 69).

Lynch and Harnish (1998) noted that teachers should be striving to “...critically examine their practice, seek to expand their repertoire, deepen their knowledge, sharpen their judgment and adapt their teaching to new findings, ideas and theories” (p. 53). Chickering and Gamson (as cited in Guskin, 1994) reported that faculty could aid in student learning by using better teaching practices. Tsui (2002) felt that there was a need to modify current pedagogies to be more effective and efficient. Thompson, Licklider, and Jungst (2003) encouraged learner-centered approaches to teaching in secondary settings to meet the needs of all learners.

Doyle and Carter (1987) described the *means of instruction* as teaching methods. Gregory (2001) wrote that using a variety of teaching methods enables students to continue developing their own thinking abilities, compared to one continuous method of teaching. Mitchell, Knobloch, and Ball (2004) found that exemplary professors were able to motivate their students, and thus encouraged them to think critically during class. Child and Williams (1996) believed teachers’ practices discouraged students to willingly become involved in the class; students were “forced” to participate.

### *Teaching Techniques*

Newcomb, McCracken, Warmbrod, and Whittington (2004) advocated that teachers needed to vary their teaching techniques depending on the situation in which they were teaching. Group teaching techniques are used when the information to be presented must be understood by all learners simultaneously and can be taught in the group setting. The group teaching techniques outlined by Newcomb et al. (2004) were lecture, discussion, demonstration, field trips, role-play, resource people, and cooperative learning. Individualized teaching techniques are used when

working individually or in small groups to optimize student learning. The individualized teaching techniques outlined by Newcomb et al. were supervised study, experiments, independent study, information sheets, assignment sheets, and skill sheets.

### *The Classroom Context*

Since that which occurs in classrooms has a great effect on creating curiosity on the part of the student (NCPTLA, 1995), McKeachie (2002) wrote that professors should allow students to develop thinking skills through the use of the content rather than by pushing through the content. “Faculty are the key to making the necessary changes for meaningful improvements in undergraduate education. They need to be more supportive of collaborative, coherent curricula” (NCPTLA, 1995, p. 360). Sternberg (2002) described how students could be taught more effectively: students are able to learn at higher cognitive levels when the teacher employs multiple methods, because each student learns in different ways. Barr and Tagg (1995) pointed out that the college purpose should not be instruction, but instead, finding a way to produce learning using any method that works. Teaching methods that use multiple techniques and require the student to be active in their learning are likely to be more effective in increasing student thinking skills compared to single methods that allow the student to be passive (Halpern, 1993).

Mangurian, Feldman, Clements, and Boucher, (2001) discussed how information is growing in many areas at such a fast pace that it is impossible to lecture to students about all there is to know in a particular field of study. Guskin (1994) stated that teachers want students to be able to develop the ability to compare and contrast material and to make judgments on important issues. Teaching strategies, therefore, should contribute to content knowledge in both breadth and depth, as well as develop students’ metacognitive ability (Thompson et al., 2003).

Mayer (2002) stated, “Two of the most important educational goals are to promote *retention* and to promote *transfer* (which, when it occurs, indicates meaningful learning)” (p. 226). Research (Barr & Tagg, 1995; Boggs, 1995; Guskin, 1994; Chickering & Gamson, 1987) shows that students retain information better if they are active in their learning. Classroom discussion aids in the development of critical thinking skills by allowing students to think through their ideas and work on them verbally (Tsui, 2002).

### Theoretical Framework

Piaget’s (1970) theory of cognitive development states that thinking is influenced by maturation, activity, and social transmission. He theorizes that teachers can have little impact on the maturation influence, but through the activity influence teachers provide exploration, observation, testing, and information organization, all of which are likely to alter thinking processes.

Building upon Piaget’s (1970) activity influence from his cognitive development theory, classroom activity is likely to impact students’ “classroom cognition”. The cognitive level of classroom activity can be framed with assistance from *Bloom’s Taxonomy of educational*

*objectives: The classification of educational goals, Handbook 1: Cognitive domain* (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) which is useful for documenting the cognitive levels at which teachers and learners process classroom content. Bloom et al. (1956) six-step hierarchical system of thought processing moves from the knowledge level, emphasizing subject matter recall, to the evaluation level, that entails making judgments (see Table 1). Each level is reflected through cognitive classroom activity. Given that learning is enhanced by increasing the percentage of cognitive activity occurring at the higher levels of Bloom’s Taxonomy, this framework provides focus and direction to teachers who desire to enhance the quality of teaching and learning in their class sessions (Whittington & Bowman, 1994).

