A COMPARISON OF THE COGNITIVE BEHAVIORS EXHIBITED BY SECONDARY AGRICULTURE AND SCIENCE TEACHERS

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Abstract

The purpose of this study was to investigate the level of cognitive behavior exhibited by secondary agriculture teachers and compare the behavior to science teachers. Teachers within the two groups were found to have similar attitudes toward teaching at higher levels of cognition. Agriculture teachers spent 83% of their time on lower-order behavior. Similarly, 84% of science teachers' time was spent on lower-order behavior. It was concluded that pre-service and in-service instruction should address teaching at higher-levels of cognition. When comparing the cognitive behavior of the two groups, no differences were found in their total cognitive behavior or their behavior exhibited at the six levels of Bloom's Taxonomy. Opportunities for agriculture teachers to model higher-order thinking are abundant, teachers should utilize the opportunities to assist in the development of students' higher-order thinking.

Introduction - Theoretical Framework

"Why is higher-order thinking a desirable educational goal" (Newmann, 1990, p. 45)? Responding to his own question, Newmann asserted there are three reasons (A) to be responsible and empowered citizens, (B) to contribute as productive workers, and (C) to manage one's personal dealings and continue to learn. But what is higher-order thinking? Lewis and Smith (1993) suggested that higher-order thinking requires a person to use new information or prior knowledge and manipulate the information to reach possible answers in new situations. Contrasting lower-order from higher-order thinking, Newmann concluded 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). But why is higher-order thinking a desired skill?

The *National Strategic Plan and Action Agenda for Agricultural Education: Reinventing Agricultural Education for the Year 2020* was developed to maintain agricultural education's place in the American school system (National Council for Agricultural Education, 2000). The plan included the mission for agricultural education which stated: "Agricultural education prepares students for successful careers and a lifetime of informed choices in the global agriculture, food, fiber, and natural resources system" (p. 3). Inclusion of the phrase, "informed choices," indicates the mission was grounded in higher-order thinking. According to Paul and Elder (2004), uninformed choices or unrefined thinking leads to bias and prejudice. Many problems in life can be attributed to poor thinking. When individuals are thoughtful they are more likely to be motivated to act in a manner that helps themselves and others. Arguably, persons that make informed decisions must be able to synthesize information and evaluate options.

Further, Beyer (1987) identified two reasons for schools and teachers to be concerned with teaching thinking skills. The first concern is that when left to themselves, individuals will most likely not develop their thinking skills to their fullest potential. However, many believe thinking is a skill which will develop on its own, a position which is not entirely true. Some, especially immature thinkers, are not as able to develop thinking skills on their own. 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). With this thought in mind, the question becomes, can higher-order thinking be taught?

Three general approaches for teaching higher-order thinking skills have been identified which include: (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 contents (Resnick, 1987). Specific methods to increase higher-order thinking skills were identified by Herrington and Oliver (1999), Marzano (1993), and McGregor (1994) which include raising oral questions, writing, teaching the thinking process, and cooperative learning groups. Many methods of teaching (e.g., problem solving, cooperative learning, case study) include developing higher-order thinking as a goal (Arends, 1996; Johnson & Johnson, 1989). In combination with each of these methods are classroom and instructional behaviors of the teacher. These teacher behaviors can be associated with each level of Bloom's Taxonomy of cognition (Brown, Ober, Soar, & Webb, 1968). Cognitive behaviors are teacher actions which create opportunities for the students to think and exercise higher-order thinking. Newmann (1990) identified general teacher behaviors that can be identified when investigating cognitive behaviors. Examples of some of these teacher behaviors include asking challenging questions, carefully analyzing conclusions, using Socratic dialog, encouraging creativity and problem solving, questioning authoritative sources, using student experiences, and modeling higher-order thinking during classroom discourse.

Many researchers have identified teacher behaviors or research questions for studying aspects of the classroom. Dunkin and Biddle (1974) developed a model for studying classroom teaching. The model represents four major variable types: (A) presage, (B) context, (C) process, and (D) product. 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 under the context variables. The presage and context variable types 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 variable types. Pupil growth is categorized under the product variable. Dunkin and Biddle identified a linear relationship between the variable types.

