A Classroom Assessment of Agriculture Teachers' Cognitive Behaviors

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Abstract

The purpose of the study was to describe teachers' levels of cognitive behaviors and to investigate characteristics that influence teaching at higher cognitive levels. Agriculture teachers in a Midwestern State were observed using the Florida Taxonomy of Cognitive Behaviors. Teachers' attitude toward teaching at higher levels of cognition was collected using a summated rating questionnaire. Teachers' cognitive behavior was found to be at the knowledge and comprehensive levels of cognition 82.52% of instructional time. The total weighted cognitive behavior of teachers was 17.31. Teachers' attitude toward teaching at higher levels of cognition was found to be slightly favorable and had a substantial positive relationship with their cognitive behavior.

Introduction/Theoretical Framework

People need higher-order thinking skills to be responsible and empowered citizens to contribute as productive workers (Newmann, 1990). Newmann also stated that higher-order thinking skills are needed to manage one's personal dealings and continue to learn. When people are thoughtful they are motivated to act in a manner that helps themselves and others. Two reasons for teachers to be concerned about the teaching of thinking have been identified by Beyer (1987). First, many people believe thinking is a skill which develops on its own; this is not entirely true. Most people, especially immature thinkers, are not as able to develop thinking skills on their own. Left to themselves, people will most likely not develop their thinking skills to their fullest potential. Second, if teachers do not "deliberately and explicitly teach how to execute the various thinking tasks required for academic as well as common out-of-school tasks, students' chances of success at these tasks are greatly limited" (Beyer, p. 3).

As a mission, "Agricultural Education prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber, and natural resources system" (National Council for Agricultural Education, 2000, p. 3). The mission of agricultural education was defined in the National Strategic Plan and Action Agenda for Agricultural Education: Reinventing Agricultural Education for the Year 2020 as a guide for the future of the profession. Arguably, the mission is rooted in the development of higher-order thinking skills by the inclusion of the phrase, "a lifetime of informed choices."

Bloom (1956) categorized thinking skills, or cognition, into increasingly complex levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. The four upper levels (application, analysis, synthesis, and evaluation) were concluded by Bloom to be higher-order. Higher-order thinking is a cognitive process that occurs when a person "takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations" (Lewis & Smith, 1993, p. 136). Higher-order thinking requires the use of new information or prior knowledge and manipulation of that information to reach possible solutions in new situations (Lewis & Smith, 1993). Newmann (1990) suggested that, "lower-order thinking demands only routine, mechanistic application of previously acquired knowledge…. By contrast, higher-order thinking challenges the student to interpret, analyze, or manipulate information" (p. 44). Bias, prejudice, and many problems in life, can be attributed to unrefined thinking (Paul & Elder, 2004). The aforementioned reasons have led teachers to include instruction that incorporates the use of methods and techniques that promote higher-order thinking skills among students.

Educators have argued that instructors are the most influential factor in creating opportunities for students to think at higher levels of cognition (Whittington, Stup, Bish & Allen, 1997). According to Resnick (1987), teaching higher-order thinking skills can be performed in three ways: a) teach the content with higher-order thinking as a by-product; b) teach higher-order thinking with the content as the by-product; and c) teach higher-order thinking that can be transferred to other contexts. Specifically, questioning, writing, and teaching the thinking process are methods frequently identified as a means of promoting higher-order thinking (Herrington & Oliver, 1999; Marzano, 1993; McGregor, 1994). Other methods of teaching (e.g., problem solving, cooperative learning, case study) include higher-order thinking as a process goal (Arends, 1996; Johnson & Johnson, 1989). In combination with each teaching method are specific teacher behaviors. According to Brown, Ober, Soar and Webb (1968), teacher behaviors can be assigned to various levels of cognition. Cognitive behaviors are actions of the teacher which create opportunities for the students to think. Newmann (1990) identified general teacher behaviors that could be used for studying teachers' cognitive behaviors. Measured teacher behaviors included asking challenging questions, carefully analyzing conclusions, using Socratic dialogue, encouraging creativity and problem solving, questioning authoritative sources, using student experiences, and modeling higher-order thinking skills.