Table 1  
*A Synopsis of Bloom’s Hierarchy of Thought Processing*

Cognitive Level	Definition	Activity
Knowledge	Recalling subject matter	List, define, label, and match
Comprehension	Learners know information that has been communicated, but cannot apply in other situations	Explain, rewrite, paraphrase, summarize, and give examples
Application	Learners apply information to different situations and learning tasks	Compute, demonstrate, use, predict, discover, and solve
Analysis	Learners separate data into its component parts; these parts are differentiated and related based on their relationship	Differentiate, discriminate, relate, diagram, and distinguish
Synthesis	Combines learned elements to create a new whole; working into pieces and elements, arranging so as to create new forms, patterns, or structures	Create, compose, produce, and develop
Evaluation	Entails making judgment on the value of materials and methods for given purposes	Justify, compare, contrast, evaluate, and interpret

*Note.* McCormick and Whittington (2000). Adapted from Bloom et al. (1956).

#### Purpose/Objectives

The purpose of this study was to describe the teaching techniques used in selected college of agriculture courses and their relationship to professor cognition score. The objectives of the study were to 1) use Newcomb et al. (2004) descriptions of teaching techniques to record the frequency of group and individualized teaching techniques used by professors, to 2) use Bloom et al. (1956) to describe the cognitive level of classroom discourse of professors, and to 3) describe the relationship between professor cognition score and percent of lecture versus non-lecture used by professors.

## Methods

The researcher cooperated with the Senior Associate Dean to acquire support for conducting the study in every department in the college ( $N = 8$ ). The researcher then met with the department chairs, explained the study and asked them to nominate three faculty members from their departments who were deemed “good” teachers. The respective department chairs nominated professors who were good teachers based on student evaluations, exit interviews, and annual reviews of teaching.

### *Faculty*

Twelve faculty members from seven departments (the only department not participating was Food Science and Technology because the department chair nominated only one professor; his schedule did not permit his participation) participated in the study. The researcher was scheduled to observe and videotape each participating professor’s class session twice during the quarter. However, scheduling conflicts prevented two observations for every professor. The class observations took place during Autumn quarter 2003, Winter quarter 2004, and Spring quarter 2004. Professors were assigned a letter and a number, which were used throughout the study to identify each participant and class session (per protocol # 2004B0374).

### *Data Instrumentation, Collection, and Analysis*

Appropriate measures of central tendency, variability, frequency counts, and percentages were generated for each of the characteristics of interest in the study. The SPSS 14.0 computer program was used to run all analysis of the data for the study. The unit of analysis for this study was the class session ( $n = 21$ ).

### *Cognitive Level of Professor Discourse*

The Florida Taxonomy of Cognitive Behavior (FTCB), (Webb, 1970; Brown, Ober, Soar, & Webb, 1966) based on Bloom’s Taxonomy, was utilized in this study. The FTCB was designed to measure the frequency of the presence of each cognitive behavior during six-minute observation periods, and determine the extent to which the emphasis was on acquiring information versus using cognitive processes (Webb, 1970). Miller (1989) stated that the FTCB was based upon Bloom’s Taxonomy, but that there are differences in the two assessment instruments.

### *Reliability*

The researcher rated all of the professors by videotaping the classes, then evaluating the videotapes at a later date. The rater received training from a researcher with extensive training in the use of the FTCB. Training involved an explanation of the instrument followed by practice evaluating a videotaped lesson. The trainer was present during the first practice rating to answer questions for the researcher. After the training, intra-rater reliability (a measure of rater consistency) was assessed by using observations of two videotapes. The Pearson Product-

Moment Coefficient was  $r_{(9weeks)} = .91$ . Inter-rater reliability was established for this study by having an individual that was familiar with the FTCB complete an evaluation of a sample videotape. The inter-rater reliability was  $r = .94$ .