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

Existing research in agricultural education recommends that teachers should self-assess the levels of cognition at which they are teaching and increase the levels of cognition as students increase in age and development (Cano & Newcomb, 1990). When agriculture teachers' cognitive behavior has been measured, it has been observed to be predominantly at lower levels (Cano & Metzger, 1995). Whittington (1995) recommended the exploration of "barriers to teaching at higher cognitive levels" (p. 37). Also, research (Whittington, Stup, Bish, & Allen, 1997) found that instructors were the most influential factor in creating the opportunities for students to think at higher levels of cognition. However, instructors' cognitive behavior was not found to be associated with their attitude toward teaching at higher cognitive levels (Whittington, 1991). In addition, Lewis and Smith (1993) stated that further research is needed to determine 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 displayed by teachers in the classroom. Research has failed to reveal how characteristics of teachers, schools, and/or classes affect teaching at higher levels of cognition or how related disciplines compare in cognitive behavior. Consequently, there is lack of evidence of instruction at higher-order cognitive levels. In addition, very little evidence is present to indicate the factors influencing the cognitive behaviors of teachers.

Purpose and Objectives

The purpose of the study was to investigate the level of cognitive behavior among secondary agriculture teachers. Additionally, a second purpose of the study was to compare the levels of cognitive behaviors with those teachers of a related content area (science). The following objectives were used to address the purpose:

1. Describe teachers' attitude toward teaching at higher levels of cognition.
   a. H_o: There is no difference in attitude toward teaching at higher levels of cognition between agriculture and science teachers (H_o: $\mu_{ag} = \mu_{sci}$).
2. Measure the level of cognitive behavior of teachers.
3. Describe how agriculture and science teachers compare by personal, school, and class characteristics.
4. Describe the difference in the level of cognitive behavior between agriculture and science teachers.
   a. H_o: There is no difference in each of the six levels of cognitive behavior and lower and higher level behavior between agriculture teachers and science teachers ($H_{o\ (1\text{-}8)}$: $\mu_{ag} = \mu_{sci}$; 1= knowledge, 2 = comprehension, 3 = application, 4 = analysis, 5 = synthesis, 6 = evaluation, 7 = lower-order, 8 = higher-order).
   b. H_o: There is no difference in mean cognitive behavior scores between agriculture teachers and science teachers (H_o: $\mu_{ag} = \mu_{sci}$).

Methods and Procedures

The design of this study was descriptive-correlational. The target population for the study consisted of all secondary agriculture teacher in Missouri. The accessible population was agriculture teachers in twenty contiguous counties around the University of Missouri-Columbia. If any portion of a county was within fifty miles of Columbia, Missouri, the teachers within the entire county were eligible for selection. The population was further defined by school and teacher characteristics. Only teachers who were teaching Agricultural Science II during a 7 or 8-period day were considered. Teachers who were serving as a cooperating teacher to a student teacher were removed from consideration. An additional requirement for participation in the study by an agriculture education teacher was the willingness of a science (Biology) teacher within the school system to participate in the study. Biology was chosen because of similar science content to Agricultural Science II. Due to the enormous amount of time required to observe the subjects, a sample of ten (n = 10) teachers meeting the requirements was selected randomly from the target population. One teacher was removed from the sample, due to scheduling conflicts, resulting in the study of nine agriculture teachers. A total of 18 (agriculture education teachers = 9; science teachers = 9) teachers were observed.

Teachers were contacted by telephone to determine their interest to participate in the study. Following positive feedback from the agriculture teacher, the recommended

Biology teachers were contacted. After positive feedback from both teachers, the schools' administrators were called to seek permission for the in-class observations.

For the purposes of this study two instruments were used to collect data. Teachers' level of the cognitive behavior was obtained using the Florida Taxonomy of Cognitive Behaviors (FTCB) (Brown et al., 1968). The FTCB scoring system can be used directly by an observer in the classroom to assess the cognitive behavior of teachers. Cognitive behavior is personal conduct leading to conscious mental activity (such as thinking, remembering, learning, or using language) (Merriam-Webster, 1997).

The FTCB is used to categorize teacher cognitive behaviors observed in six-minute intervals of a teaching session. As a behavior was observed, a corresponding box was marked once per six-minute interval within the cognitive category regardless of the number of times it occurred. In addition to verbal communication, direct activities, and written instructions such as visuals or handouts were also categorized.

Bloom's Taxonomy (Bloom, 1956) has been widely accepted as a means of categorizing behaviors into levels of cognition. The FTCB was directly derived from Bloom's Taxonomy. These two 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 other studies (Ball & Garton, 2005; Cano & Metzger, 1995; Whittington, 1991; 1998).

The rater using the FTCB is directly related to the reliability of the FTCB. For this study, one rater observed all participants. Prior to field observations, the rater analyzed four video tapes of teaching using the FTCB. The tapes were then analyzed again two weeks later to assess intra-rater reliability (r_{pb} = .94). Criterion-related validity was established through the correlation between a researcher who had used the FTCB in previous research, and the researchers in this study (r_{pb} = .91).

