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DESCRIBING THE COGNITIVE LEVEL OF PROFESSOR DISCOURSE AND STUDENT COGNITION IN COLLEGE OF AGRICULTURE CLASS SESSIONS

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Abstract

The purpose of this study was to describe the cognitive level of professor discourse and student cognition during selected college of agriculture class sessions. Twenty-one undergraduate class sessions were videotaped in 12 professors' courses. Results were interpreted to show that professors' discourse was mostly (62%) at the knowledge and comprehension levels of cognition, the lower levels of cognitive thought (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). During the 21 class sessions, 1,448 student thoughts were recorded. Forty percent (n = 564) of those thoughts were found to be engaged. Engaged thoughts were then analyzed using Bloom's Taxonomy (1956). Sixty-two percent of the total 564 engaged thoughts occurred at the knowledge and comprehension levels of cognition. The cognitive levels of professor discourse and student cognition (engaged thoughts categorized and weighted using Bloom's Taxonomy) were mostly at the two lowest levels of Bloom's Taxonomy, knowledge and comprehension. Recommendations included professor and student awareness of the cognitive levels at which they teach and think, and further study of relationships between professor and student variables.

Introduction

Several reports in the 1980s questioned the quality of undergraduate education and identified the need for instructional improvement (Paulsen & Feldman, 1995). Critics of higher education believe that the university system is failing in the preparation of students (Tom, 1997). Kerr (2001) noted that teaching at many research institutions had generally deteriorated. The critics of current undergraduate education encourage institutions to reflect on that which is currently being done and make changes that would otherwise be overlooked (Tom).

Halpern (1993) emphasized that teaching students to think critically was the desired outcome of undergraduate education. Brown and Lane (2003) wrote that universities and colleges must examine what is occurring in their classrooms and be ready to produce evidence of what has occurred. However, the Boyer Commission on Educating Undergraduates in the Research University (1998) believed that students were not being prepared sufficiently to think beyond the lower levels of cognition. Stakeholders, such as future employers, want students that are able to think critically and analyze information that has been presented to them (Education Commission of the States, 1995). In fact, during class sessions, students often cognitively engage at levels below what professors are teaching (Lopez, Whittington, Schley, & Fisher, 1999).

Because what occurs in the classroom has a great effect on creating curiosity on the part of the student (National Center on Postsecondary Teaching, Learning, and Assessment [NCPTLA], 1995), McKeachie (2002) believed that professors should allow students to develop thinking skills through using the content, rather than by pushing-through the content. Shulman (2000) stated that students are not blank slates that need to be written upon, but rather they are people that need opportunities to take the information that is presented, and work with it to make sense of it in their own way. The NCPTLA believed that faculty can make changes that will improve education at the

undergraduate level. Nordvall and Braxton (1996) recommended examining course-level academics to identify institutional quality, and suggested Bloom's Taxonomy (1956) for assessing level of understanding related to course content.

Bloom et al. (1956) defined higher order thinking as application, analysis, synthesis, and evaluation; the four levels of Bloom's hierarchy above the two lower levels of knowledge and comprehension. According to Bloom et al., knowledge, the lowest level of cognition, requires an individual to recall and remember facts and situations. Comprehension, the next level in Bloom's hierarchy, is described as demonstrating a general understanding of the content. These two lower levels of cognition are necessary in the thinking process to lay the foundation from which to proceed cognitively through the hierarchy. However, according to Bloom et al., the four higher levels of cognition, when reached, will cognitively challenge students beyond knowledge and comprehension and thus, theoretically, aid students' long-term content retention.

Bloom et al. (1956) further wrote that application is the process of using information gained in one situation to solve a problem or problems in other situations. Analysis, Bloom et al. contend, involves taking the information at hand and working with it in a way that the learner notes relationships and then organizes those relationships in meaningful ways. The next level, synthesis, requires learners to assess the component parts of the given information and to formulate the component parts into a new whole. The highest level of cognition, as described by Bloom et al., is evaluation. Evaluation is the level at which the learner makes judgments about the material presented.