While developing higher-order thinking skills is a clear goal of education, the process for developing these skills is not clear. Dunkin and Biddle (1974) proposed a four-variable model to better understand the complicated aspects of classroom teaching, and how teacher behaviors impact learning. Dunkin and Biddle proposed that classroom teaching is influenced by a) presage, b) context, c) process, and d) product variables. Presage variables are existing characteristics of the teacher which influences the teacher's behavior. Context variables are divided into two sub-categories: pupil, and school and community. The pupil category is existing characteristics of students which influence their behavior and learning. Characteristics from the community, school, and classroom that influence student learning are also categorized as context variables. The presage and context variables directly influence the process variables. Process variables include the teacher and students' behavior and the interaction between the two. The final variables are the product variables. Pupil growth is categorized under the product variables. Dunkin and Biddle identified a linear relationship between the variables. Presage and context variables affect process variables, and the results of process variables are product variables.

Cruickshank (1990) further compiled a list of variables that are categorized under each of the major variable-types identified by Dunkin and Biddle (1974). According to Cruickshank, examples of presage variables are teacher age, sex, experience, education, and attitudes. School and class size and composition (ethnic and social economic status) are included under the context variables. Cruickshank included teacher's structuring of comments, questioning techniques, and the level of difficulty of instruction as process variables. When compared to Newmann's (1990) teacher behaviors for the study of cognitive behaviors, the three process variables included can be categorized as related to cognitive behavior.

There is limited research measuring the cognitive behaviors of secondary agriculture teachers. When agriculture teachers' cognitive behavior has been measured it has been observed to be predominately at lower levels (Cano & Metzger, 1995). Cognitive behaviors at the college level were also found to be at lower cognitive levels (Ball & Garton, 2005; Whittington, 1995; Whittington, Stup, Bish, & Allen, 1997). Additionally, instructors' cognitive behavior was not found to be associated with their attitude toward teaching at higher cognitive levels (Whittington, 1991). Attitude may be just one barrier related to teaching at higher cognitive levels.

Whittington (1995) recommended that the barriers toward teaching at higher cognitive levels, such as teacher, school, and student characteristics, be explored. In addition, Lewis and Smith (1993) stated further research was needed about how higher-order thinking skills should be taught and how the skills should be incorporated into pre-service and in-service teacher programs. To study the skills that are needed, an investigation must include the current status of the levels of cognitive behavior in secondary public school classrooms to date. Research has not revealed how characteristics of teachers, schools, and/or classes influence teaching at higher levels of cognition.

There is a widespread call for teaching higher-order thinking skills; however, there is a lack of evidence of cognitive behaviors among teachers. In addition, limited evidence indicates factors that influence teachers' cognitive behaviors. The problem addressed by this study is: what factors influence the level of cognitive behavior among secondary agriculture education teachers?

Purpose/Objectives

The purpose of the study was to describe the level of cognitive behaviors and to investigate characteristics that influence teaching at higher cognitive levels. The following research objectives were used to guide the study:

1. Describe the demographic characteristics (sex, age, years of teaching, & educational level) of agriculture teachers.
2. Describe selected characteristics of the schools (number of students, number of free and reduced lunch qualified students, & teacher to student ratio), and demographics of the classes (number of students, number of individualized instructional plans, sex, & classification).
3. Describe the level of cognitive behavior displayed by agriculture teachers.
4. Describe agriculture teachers' attitude toward teaching at higher levels of cognition.
5. Explain agriculture teachers' weighted cognitive behavior in terms of selected (teacher and school) characteristics.
6. Explain agriculture teachers' cognitive behavior in terms of their attitude toward teaching at higher levels of cognition.

Methods and Procedures

The research design was descriptive-correlational (Gall, Gall, & Borg, 2003). The population consisted of secondary agriculture teachers in Missouri. Due to the large amount of time, travel, and funding required for data collection, the population was limited to teachers in the 20 contiguous counties to the University of Missouri-Columbia. If any portion of a county was within fifty miles of the institution, the teachers within the entire county were eligible for inclusion. Inclusion was further narrowed based upon additional criteria. Only teachers who taught agricultural science II were identified as the population. The agricultural science II course was selected based upon content (a suggested statewide curriculum) and similar aged students (predominately sophomore). To eliminate length of class as a confounding variable, only teachers in schools with a seven or eight period day were considered. To avoid interfering with the student teaching process, teachers with assigned student teachers were removed from consideration. A sample of ten (n = 10) teachers meeting the selection criteria was randomly selected from the population (N = 39). Due to scheduling conflicts, one teacher was removed from the sample, resulting in the observation of nine teachers (n = 9).

Prospective teachers were contacted by telephone to determine their willingness to participate in the study. A script was used with each phone call to insure uniformity of information when extending the invitation to participate in the study. Upon positive feedback from teachers, the school's administrator was called to seek permission for the in-class observation. After verbal permission was granted, school administrators were sent a letter of participation to formalize the process.