To collect the attitude toward teaching at higher levels of cognition, a second questionnaire was adapted from the work of Whittington (1991). Attitude toward teaching at higher levels of cognition was measured using a 50 question, summated scale instrument. The instrument was reviewed by a panel of experts (*n* = 7) to address content and face validity. Suggestions from the panel led to the addition, removal, and revision of items. A pilot test consisting of secondary teachers (*n* = 23) who were not in the study were used to assess the reliability of the instrument. A Cronbach's alpha was conducted on the pilot test data which resulted in an alpha value of .87.

Each secondary class was observed three times from the beginning of March until the middle of May, 2005. Observations were scheduled at approximately three week intervals starting the first week of March. The observation schedule was adapted to avoid tests, quizzes or out of class activities. At the completion of the third and final observation, each teacher was instructed to complete the questionnaire and return it in a self-addressed, stamped envelope.

Cognitive behavior was identified within three observations of the 18 teachers. Behaviors were recorded according to the 55 categories on the Florida Taxonomy of Cognitive Behaviors. Behavior across the six levels of cognition of Bloom's Taxonomy (knowledge, comprehension, application, analysis, synthesis, and evaluation) was assessed as a percentage of the total 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 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 identified 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. A weighted value of 50 would represent cognitive behaviors only at the synthesis and/or evaluation levels.

The six mean levels of cognitive behavior and the total mean cognitive behavior were compared between agriculture teachers and science teachers. A two-tailed, independent *t*-test was used to compare the six mean levels of cognition and the total mean cognitive behavior between agriculture teachers and science teachers. A *t*-test was used because there were only two groups for comparison and the sample size was small (Myers & Well, 1995). The alpha level was set *a priori* at .05.

Findings

A summated scale questionnaire was administered to all teachers to determine their attitude toward teaching at higher levels of cognition (Table 1). The 50-item instrument 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' total scores ranging from 1 to 3.49 were considered to be an unfavorable attitude toward teaching at higher levels of cognition. Teachers' total scores ranging from 3.50 to 6.00 were considered to be a favorable attitude toward teaching at higher cognitive levels. The mean attitude score for agriculture teachers was found to be 4.21 (*SD* = 0.26). Science teachers' mean score was 4.21 (*SD* = 0.23). A two-tailed independent *t*-test indicated that the attitude scores were not statistically different (t = 0.07) leading to the acceptance of the null hypothesis.

Table 1
Mean Attitude Score for Agriculture and Science Teachers for Teaching Cognition (n = 9)

Content	Mean Attitude	*SD*	Range (min-max)	*t*	*p*
Agriculture	4.21	0.26	3.88-4.62	0.07	0.95
Science	4.21	0.23	3.82-4.44		

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

Knowledge-level behavior was observed 53.3%, 66.9%, and 40.6% of the time, for the three observations in the agriculture classrooms, respectively (Table 2). For observation one, comprehension was present 31.4%, observation two 26.8%, and observation three 25.2%. During observation one, application was present 8.4%, observation two, 2.6%, and for observation three 24.4%. Analysis-level behavior was present 3.2% for observation one, 3.7% for observation two and 9.8% for the final observation. Synthesis and evaluation were not observed during the second and third visits, but were present 0.3% and 3.4% respectively, during the first observation. Lower-order behavior was observed 84.7%, 93.7%, and 65.8% of the time over the three observations.

Table 2
Mean Percentage by Cognitive Level for Classroom Behavior Over the Three Observations

	Agriculture (n = 9)			Science (n = 9)		
	Obs. 1	Obs. 2	Obs. 3	Obs. 1	Obs. 2	Obs. 3
Cognitive Level	*M* %	*M* %	*M* %	*M* %	*M* %	*M* %
Lower-Order	84.73	93.69	65.78	86.38	76.18	87.59
Knowledge	53.33	66.94	40.60	52.17	56.82	60.46
Comprehension	31.40	26.75	25.18	34.21	19.36	27.13
Higher-Order	15.27	6.30	34.22	13.63	23.82	12.41
Application	8.35	2.61	24.44	7.77	11.09	5.23
Analysis	3.17	3.69	9.78	5.35	12.73	4.37
Synthesis	0.33	0.00	0.00	0.51	0.00	2.38
Evaluation	3.42	0.00	0.00	0.00	0.00	0.43

In the science classrooms, the three observations yielded 52.2%, 56.8%, and 60.5 % of knowledge behavior, respectively (Table 2). At the comprehension level, observations resulted in 34.2%, 19.4%, and 27.1% of behavior. Application and analysis-level behavior was observed 7.8% and 5.4% for the first visit, 11.1% and 12.7% for the second, and 5.2% and 4.4% for the final observation. For observation one, synthesis was present 0.5% and 2.4% for the third observation. Synthesis was not present in observation two. The third observation was the only observation in which evaluation was present (0.4%). Lower-order behavior was observed 86.4%, 76.5%, and 87.6% of the time over the three observations.