Two of the most common uses of Bloom's Taxonomy have been classifying objectives, and testing items (Krathwohl, 2002). Bloom et al. (1956) stated that the taxonomy was designed for classifying " … student behaviors which represent the intended outcomes of the educational process" (p. 12). The authors of the taxonomy believed that student behaviors could be seen and classified in a variety of classes and levels of education.

Theoretical Framework

"Cognitive development is much more than the addition of new facts and ideas to an existing store of information" (Woolfolk, 2007, p. 27). Piaget's (1970) theory of cognitive development stated that thinking is influenced by maturation, activity, and social transmission. Piaget theorized that teachers have little impact on the maturation influence, but that through the activity influence, teachers provide exploration, observation, testing, and information organization, all of which are likely to alter thinking processes. In addition, Piaget believed that teachers impact the social transmission influence, learning from others, depending on the stage of cognitive development the student has reached.

Whittington and Bowman (1994) assessed the cognitive level of instruction of faculty members in a college of agriculture and found that instructors were mainly teaching at the remembering level of cognition. Whittington (1995) found that professors sought to teach at all levels of cognition, but much of the discourse was at lower levels of cognition. Whittington, Stup, Bish, and Allen (1997) examined the thinking opportunities provided by professors through cognitive discourse. A majority (80%) of the classroom discourse was found to be at the knowledge and comprehension levels of cognition.

Building upon Piaget's (1970) activity influence from his cognitive development theory, classroom activity is likely to impact students' thinking, in other words, students' classroom cognition. The cognitive level of classroom activity can be framed using *Bloom's Taxonomy of Educational Objectives: Handbook 1, Cognitive Domain* (Bloom, 1964), which is useful for documenting the cognitive levels at which teachers and learners process classroom content. Bloom et al.'s (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 (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 classes (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).

As part of an ongoing line of inquiry related to cognitive levels of teaching and learning at the university level, the *cognitive level of professor discourse, classroom engagement,* and ultimately *student cognition* (frequency of classroom engagement categorized and weighted using Bloom's Taxonomy) were examined in this study (see bold/italicized items in Figure 1). Other professor variables (teaching techniques used, cognitive level of professor questions, and cognitive level of course objectives), a student variable (cognitive level of student questions), and three course variables (level of the course, class size, and time of day at which the course was offered) are part of the overall conceptual framework that has been developed to examine the impact of these variables on student cognition during class sessions (Figure 1).