For the purpose of this study, two data collection instruments were used. The level of the teachers' cognitive behavior was obtained using the Florida Taxonomy of Cognitive Behaviors (FTCB) (Brown, Ober, Soar, & Webb, 1968). The FTCB provided the framework for observing and recording the cognitive behaviors of teachers and students in the classroom. Cognitive Behavior was defined as personal conduct leading to conscious mental activity (such as thinking, remembering, learning, or using language) (Merriam-Webster, 1997).

The FTCB was used to categorize teachers' cognitive behaviors observed during six-minute intervals of a teaching session. As a behavior was observed, a corresponding box was marked within the cognitive category (knowledge, translation, interpretation, application, analysis, synthesis, and evaluation). A behavior was recorded only once per six-minute interval, regardless of the number of times it occurred. For example, if a teacher gave a fact three times in a six-minute interval, the corresponding box was only marked once. In contrast, if a different fact was given during three different time intervals, it is marked in all three of the corresponding intervals. In addition to verbal communication, directed activities and written instructions such as visuals or handouts were also categorized into a cognitive level.

Bloom's Taxonomy (Bloom, 1956) has been widely accepted as a means of categorizing human behaviors into levels of cognition. The FTCB was directly derived from Bloom's Taxonomy. These assertions led Miller (1989) to state, "The FTCB can be considered valid in light of the support generally given to Bloom's Taxonomy as a means of identifying behaviors in the various levels of cognition" (p. 43). Additionally, the FTCB was used and deemed valid in several studies in agricultural education (Ball & Garton, 2005; Cano & Metzger, 1995; Whittington, 1991; Whittington, 1998).

Potential reliability issues with the FTCB result in the rater's (i.e., observer's) ability to make observations consistently. For this study, one rater, familiar with the FTCB and cognitive behaviors, observed all participants, eliminating the issue of inter-rater reliability. Additionally, the rater analyzed four teaching video tapes using the FTCB prior to field observations. The tapes were then analyzed again two weeks later to assess intra-rater reliability (r_{pb} = .94). Furthermore, criterion-related validity was established through the correlation between a researcher who had used the FTCB in previous research, and the researcher in this study (r_{pb} = .91).

To collect attitudinal and demographic data, a questionnaire was adapted from the work of Whittington (1991). Attitude toward teaching at higher levels of cognition was measured using a 50 question summated rating scale. The questionnaire was reviewed by a panel of experts (*n* = 9) to address content and face validity. Modifications were made to the questionnaire based on recommendations from the panel. Suggestions from the panel led to editorial changes consisting of the addition, removal, and revision of items. A pilot test consisting of secondary teachers (*n* = 23) who were not in the research sample was used to estimate the reliability of the questionnaire. Cronbach's alpha was calculated on the 50 items and resulted in an alpha of .87. Demographic data were not subject to reliability issues because of their static nature.

When collecting data, each teacher was observed in the same class three times from March through May, 2005 for a total of 150 minutes. Observations were scheduled at approximately three week intervals beginning the first week of March. Observations were scheduled to avoid tests, quizzes or out of class activities. At the completion of the final observation, each teacher completed the teacher attitudinal and demographic questionnaire. Teachers were instructed verbally to complete the questionnaire and return it to the researcher in a self-addressed, stamped envelope. The Missouri Department of Elementary and Secondary Education's (2005a) website was used to obtain school related information (i.e., number of students, teacher to student ratio, and percentage of students who qualified for free and reduced lunch).

Data were entered into SPSS 12.0 for analysis. Data collected in nominal form (teacher sex, certification; student gender) were analyzed using frequencies and percentages. The remaining data related to objectives one and two were interval and ratio data (teacher age, years of teaching, number of students qualified for free and reduced lunch, class size, age of students, school size, number of IEPs in class, and student to teacher ratio). For interval and ratio data, means and medians were reported for the measures of central tendency. Standard deviation and range were calculated for the measures of variability.

Cognitive behavior was determined using three teacher observations for deriving a single score. Behavior across the six levels of cognition according to Bloom's Taxonomy (knowledge, comprehension, application, analysis, synthesis, and evaluation) was assessed as a percentage of the total teacher behaviors for the three observations. For each observation, the observed behavior at each level was subtotaled, resulting in a subtotal of each cognitive level for each teacher. Subtotals for each observation were totaled for all three observations. The total for each level was divided by the grand total, resulting in a percentage of classroom behavior at each level.