*Validity*

The FTCB is based upon Bloom's Taxonomy; therefore it is argued that the FTCB is content valid given that Bloom's Taxonomy is generally supported as a way to identify behaviors of teachers and students at various levels of cognition (Pickford, 1988).

*Measuring and Analyzing Cognitive Level of Professor Discourse*

By watching a videotaped class session and completing the FTCB (Webb, 1970), the researcher determined the cognitive level of professor discourse by using the process employed by Pickford (1988). A weighting system was implemented to give higher levels of cognition more weight due to the cognitive level of processing required to perform the task. The weighting factors are consistent with the general support given to the hierarchical nature of Bloom's Taxonomy. The cognitive weighting factors used for professor discourse in the study are displayed in Table 2.

Table 2  
*Cognitive Weighting Factors for Professor Discourse*

Level of Cognition	Weighting Factor
Knowledge	.10
Translation	.20
Interpretation	.25
Application	.30
Analysis	.40
Synthesis	.50
Evaluation	.50

*Note:* Bloom et al. (1956), Newcomb & Trefz (1987), Pickford (1988).

During each class session, the total number of cognitive behaviors that the professor displayed was recorded using the FTCB. The total number of observations per professor was summed to give an overall frequency at each cognitive level for each individual professor. A percentage of teaching behaviors was then determined for each cognitive level of professor discourse. The cognitive weighting factor for each level of cognition was then multiplied by the percentage for each level of cognition to yield a cognitive weighted score for professor discourse at each level of cognition. The cognitive weighted scores for professor discourse at each level of cognition were then added together to yield a total cognitive weighted score for professor discourse during each class session. For example, Professor Z was observed to have 28 behaviors

(31.8%) at the knowledge level of cognition, eight behaviors (9.09%) at the translation level of cognition, twelve behaviors (13.6%) at the interpretation level of cognition, eighteen behaviors (20.4%) at the application level of cognition, five behaviors (5.7%) at the analysis level of cognition, fourteen behaviors (15.9%) at the synthesis level of cognition, and three behaviors (3.4%) at the evaluation level of cognition for a total of 88 cognitive behaviors during the class session. Then by multiplying the percentage of behaviors recorded at each cognitive level of the taxonomy by the respective cognitive weighting factor (see Table 2) at each level of cognition, Professor Z received scores of; knowledge = 3.18, translation = 1.82, interpretation = 3.4, application = 6.12, analysis = 2.28, synthesis = 7.95, and evaluation = 1.7. By summing the cognitive weighted scores for professor discourse at each level of cognition, Professor Z had a total cognitive weighted score for professor discourse of 26.45 (see Figure 1).

Level of Cognition	Number of Professor Behaviors	% of Behaviors	*	Weighting Factor	Cognitive Weighted Score
Knowledge	28	31.8	*	.10	3.18
Translation	8	9.09	*	.20	1.82
Interpretation	12	13.6	*	.25	3.4
Application	18	20.4	*	.30	6.12
Analysis	5	5.7	*	.40	2.28
Synthesis	14	15.9	*	.50	7.95
Evaluation	3	3.4	*	.50	1.7
Total	88				26.45

Note. Total Cognitive Weighted Score for Professor Discourse Range; 10 – 50.

Figure 1. Sample Calculation of Professor Z's Total Cognitive Weighted Score for Professor Discourse.

### Professor Teaching Techniques

The teaching techniques used by professors during class sessions were documented using a researcher-developed instrument. Individualized-teaching techniques included; experiments, independent study, information sheets, skill sheets, and supervised study (Newcomb et al., 2004). Group-teaching techniques included; lecture, discussion, demonstration, field trips, role-play, resource people, and cooperative learning (Newcomb et al.).

### *Reliability*

After a three-week period, reliability for the instrument was established by watching a videotaped class session for a second time and recording each teaching technique that was observed. The Pearson Product-Moment Coefficient was  $r_{(3 \text{ weeks})} = .90$ . Another researcher familiar with teaching techniques completed an analysis of a videotape to determine inter-rater reliability ( $r_{(3 \text{ weeks})} = .84$ ).