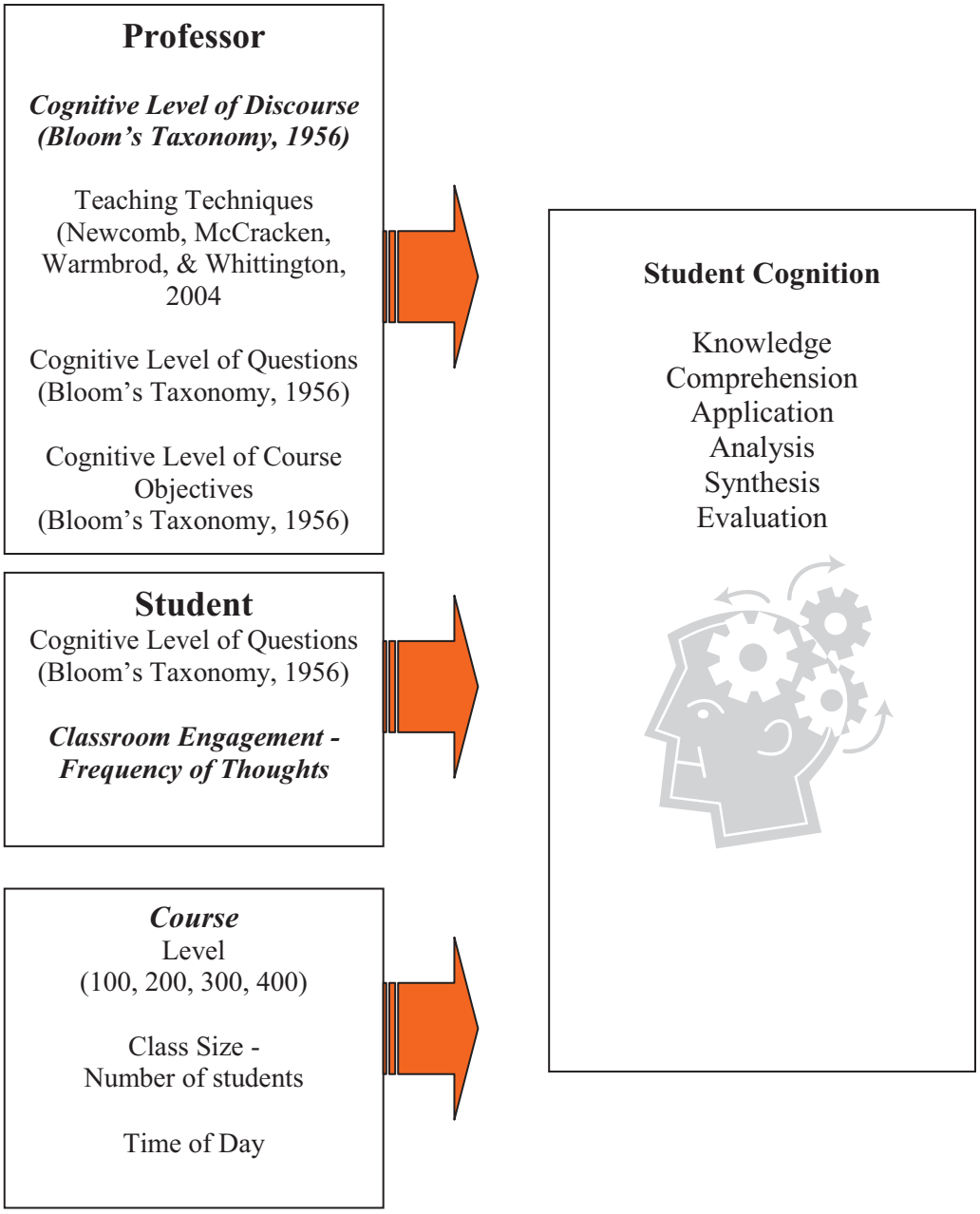

Figure 1. Conceptual framework of proposed factors influencing student cognition.

Purpose and Objectives

The purpose of this study was to describe professor and student cognition during selected college of agriculture class sessions at The Ohio State University. Specific objectives guiding the study were to:

1. Describe the cognitive level at which professors delivered in-class discourse as measured using the Florida Taxonomy of Cognitive Behavior (FTCB; Webb, 1970).
2. Describe student cognition as measured using think-aloud protocol transcripts, and then weighted using Bloom's Taxonomy.

Definitions of Terms

Engagement – The frequency of student thoughts related to course content during a class session (Ewing, 2006).

Professor discourse – The verbal statements spoken by professors during class sessions (Whittington & Newcomb, 1990).

Student cognition – The frequency of classroom engagement categorized and weighted using Bloom's Taxonomy (Ewing, 2006).

Methods

The researcher cooperated with the senior associate dean and director of academic affairs in the College of Food, Agricultural and Environmental Sciences to acquire support for conducting the study in every department in the college. The associate dean sent a letter to all department chairs ($N = 8$) in the college, describing the study and asking for their participation. 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 based on student evaluations, exit interviews, and annual reviews of teaching. Individual appointments were scheduled with the professors who were nominated, to explain the study and to seek their participation.

Twelve nominated faculty members from seven departments in the college of agriculture participated in the study. The researcher attempted to observe and videotape two class sessions for each professor. However, scheduling conflicts prevented two observations for every professor. Thus, all professors were observed once, and nine professors were observed twice. Consequently, 21 undergraduate class sessions in horticulture, animal science, food science, environmental and natural resources, and plant pathology were observed for the study.