Miller (1989) identified several studies (Kropp & Stoker, 1966; Madaus, Woods, & Nuttall, 1973; McGuire, 1963; Ormell, 1974) that justified the use of a weighting system for each level of cognition. The weighting system was justified based on the increasing complexity of Bloom's taxonomy. Miller identified the following weights: knowledge = .10; comprehension = .20; application = .30; analysis = .40; synthesis = .50; and evaluation = .50. Miller asserted that synthesis and evaluation should be equally weighted due to the lack of evidence for increased complexity between the two levels. The calculated percentage for each cognitive level was multiplied by the corresponding weight value. The weighed cognitive percentages for each teacher were totaled to obtain a single cognitive behavior value. Weighted cognitive behavior values could range from 10 to 50. A weighted cognitive value of 10 would represent cognitive behavior only at the knowledge level. By contrasts, a weighted value of 50 would represent cognitive behaviors only at the synthesis and/or evaluation levels.

Pearson correlation coefficients, point-biserial, and Spearman rank-order correlations were calculated between teachers' observed cognitive behavior and selected characteristics. In addition, Pearson correlation coefficients were calculated between teachers' observed cognitive behavior and their attitude toward teaching at higher levels of cognition. Davis' (1971) conventions were used to describe the magnitude of the correlations.

Findings

Due to the small sample size (n = 9) caution should be taken when generalizing beyond the subjects. Of the nine subjects six (66.67%) were male and three (33.33%) were female. Three levels of education were found among the teachers, with five (55.56%) earning only a bachelor's, three (33.33%) earning a master's, and one (11.11%) holding a specialist degrees. Three different areas of certification were found to be held my teachers. Seven (77.78%) of the nine agriculture teachers were certified only in agriculture. One teacher (11.11%) was certified in agriculture and science and one (11.11%) in agriculture, science, and industrial arts. The age of the teachers ranged from 23.00 to 51.00, with a mean of 34.56 (*SD* = 11.08) years-old. Teaching experience ranged from one to 28.00 years with an average of 9.56 (*SD* = 10.20) years.

Selected characteristics (number of students, number qualified for free and reduced lunch, and number of students per teacher) of the participating schools were collected from the Missouri Department of Elementary and Secondary Education's (2005a) Web site (see Table 1). The mean number of students in the nine schools was 412.67 (*SD* = 289.12), with a range of 87.00 to 903.00. The schools averaged having 23.51% (97.04, *SD* = 70.64) of the students who qualified for the free and reduced lunch program. Participating schools had a mean of 18.00 (*SD* = 3.94) students per classroom teacher with a range of 10.00 to 24.00.

Table 1
School Characteristics of Teacher Participants (n = 9)

School Characteristic	Mean	Median	*SD*	Range (min-max)
Number of Students	412.67	290	289.12	87-903
Number Qualified for Free and Reduced Lunch	97.04	58	70.64	17-205
Number of Students per Teacher	18.00	18	3.94	10-24

Teachers provided demographic information pertaining to students enrolled in the observed classes. Classes had a mean of 13.89 (*SD* = 4.70) students per class (see Table 2). The mean number of male students in the agriculture classes was 8.22 (*SD* = 2.82) or 59.18% and 40.82% (*M* = 5.67, *SD* = 3.71) were female. There were no freshman students enrolled in the classes; however, 86.40% (*M* = 12.00, *SD* = 3.28) were sophomores, 8.78% (*M* = 1.22, *SD* = 1.71) were juniors, and 5.82% (*M* = 0.67, *SD* = 1.00) were seniors students. The classrooms had a mean of 2.00 (*SD* = 1.50) students with Individualized Instructional Plans (IEP) or 14.39% of all students.

Table 2
Student Demographics of Observed Classrooms (n = 9)

Student Characteristic	%	*M*	*SD*	Range (min-max)
Sex				
Males	59.18	8.22	2.82	4-13
Females	40.82	5.67	3.71	2-12
Grade Level				
Freshman	0.00	0.00	0.00	0-0
Sophomores	86.40	12.00	3.28	7-16
Juniors	8.78	1.22	1.71	0-5
Seniors	4.82	0.67	1.00	0-3
IEPs	14.39	2.00	1.50	0-5
Total Students		13.89	4.70	7-20

Lower-order cognitive behaviors were observed 84.73%, 93.69%, and 65.78% of the time, respectively, during the three observations (see Table 3). Over the three observations, higher-order behaviors were observed 15.27%, 6.30%, and 34.22% of the time, respectively. Knowledge-level behavior was observed 53.33%, 66.94%, and 40.60% of the time for the three observations, respectively. For observation one, comprehension level behaviors were present 31.40%, observation two, 26.75%, and observation three, 25.18%. During observation one, the application level behaviors were present 8.35%, observation two, 2.61%, and for observation three, 24.44%. Analysis-level behaviors were present .173% for observation one, 3.69% for observation two, and 9.78% for the final observation. Synthesis and evaluation level behaviors were not observed during the second and third visits, but were present 0.33% and 3.42%, respectively, during the first observation.