### *Validity*

Two individuals who have studied and experienced multiple teaching techniques conducted content and face validity tests for this instrument. The instrument was found to measure the frequency of these teaching techniques. Example comments from the raters included, “the instrument measured the frequency with which professors were using various teaching techniques in the classroom” and “the instrument represents a variety of teaching techniques that would be seen in college classrooms”.

### *Measuring and Analyzing Professor Teaching Techniques*

The types (Newcomb et al., 2004) and frequencies of group teaching techniques and individualized teaching techniques used by individual professors during class sessions were recorded on the researcher-developed instrument. Percentages were then calculated. A sample calculation would be, Professor Z used a total of fifteen teaching techniques during the class session and five of those were lecture, two were role-play, and eight were discussion. The professor, thus, had percentages of 33 percent for lecture, 13 percent for role-play, and 54 percent for discussion. Other techniques received 0 percent of the teaching technique percentage due to the fact that these techniques were not observed during the class session. A percentage was also calculated for lecture versus not-lecture techniques used during class sessions. Professor Z, from above, would have 33 percent lecture, and 67 percent not-lecture.

## Findings

### *Professor Teaching Techniques*

Independent study and supervised study were the only individualized teaching techniques (Newcomb et al., 2004) used. Professors used six different group teaching techniques (Newcomb et al.) including: cooperative learning, demonstration, discussion, lecture, resource people, and role-play (Table 3). Individualized teaching techniques were used a total of nine times: independent study was observed eight times, supervised study was observed once, while experiments, information sheets, and skill sheets were not used by professors during the observed class sessions. Group teaching techniques were used 149 (94%) times during the observed class sessions: cooperative learning was used seven times, demonstration was used three times, discussion was used 59 (38%) times, lecture was used 70 (44%) times, resource people were utilized twice (1%), role-play was used eight times (5%) while field trips were not

observed (Ewing, 2005).

Table 3  
*Frequency and Percent of Teaching Techniques Used During Class Sessions*

<u>Teaching Technique</u>	<u>Frequency</u>	<u>Percent</u>
<b>Individualized-Teaching Techniques</b>		
Experiments	0	0
Independent Study	8	5
Information Sheets	0	0
Skill Sheets	0	0
Supervised Study	1	1
<b>Group-Teaching Techniques</b>		
Cooperative Learning	7	4
Demonstration	3	2
Discussion	59	38
Field Trip	0	0
Lecture	70	44
Resource People	2	1
Role-Play	8	5

*Note:* N = 21 Class Sessions.

*Cognitive Level of Professor Discourse*

As can be seen in Table 4, total cognitive weighted score for professor discourse ranged from a low of 14.47, which means the total cognitive weighted score for professor discourse was between the knowledge and comprehension level of cognition, to a high of 30.67, which means that the professor's discourse was at the application level of cognition. The professors with lower total cognitive weighted scores for professor discourse were providing classroom discourse at lower cognitive levels than those professors with higher total cognitive weighted scores for professor discourse. Almost two-thirds (62%) of the total cognitive weighted scores for professor discourse were at the two lowest levels of cognition, (knowledge and comprehension) which include translation and interpretation on the FTCB. Approximately 38 percent of the total

cognitive weighted scores for professor discourse were at the four higher levels of cognition (application, analysis, synthesis, and evaluation).

Table 4

*Total Cognitive Weighted Score for Professor Discourse as Measured by the Florida Taxonomy of Cognitive Behavior by Class Session.*