Twenty-one students who enrolled in the participating professors' courses were randomly selected, one from each professor's class roster, to participate in the study. Researchers videotaped all selected class sessions. By watching each videotaped class session and completing the FTCB (Webb, 1970), the researcher determined the cognitive level of professor discourse.

The FTCB (Webb, 1970; Brown, Ober, Soar, & Webb, 1966), based on Bloom's Taxonomy (1956), identifies and quantifies teacher behaviors into cognitive levels. The categories of the FTCB are identical to Bloom's Taxonomy, except the FTCB divides the *comprehension* level of the Taxonomy into *translation* and *interpretation*. The FTCB was designed to measure the frequency of the presence of each behavior during 6-minute observation periods to determine the extent to which the emphasis was on acquiring information versus using cognitive processes (Webb, 1970).

In accordance with the instrument protocol, each professor behavior was recorded only once for each 6-minute observation period, even if the behavior was observed more than once during the time period. Any behavior observed, which represented more than one category, was given a checkmark for all categories that applied. A weighting system, employed by Pickford (1988), 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 (1956). The weighting factors were developed in consultation with Krathwohl (2002); synthesis and evaluation were weighted equally due to some discrepancy in which level required greater cognitive capacity (Newcomb & Trefz, 1987). The frequency of observed behaviors per cognitive level was summed up to give a total frequency of observed behavior per professor. A percentage of behaviors at each cognitive level was calculated by dividing the frequency of behaviors at each cognitive level by the total frequency of behaviors observed during the class session. This yielded the percent of professor discourse at each cognitive level.

The cognitive weighting factor for each level of cognition was then multiplied by the percent of professor discourse at each cognitive level 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 summed up to yield a total cognitive weighted score for professor discourse during each class session. The weighting score for each professor could range from a score of 10 to 50. A score of 10 would indicate that all of the professor's discourse was at the *knowledge* level of cognition, whereas a score of 50 would indicate that all of the professor's discourse was at the higher levels of cognition, *synthesis* or *evaluation*. The cognitive weighting factors used for professor discourse and a sample calculation are displayed in Table 2.

Table 2
Cognitive Weighting Factors and a Sample Calculation of Professor Z's Total Cognitive Weighted Score for Professor Discourse

Level of cognition	*f* of professor behaviors	Percent of behaviors		Weighting factor	Cognitive weighted score
Knowledge	28	31.80	X	.10	3.18
Translation	8	9.09	X	.20	1.82
Interpretation	12	13.60	X	.25	3.40
Application	18	20.40	X	.30	6.12
Analysis	5	5.70	X	.40	2.28
Synthesis	14	15.90	X	.50	7.95
Evaluation	3	3.40	X	.50	1.70
Total	88				26.45

Note. Possible range for total cognitive weighted score for professor discourse (10-50).

Pickford (1988) believed that reliability of the FTCB was dependent upon the rater's utilization of the instrument. The rater received training from a researcher with extensive experience in using the FTCB. Training involved an explanation of the instrument followed by practice evaluating videotaped class sessions. 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 using two videotapes of teaching. The overall intra-rater reliability was $r_{(9weeks)} = .91$. Inter-rater reliability was established by asking an expert in cognition research to complete an evaluation of a sample videotape. The inter-rater reliability was r = .94. The FTCB is based upon Bloom's Taxonomy (1956); 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 cognitive levels (Pickford).

"Classroom engagement" was recorded based on completion of think-aloud protocols. To collect these data, a student from each videotaped class session was asked to watch the videotape of the class session that he/she had just experienced and to complete a think-aloud protocol. Completing a think-aloud protocol, which was done immediately following the class session, required students to verbalize that which they had been thinking during the class session, into a hand-held cassette tape-recorder. Each student was reminded that the brain is constantly thinking; thus there should be few moments when they were not speaking while watching the videotape. The students were instructed to let the cassette recorder run during the entire session; however, the videotape could be stopped or rewound at any time to allow for the student to gather their thoughts.