The percentages for the three observations were totaled by cognitive level. To reflect the increasing mental complexity required of Bloom’s Taxonomy the mean for each level was weighted as recommended by Miller (1989). Knowledge level behaviors were observed 52.77% of the time ranging from 44.26% to 86.27%; thus, the resulting cognitive weight was 5.28 (see Table 4). With a mean of 29.75%, comprehension behaviors had a cognitive weight of 5.95 with a range of 7.84% to 44.66%. Application was observed an average of 10.35% of the time with an observed range of 0.00% to 20.63%. Application level behaviors had a cognitive weight of 3.10. With a range of 0.00% to 12.86%, analysis level behavior accounted for 5.81% of the observations and a cognitive weight of 2.32. The cognitive weight for synthesis level behaviors was 0.06 with a mean of 0.11% and a range of 0.00% to 0.97%. Evaluation behaviors were found to have a mean of 1.21%, a range of 0.00% to 6.35%, and a cognitive weight of 0.60. Lower-order behaviors (knowledge and comprehension) were observed, on average, 82.52% of the time during the observations. A total cognitive weight of 10.00 indicates all instructions at the knowledge; conversely, a value of 50.00 indicates instruction only at the synthesis and/or the evaluation levels. Teachers were found to have a total average cognitive weight of 17.31, indicating an average cognitive level of instruction below the comprehension level.

Table 3
Mean Percentage by Cognitive Level for Classroom Behavior Over Three Observations (n = 9)

Cognitive Level	Observation 1 *M* %	Observation 2 *M* %	Observation 3 *M* %
Lower-Order	84.73	93.69	65.78
Knowledge	53.33	66.94	40.60
Comprehension	31.40	26.75	25.18
Higher-Order	15.27	6.30	34.22
Application	8.35	2.61	24.44
Analysis	3.17	3.69	9.78
Synthesis	0.33	0.00	0.00
Evaluation	3.42	0.00	0.00

Table 4
Mean Percent of Time of Cognitive Behavior by Level for Agriculture Teachers (n = 9)

Cognitive Level	*M* %	Cum %	Range (min-max)	Weight Value	Cognitive Weight	Cum Cog Weight
Lower-Order						
Knowledge	52.77	52.77	44.26-86.27	.10	5.28	5.28
Comprehension	29.75	82.52	7.84-44.66	.20	5.95	11.23
Higher-Order						
Application	10.35	92.87	0.00-20.63	.30	3.10	14.33
Analysis	5.81	98.68	0.00-12.86	.40	2.32	16.65
Synthesis	0.11	98.79	0.00-0.97	.50	0.06	16.71
Evaluation	1.21	100.00	0.00-6.35	.50	0.60	17.31

A summated rating scale questionnaire was administered to all teachers to assess their attitude toward teaching at higher levels of cognition (see Table 5). The 50-item questionnaire used a six-point summated scale. The scale for the questions ranged from 1 (strongly disagree) to 6 (strongly agree). Mean attitude scores were dichotomized into unfavorable and favorable attitude. Teachers' whose total mean score range from 1.00 to 3.49 were considered to have an unfavorable attitude toward teaching at higher levels of cognition. Teachers' whose total mean score ranged from 3.50 to 6.00 were considered to have a favorable attitude toward teaching at higher cognitive levels. The mean attitude score for teachers was found to be 4.21 (*SD* = 0.26). Agriculture teachers' attitude scores ranged from 3.88 to 4.62.

Table 5
Attitude Towards Teaching at Higher Levels of Cognition (n = 9)

Construct	Mean Attitude	*SD*	Range (min-max)
Attitude	4.21	0.26	3.88-4.62

Note. Scale: 1 = Strongly Disagree, 2 = Moderately Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Moderately Agree, and 6 = Strongly Agree.