Class Session	Knowledge	Translation	Interpretation	Application	Analysis	Synthesis	Evaluation	Cognitive Weighted Score
1	6.13	3.06	4.03	.9	1.6	0	0	15.72
2	5.67	3.8	3.6	1.4	1.9	.5	0	16.77
3	5.6	1.9	3.75	1.2	4.8	.5	.5	18.25
4	6.3	2.8	4.65	0	1.86	0	0	15.61
5	4.94	2.04	3.2	4.71	4.32	.5	.5	20.21
6	4.67	2.88	1.95	4.65	4.9	1	.5	20.55
7	5.8	3.2	3.25	0	1.92	4	0	18.17
8	5.7	1.8	3.6	.39	6.76	0	.65	18.9
9	5.63	1.46	4.05	1.5	7.08	0	0	19.72
10	5.53	2.56	4.53	0	5.52	0	0	18.14
11	3.23	4.52	7.25	0	5.2	1.5	0	21.7
12	5.15	3.04	4.55	1.8	3.6	0	0	18.14
13	6.2	3.44	2.5	1.02	2.8	0	0	15.96
14	5.47	2.2	3.9	1.41	5.6	0	0	18.58
15	6.22	1.76	7.23	0	0	0	0	15.21
16	7.01	1.8	4.23	.39	1.04	0	0	14.47
17	5.26	2.94	3.18	3.15	2.52	1.5	0	18.55
18	6.34	2.68	3.35	2.19	.96	0	0	15.52
19	5.83	1.94	5.55	.84	2.8	0	0	16.96
20	2.16	.8	5.63	2.64	8.64	9.8	1	30.67
21	2.88	2.04	.85	3.57	8.12	11.85	.85	30.16
Total	111.72 (28)	52.66 (13)	84.83 (21)	31.76 (8)	81.7 (20)	31.15 (8)	4 (1)	397.96

*Note:* Possible Range for Total Cognitive Weighted Score for Professor Discourse = 10 – 50.

## Conclusions/Recommendations/Implications

### *Teaching Techniques*

Professors in this study used lecture and discussion to deliver their content during class sessions. Other group-teaching techniques (cooperative learning, resource people, role-play, and demonstration) were seldom used. Individualized-teaching techniques were seldom used during class sessions.

### *Implications for Teaching Techniques*

Researchers (Tsui, 2002; Sternberg, 2002; Barr & Tagg, 1995; Halpern, 1993) advocated using multiple teaching methods for reaching all students. Giving students the opportunity to auditorily and visually experience content presented in more than one modality, enables students to process the material presented. Thus, if professors are using multiple teaching techniques to actively engage students, opportunities to reach higher levels of cognition are gained. Teachers that use the same technique of teaching for the entire class session may reach a particular student with the information, but another student may not have understood the information that was just presented given the single technique that was used by the professor.

### *Recommendations for Teaching Techniques*

Professors need to engage students in the lesson as active participants rather than allowing them to sit as passive recipients of information. Professors seeking to avoid Shulman's (2000) "illusory learning", when students say they know, but they really do not, need to present material in a way that provides opportunities for students to individually process the information. Professors need to pull what is inside the student out, allow them to work on it, and then put it back into the student to form their own understanding (Shulman, 2000). By actively engaging the students in this way, professors can see that the students understand and that they can use the information being taught.

### *Professor Discourse*

Professor discourse was mainly at the two lowest levels of cognition, knowledge and comprehension.

### *Implications for Professor Discourse*

If students are to think at higher cognitive levels, professors should provide discourse at levels that will challenge students appropriately. Professors who offer discourse at mainly lower levels of cognition may not be providing opportunities for students to think at higher levels of cognition during class sessions (Blosser, 2000). Thus, professors should not expect students to operate at levels higher than that which they are currently being challenged. Professors must first be made aware of the cognitive levels at which they are currently offering classroom discourse, and then adjust the level of discourse, if necessary.

### *Recommendations for Professor Discourse*

Professors should analyze the level at which they are delivering course content during class sessions. Once professors realize the level at which content is being delivered, a comparison can be made to the course and individual lesson objectives, to examine if the level of professor discourse accomplishes the purpose of the course. Professor discourse should be delivered at a level that meets the objectives of the course.

### Summary

Some teaching techniques lend themselves to engaging students at higher cognitive levels during class sessions. By processing course content at higher cognitive levels, theoretically students will retain and use the new knowledge more frequently and on a more long-term basis. Whittington (2003) believed that there was a need to examine current teaching in colleges of agriculture to determine if the teaching was contributing to students' ability to think. Observing and recording those teaching techniques being used by professors will aid in understanding the current status of classroom cognition in colleges of agriculture. Students are not coming to college with the ability to think (Weimer, 2003), yet stakeholders expect excellence in undergraduate education (Bess, 1998). Therefore, professors must offer students opportunities to practice the higher order thinking skills that are necessary for cognitively engaging learners in the course content, and in life-long cognitive skill development. Choosing teaching techniques that increase student cognitive engagement will contribute to excellence in undergraduate education.

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