All student thoughts were then transcribed, and categorized into one of six thought-types. The six thought-types, based on previous research (Whittington, Lopez, Schley, & Fisher, 2000; Shertzer, Ewing, & Whittington, 2005), were: (1) thoughts or observations about the professor, (2) nonsense or unrelated thoughts, (3) thoughts connected to previous learning, (4) thoughts about past experiences prompted by class subject matter, (5) deeper learning/questioning thoughts, (6) thoughts about behavior that received/maintained attention.

Reliability for the process was established using a sample transcript and recording the frequency of engagement during the class session. The Pearson product-moment coefficient was then calculated. The intra-rater reliability for engagement was $r_{(3weeks)} = .92$. Another individual who was familiar with engagement and teaching/learning analyzed a sample transcript to establish inter-rater reliability. The inter-rater reliability for engagement was r = .89. Two students, who had studied and been trained in cognition research, analyzed face and content validity for this instrument. The raters indicated that the instrument was useful for categorizing engagement.

Engaged thoughts were those that elicited cognitive engagement with the course content and were therefore classified into one of the six levels of Bloom's Taxonomy (1956), and a frequency was determined for each cognitive level. Thoughts that were categorized as thought-type 1 or thought-type 2 were not included in the analysis for student cognition. A percentage for engagement at each level of Bloom's Taxonomy was then calculated by dividing the frequency of student thoughts at each cognitive level by the total number of engaged thoughts during the class session. The cognitive weighting factor (Table 3) for each cognitive level was then multiplied by the percentage of student thoughts at each cognitive level to yield a cognitive weighted score for student cognition at each cognitive level. The cognitive weighted scores for student cognition at each level of cognition were summed up to yield a total cognitive weighted score for student cognition.

After a 3-week period, reliability was established by using a sample transcript and recording the cognitive level for each student thought during the class session. The Pearson product-moment coefficient was then calculated. The intra-rater reliability for student cognition was $r_{(3weeks)} = .94$. Another individual familiar with cognitive levels of learning completed inter-rater reliability.

The inter-rater reliability for student cognition was $r = .91$. Content validity for this instrument was based upon its direct development from Bloom's Taxonomy (1956) and the support, from theory and evidence (Ary, Jacobs, & Razavieh, 2002), generally given to the hierarchy of cognitive behaviors.

A sample calculation for student cognition is completed in Table 3. Student Z yielded 126 thoughts during the class session. Eighty-six (68.25%) of these were at the knowledge level, 19 (15.08%) were at the comprehension level, 15 (11.9%) were at the application level, 4 (3.2%) were at the analysis level, 1 (.75%) was at the synthesis level, and 1 (.75%) was at the evaluation level. Student Z yielded a total cognitive weighted score for student cognition of 15.37.

Table 3
Cognitive Weighting Factors and a Sample Calculation of Total Cognitive Weighted Score for Student Cognition

Level of cognition	Frequency of student thoughts	Percent of student thoughts		Weighting factor	Cognitive weighted score
Knowledge	86	68.25	X	.10	6.83
Comprehension	19	15.08	X	.20	3.02
Application	15	11.9	X	.30	3.48
Analysis	4	3.2	X	.40	1.28
Synthesis	1	.75	X	.50	.38
Evaluation	1	.75	X	.50	.38
Total	126				15.37

Note. Possible range for total cognitive weighted score for student cognition (10-50).

Findings

Findings related to professors' in-class discourse for each class session are displayed in Table 4. The total cognitive weighted score for professor discourse ranged from a low of 14.47, which means that the total cognitive weighted score for professor discourse was between the knowledge and comprehension levels of cognition (lower levels), to a high of 30.67, which means that the professor's discourse was at the application level of cognition (higher level). Bloom et al. (1956) defined application, analysis, synthesis, and evaluation as that which requires high levels of cognitive thought and knowledge and comprehension as that which requires low levels of cognitive thought. 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% of the total cognitive weighted scores for professor discourse were at the four higher levels of cognition (application, analysis, synthesis, and evaluation). No professor's total cognitive weighted scores were above the analysis level of cognition.