A point-biserial correlation was calculated between the teachers' total cognitive behavior score and their sex (see Table 6). The correlation resulted in a low positive (r_{pb} = .26) relationship. Pearson correlation coefficients were calculated between the teachers' total cognitive behavior score and their age and years of experience. Both age (*r* = -.01) and years of experience (*r* = -.05) were found to have a negative negligible relationship. The relationship between total cognitive behavior score and teachers' highest level of education was calculated using Spearman rank order. The relationship was found to be negative and low (r_s = -.19).

Table 6
Relationship Between Teachers' Total Cognitive Behavior and Their Characteristics (n = 9)

Teacher Characteristic	Total Cognitive Behavior (*r*)
Sex	.26[a]
Age	-.01
Years of Teaching Experience	-.05
Level of Education	-.19[b]

Note. Coding; male = 0, female = 1. age range = 23-51. years of experience range = 1-28. Level of education coding: bachelors = 1, masters = 2, specialist = 3.
[a] point-biserial; [b] spearman rank-order.

Pearson correlation coefficients were calculated for the relationships between teachers' observed total cognitive behavior score and the selected school characteristics (see Table 7). A positive moderate relationship was found for each correlation. A Pearson product-moment correlation coefficient of .33 was found between total students in the school and the teacher's cognitive behavior score. Number of students qualified for the free and reduced lunch program was found to have a coefficient of .37. Additionally, the number of students per teacher had a coefficient of .49.

Table 7
Relationship Between Teachers' Total Cognitive Behavior and Selected School Characteristics (n = 9)

School Characteristic	Total Cognitive Behavior (*r*)
Total Students	.33
Number of Free and Reduced Lunch Students	.37
Student to Teacher Ratio	.49

Relationships were calculated between total cognitive behavior and the characteristics of the observed class using the Pearson product-moment correlation (see Table 8). The number of students in the class was found to have a positive substantial (*r* = .50) relationship. Also, with a positive substantial relationship (*r* = .56) was the number of upperclassmen in the class. Found to have positive moderate relationships were number of females in the class (*r* = .42) and number of underclassmen in the class (*r* = .30). Two class characteristics were found to have positive low relationships: number of students with Individualized Educational Plans (*r* = .15) and number of male students (*r* = .27).

Table 8
Relationship Between Teachers' Total Cognitive Behavior and Observed Classroom Characteristics (n = 9)

Class Characteristic	Total Cognitive Behavior (*r*)
Number of Students	.50
Number of Individualized Educational Plans	.15
Number of Female Students	.42
Number of Male Students	.27
Number of Underclassmen	.30
Number of Upperclassmen	.56

The relationship between teachers' total observed cognitive behavior and their attitude toward teaching at higher cognitive levels was calculated using Pearson product-moment correlation (see Table 9). A positive substantial relationship was found (*r* =.51).

Table 9
Relationship Between Teachers' Total Cognitive Behavior and Their Attitude Toward Teaching at Higher Cognitive Levels (n = 9)

Characteristic	Total Cognitive Behavior (*r*)
Attitude Toward Teaching at Higher Cognitive Levels	.51

Conclusions/Recommendations

Conclusions and recommendations are presented by research objective. Due to the small sample size (*n* = 9) caution should be taken when generalizing beyond the subjects who participated in the study. The majority of the teachers participating in the study were male and held a bachelor's degree and a certificate in agriculture. Observed teachers had an average age of 35 years and 10 years of experience.

Participating schools had an average of 413 students with teachers reporting one-forth of the students qualifying for the free and reduced lunch program. Schools ranged from 87 students to 903 students. According to the Missouri Department of Elementary and Secondary Education (2005b) the average size for schools with agriculture programs was 507 students with 33% eligible for free and reduced lunch. Observed schools averaged 18 students per teacher which was slightly lower than the state average of 19. The sample represents smaller schools than the state average. Students in the observed classrooms were 59% male and 86% sophomores. In addition, classrooms averaged two students with Individualized Educational Plans. The observed classrooms averaged 14 students.

Teachers' total cognitive behavior was at the lower levels (Knowledge and Comprehension) 83% of the time. This conclusion is consistent with Cano and Metzger (1995) who found secondary horticulture teachers' cognitive behavior at lower levels 84% of the time. Additionally, when college instructors were studied, lower-order cognitive behaviors were observed 61% (Ball & Garton, 2005), 98% (Whittington, 1995), and 80% (Whittington, Stup, Bish, & Allen, 1997) of the time. Experimental design studies should be conducted to determine the methods and/or techniques have the greatest effect on teachers' total cognitive behavior. Additionally, educators should determine the acceptable level of cognitive behavior for the student and course content taught.

As previously stated, the time of the year in which the study occurred may not be the best time to assess teaching. It could also be argued that teaching should be consistent throughout the school year. It is recommended that teachers assess the level at which they are teaching and improve it if needed. This conclusion is similar to that of Cano and Newcomb (1990). If teachers' level of cognitive behavior is not deemed appropriate, in-service instruction should be conducted. Whittington (1998) found that professional development improved instructors' ability to teach using higher cognitive behaviors. Based on the argument that teachers teach the way they are taught (Eraut, 1997), pre-service instruction should include instruction on increasing levels of cognitive behavior. It must be pointed out that the classroom is not the only opportunity for instruction in agricultural education. Leadership development, experiential learning, and Career Development Events are also teaching tools. The effect of these activities on students' cognitive ability should be studied.

Observed teachers displayed higher levels of cognitive behaviors during the third observation. Many of these observations were conducted after the State's FFA Convention. Additionally, many of the teachers commented on keeping students busy based on the spring weather. The completion of the convention and the spring weather is a plausible explanation for the observed increase in higher levels of cognitive behaviors. The cognitive behavior of teachers was at its lowest during the second observation, many of which were conducted prior to the State FFA Convention. Unfortunately synthesis and evaluation were not observed during the second and third observations.

Based on the changing levels of cognitive behavior, it is recommended that the study be replicated at different times of the school year. It is not known if the weather had an effect on teacher behavior, but late summer could show similar effects. With the State FFA Convention being one of the busiest times of the year, fall and early winter observations may result in different findings. Exploration should be conducted to determine why synthesis and evaluation were not being observed.

Teacher personal characteristics had low and negligible relationships with cognitive behavior. Intuitively a relationship would be assumed between cognitive behavior and years of teaching experience or level of education, when in-fact they were negligible and low, respectively. In addition, the relationships that were present between the two variables and total cognitive behavior were negative. Further research should be conducted to help determine what caused that to occur.

All three school variables (number of students, number of students qualified for free and reduced lunch, and number of students per teacher) have positive moderate relationships with teachers' total cognitive behavior. Additionally, teachers' class size had a positive substantial relationship with their cognitive behavior. Based on these findings, teachers' cognitive behavior tended to increase with the number of students. The number of upperclassmen in the class has a positive substantial relationship with cognitive behavior. Many would argue that as students increase in age the cognitive level of instruction should also increase. This finding is consistent with Cano and Newcomb (1990). It must be pointed out that the observed class was chosen because it was predominately sophomores. Further research should study classes that include mostly upperclassmen.

Teachers' attitude toward teaching at higher levels of cognition was favorable. Additionally, teachers' attitude was associated with cognitive behaviors. As teachers' attitude toward teaching at higher cognitive levels became more favorable, their cognitive behaviors increased. This is contrary to Whittington (1991) who studied college instructors and found no relationship between their attitude and cognitive behavior. The implications of this finding reach into pre-service instruction and in-service instruction, and professional development. If teacher development can address the affective domain and increase teachers attitudes it may assist in the increase of teachers' cognitive behavior. The substantial relationship found between attitude and teachers' total cognitive behavior implies that teaching at higher levels of cognition must become part of one's philosophical beliefs about good teaching.

Pre-service education should not only include the affective domain for attitude, it should also include the instruction and modeling of higher level cognitive behaviors. In-service professional development should assist in the continued development of the skills needed to teach at higher levels of cognition. Research about teachers' cognitive behavior should continue. The cognitive behavior of secondary agriculture teachers should be monitored further to determine if this research is representative of the situation beyond the sample.

References

Arends, R. I. (1996). *Classroom instruction and management*. New York: McGraw-Hill.

Ball, A. L., & Garton, B. L. (2005). Modeling higher order thinking: The alignment between objectives, classroom discourse, and assessments. *Journal of Agricultural Education, 46*(2), 58-69.

Beyer, B. K. (1987). *Practical strategies for the teaching of thinking.* Boston, MA: Allyn and Bacon, Inc.

Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain.* New York: David McKay Company, Inc.

Brown, B. B., Ober, R., Soar, R., & Webb, J. N. (1968). *Florida taxonomy of cognitive behavior: Directions.* Unpublished manuscript, University of Florida, Gainesville.