Table 4
Total Cognitive Weighted Score for Professor Discourse as Measured using the FTCB by Class Session

Class session	Knowledge	Translation	Interpretation	Application	Analysis	Synthesis	Evaluation	Cognitive weighted score
20	2.16	.80	5.60	2.64	8.64	9.80	1.00	30.67
21	2.88	2.04	.85	3.57	8.12	11.80	.85	30.16
11	3.23	4.50	7.25	0.00	5.20	1.50	0.00	21.70
6	4.67	2.88	1.95	4.65	4.90	1.00	.50	20.55
5	4.94	2.04	3.20	4.71	4.32	.50	.50	20.21
9	5.63	1.46	4.05	1.50	7.08	0.00	0.00	19.72
8	5.70	1.80	3.60	.39	6.76	0.00	.65	18.90
14	5.47	2.20	3.90	1.41	5.60	0.00	0.00	18.58
17	5.26	2.94	3.18	3.15	2.52	1.50	0.00	18.55
3	5.60	1.90	3.75	1.20	4.80	.50	.50	18.25
7	5.80	3.20	3.25	0.00	1.92	4.00	0.00	18.17
10	5.53	2.56	4.53	0.00	5.52	0.00	0.00	18.14
12	5.15	3.00	4.55	1.80	3.60	0.00	0.00	18.14
19	5.83	1.94	5.55	.84	2.80	0.00	0.00	16.96
2	5.67	3.80	3.60	1.40	1.90	.50	0.00	16.77
13	6.20	3.44	2.50	1.02	2.80	0.00	0.00	15.96
1	6.13	3.06	4.03	.90	1.60	0.00	0.00	15.72
4	6.30	2.80	4.65	0.00	1.86	0.00	0.00	15.61
18	6.34	2.68	3.35	2.19	.96	0.00	0.00	15.52
15	6.20	1.76	7.23	0.00	0.00	0.00	0.00	15.21
16	7.01	1.80	4.23	.39	1.04	0.00	0.00	14.47
Total	111.70	52.60	84.80	31.76	81.70	31.10	4.00	397.96

Note. Possible range for total cognitive weighted score for student cognition (10-50).

The findings related to student cognition are outlined in Table 5. The frequency of student thoughts at each level of cognition are summarized. A total of 1,448 student thoughts were recorded from the think-aloud protocol sessions. Approximately 60% (n = 884) of the observed thoughts were categorized as nonsense or random thoughts, which did not elicit engagement with the course content; therefore, 564 student thoughts from the 21 class sessions were analyzed for student cognition. Three hundred and fifty (62.1%) of the student thoughts analyzed for cognitive level were categorized into the two lowest levels of cognition (knowledge and comprehension). Two hundred and fourteen (37.9%) student thoughts were categorized into the higher cognitive levels, with 53 (9.4%) student thoughts categorized at the application level of cognition, 96 (17%) student thoughts at the analysis level of cognition, 29 (5.1%) student thoughts at the synthesis level of cognition, and 36 (6.4%) student thoughts at the evaluation level of cognition. Student thoughts that were cognitively categorized ranged from a low of one thought during class session number 13 (Professor G) to a high of 61 thoughts that elicited cognitive thought during class session number 9 (Professor E).

Class session number 16 (Professor I) yielded the lowest total cognitive weighted score for student cognition of 14.8, while class session number 7 (Professor D) yielded the highest total cognitive weighted score for student cognition of 32.35. A total cognitive weighted score for student cognition of 14.8 is between the knowledge and comprehension levels of cognition, while a total cognitive weighted score for student cognition of 32.25 is at the application level of cognition. Three of the 21 courses yielded a percent of student thoughts at or above the application level of cognition. No classes yielded a total cognitive weighted score for student cognition above the analysis level of cognition.