Cano, J., & Metzger, S. (1995). The relationship between learning style and levels of cognition of instruction of horticulture teachers. *Journal of Agricultural Education, 36*(2), 36-42.

Cano, J., & Newcomb, L. H. (1990). Cognitive level of instruction and student performance among selected Ohio production agriculture programs. *Journal of Agricultural Education, 31*(1), 46-51.

Cruickshank, D. R. (1990). *Research that informs teachers and teacher educators*. Bloomington, IN: PHI DELTA KAPPA Educational Foundation.

Davis, J. A. (1971). *Elementary survey analysis.* Englewood, NJ: Prentice Hall.

Dunkin, M. J., & Biddle, B. J. (1974). *The Study of teaching.* New York: Holt, Rinehart and Winston.

Eraut, M. (1997). *Developing professional knowledge and competence.* Washington, D.C.: The Falmer Press

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Apply in educational research: A practical guide* (5th ed.). Boston, MA: Pearson Educational, Inc.

Herrington, J., & Oliver, R (1999). Using situated learning and multimedia to investigate higher-order thinking. *Journal of Educational Multimedia and Hypermedia, 8,* 401-421.

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research.* Edina, MN: Interaction Book Company.

Kropp, R. P., & Stoker, H. W. (1966). *The construction and validation of tests of the cognitive processes described in the taxonomy of educational objectives.* (Cooperative Research Project No. 217). Washington, D.C., U.S. Office of Education.

Lewis, A., & Smith, D. (1993). Defining higher-order thinking. *Theory Into Practice, 32,* 131-137.

Madaus, G. F., Woods, E. M., & Nuttall, R. L. (1973). A casual model analysis of Bloom's taxonomy. *American Educational Research Journal, 10,* 253-262.

Marzano, R. J. (1993). How classroom teachers approach the teaching of thinking. *Theory Into Practice, 32*, 154-160.

McGregor, J. H. (1994). Cognitive processes and the use of information: A qualitative study of higher-order thinking skills used in the research process by students in a gifted program. *School Library Media Annual, 12,* 124-133. Englewood CO: Libraries Unlimited, Inc.

McGuire, C. (1963). Research in the process approach to construction and analysis of medical examinations. *NCME 20th Yearbook*, Washington, D.C.: National Council on Measurement in Education.

Merriam-Webster (1997). *The Merriam Webster dictionary.* Springfield, MA: Merriam-Webster Inc.

Miller, C. (1989). Cognitive levels of instruction and student performance in college of agriculture courses (Doctoral dissertation, The Ohio State University 1989). *Dissertation Abstracts International, 51,* 386.

Missouri Department of Elementary and Secondary Education (2005a). [Annual reporting of school district data] Unpublished raw data. Retrieved May 31, 2005 from http://dese.mo.gov/schooldata/ftpdata.html

Missouri Department of Elementary and Secondary Education (2005b). [Missouri school directory: School building list] Unpublished raw data. Retrieved May 31, 2005 from http://dese.mo.gov/directory/download.html

National Council for Agricultural Education (2000). *The national strategic plan and action agenda for agricultural education: Reinventing agricultural education for the year 2020.* Alexandria, VA.

Newmann, F. M. (1990). Higher-order thinking in teaching social studies: a rationale for the assessment of classroom thoughtfulness. *Journal of Curriculum Studies*, *22*, 41-56.

Ormell, C. P. (1974). Bloom's taxonomy and the objectives of education. *Educational Research, 17,* 3-18.

Paul, R., & Elder, L. (2004). *The miniature guide to critical thinking: Concepts & tools* (4th ed.). Dillon Beach, CA: Foundation for Critical Thinking.

Resnick, L.B. (1987). *Education and learning to think.* Washington, D.C. National Academy Press.

Whittington, M. S. (1991). Aspired cognitive level of instruction, assessed, cognitive level of instruction and attitude toward teaching at higher cognitive levels (Doctoral dissertation, The Ohio State University, 1991). *Dissertation Abstracts International, 52,* 1615.

Whittington, M. S. (1995). Higher-order thinking opportunities provided by professors in college of agriculture classrooms. *Journal of Agricultural Education, 36*(4), 32-38.

Whittington, M. S. (1998). Improving the cognitive level of college teaching: A successful faculty intervention. *Journal of Agricultural Education, 39*(3), 31-40.

Whittington, M. S., Stup, R. E., Bish, L., & Allen, E. (1997). Assessment of cognitive discourse: A study of thinking opportunities provided by professors. *Journal of Agricultural Education, 38*(1), 46-53.