Conclusions/Implications/ Recommendations

Professor discourse was primarily at the two lowest levels of cognition, knowledge and comprehension. If students are to think at higher cognitive levels, professors need to provide discourse at levels at which students are appropriately challenged. Professors who consistently deliver discourse at lower cognitive levels may not be providing opportunities for students to think at the higher levels of cognition during class sessions (Blosser, 2000). Thus, professors should not expect students to operate at cognitive levels that are higher than those to 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 their level of discourse accordingly. Once professors are aware of the cognitive level at which their content is being delivered, a comparison can be made to the course, and to the individual lesson objectives, to examine if the cognitive level of professor discourse accomplishes the purposes of the course. Students were thinking during class sessions, but students were not engaged with the course content during the majority of the class sessions. At any given time during a class session, over half of the students in the class were thinking about something other than the topic at hand (Shertzer et al., 2005). Students need to recognize that their individual learning may be affected by the fact that they are engaged in class content less than half of the class session. Professors must be made aware that students elicit more random and nonsense thoughts during a class session than cognitively engaged thoughts and must plan for adding variability to content delivery (Rosenshine & Furst, 1971).

Table 5
Frequency of Cognitive Level of Student Thought and Total Cognitive Weighted Score for Student Cognition

Student	Knowledge *f*	Comprehension *f*	Application *f*	Analysis *f*	Synthesis *f*	Evaluation *f*	Engaged thoughts *f*	Total cognitive weighted score
9	12	**20**	10	17	1	1	61	26.10
16	**41**	2	7	3	0	0	53	14.80
20	2	**19**	3	4	10	2	40	31.25
7	4	**13**	1	8	3	8	37	32.35
10	**11**	**11**	2	9	1	3	37	25.60
8	**19**	6	7	4	0	0	36	18.80
3	**12**	5	1	10	1	5	34	28.05
17	**8**	7	7	6	0	1	29	24.70
12	**17**	3	3	1	2	1	27	18.90
14	5	**9**	2	4	5	1	26	28.50
19	4	**8**	0	7	0	4	23	29.60
21	4	**8**	1	7	0	3	23	28.65
2	**15**	4	0	1	1	1	22	17.20
11	2	**10**	1	3	2	3	21	29.40
4	**7**	6	0	4	1	0	18	22.30
6	5	**9**	0	1	0	2	17	21.90
15	**11**	2	3	0	1	0	17	16.80
1	**7**	4	0	4	1	0	16	22.40
5	**5**	4	1	3	0	1	14	23.40
18	**6**	3	3	0	0	0	12	17.50
13	0	0	**1**	0	0	0	1	30.00
Total	**197**	153	53	96	29	36	564	

Note. Possible range for total cognitive weighted score for student cognition (10-50). Bolded numbers are the mode for each student.

Engaged thoughts were at the knowledge and comprehension levels (the two lowest levels of Bloom's Taxonomy). However, student total cognitive weighted scores were higher than professor total cognitive weighted score in each class but one (class number 4). Thus, the students in the study were thinking at levels higher than those at which they were being challenged. Professors and students should work to increase student cognition during class sessions. Professors can use well-planned lessons and questions to attract and hold the interest of students (Blosser, 2000). Professors can also use active learning strategies to encourage student engagement (King, 1993). Students can learn to focus on the topic at hand by asking questions, taking notes, and participating in class discussions. Kuh (2001) believed that service learning projects and forming learning communities were valuable means of engaging students in their learning. These strategies point to involving students in the learning process, rather than allowing students to act as passive recipients of the information (Heuwinkel, 1996). Future research should incorporate an examination of professors' intent in terms of learning objectives for the course, and specific class sessions.

Students must be able to think critically and analyze information that has been presented to them (Education Commission of the States, 1995). If students are thinking primarily at lower levels of cognition during class sessions, critics of undergraduate education may be correct in stating that undergraduate students are not prepared to think at higher levels of cognition after leaving the university (Tom, 1997).

Professors must recognize the cognitive levels at which students are thinking and compare that to their own cognitive level of discourse to see if the relationship is appropriate for the purposes of the course. Professors can study the cognitive levels at which students are thinking by dialoguing with their students about the course content, making certain that the students are grasping the concepts being taught (Shulman, 2000). If professors are not pleased with the cognitive levels at which they are challenging students during class sessions, then change must be made in professor discourse and professor methodologies to provide more opportunities for students to reach higher levels of cognition during class sessions.

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