The percentages for the three observations were totaled by cognitive level. In addition, the mean for each level was weighted as recommended by Miller (1989) on the basis of increasing complexity of Bloom's Taxonomy. For agriculture teachers the knowledge level was observed 52.8% of the time ranging from 44.3% to 86.3%, thus, the resulting cognitive weight was 5.28 (Table 3). With a mean of 29.8%, comprehension had a cognitive weight of 5.95 with a range of 7.8% to 44.7%. Application was observed an average of 10.4% of the time with a range of 0.0% to 20.6%. Application's cognitive weight was 3.10. With a range of 0.0% to 12.9%, analysis resulted in 5.8% of the observations and a cognitive weight of 2.32. The cognitive weight for synthesis was 0.06 with a mean of 0.1% and a range of 0.0% to 1.0%. Evaluation was found to have a mean of 1.2%, a range of 0.0% to 6.4%, and a cognitive weight of 0.60. Lower-order behavior (knowledge and comprehension) was observed 82.5% of the observations. Agriculture teachers were found to have a total cognitive weight of 17.31, indicating instruction between the knowledge and comprehension level.

Table 3
Average 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	0.0-6.35	.50	0.60	17.31

The total cognitive weight for science teachers was 16.78, indicating instruction between the knowledge and comprehension level (Table 4). Knowledge and comprehension were found 57.4% and 27.0% respectively; resulting in lower-order behavior 84.4% of the observations. Knowledge had a range of 45.6% to 69.6% and comprehension 19.2% to 35.8% with cognitive weights of 5.74 and 5.40. With a range of 1.3% to 16.5% application had a mean of 7.0% and a cognitive weight of 2.09. The cognitive weight for analysis was 2.99 from a mean of 7.5% and a range of 0.9% to 23.3%. The mean percentage for synthesis was 1.0% with a range of 0.0% to 8.6%. The cognitive weight for synthesis was 0.48. Evaluation was found to have a mean percentage of 0.2% and a range of 0.0% to 1.4% with a cognitive weight of 0.08.

Table 4
Total Cognitive Behavior by Cognitive Level for Science Teachers (n = 9)

Cognitive Level	*M* %	Cum %	Range (min-max)	Weight Value	Cognitive Weight	Cum Cog Weight
Lower-Order						
Knowledge	57.42	56.48	46.58-69.57	.10	5.74	5.74
Comprehension	27.02	84.44	19.18-35.80	.20	5.40	11.14
Higher-Order						
Application	6.97	91.41	1.30-16.47	.30	2.09	13.23
Analysis	7.47	98.88	0.86-23.29	.40	2.99	16.22
Synthesis	0.96	99.84	0.00-8.64	.50	0.48	16.70
Evaluation	0.16	100.00	0.00-1.43	.50	0.08	16.78

The six levels of cognitive behavior were compared to determine if agriculture and science teachers differed in their cognitive behavior. Two-tailed, independent *t*-tests were used for the comparisons and significance was set *a priori* at .05. Results are displayed in Table 5. When comparing the teachers' behaviors within each of the six levels of Bloom's Taxonomy, no significant ($p < .05$) differences were found by area. At the knowledge and comprehension levels, the *t*-values were 0.92 ($p = .37$) and 0.64 ($p = .53$), respectively. The application and analysis levels were 1.15 ($p = .27$) and 0.58 ($p = .57$), respectively. The *t*-value for the synthesis level was found to be 0.88 ($p = .39$) and evaluation was 1.27 ($p = .24$).

Table 5
A Comparison of the Six Levels of Cognition by Content Area

	Agriculture (n = 9)		Science (n = 9)			
Cognitive Level	*M*	*SD*	*M*	*SD*	*t*	*p*
Knowledge	5.28	1.34	5.74	0.73	0.92	.37
Comprehension	5.95	2.26	5.40	1.19	0.64	.53
Application	3.10	2.16	2.09	1.53	1.15	.27
Analysis	2.32	1.99	2.99	2.81	0.58	.57
Synthesis	0.05	0.16	0.48	1.44	0.88	.39
Evaluation	0.60	1.22	0.08	0.24	1.27	.24

Table 6 summarizes the comparison of teachers' total cognitive behavior. The significance level was set *a priori* at .05. It was found that the total cognitive behavior of agriculture and science teachers was not significantly different. The *t*-test resulted in a value of 0.50 and a *p*-value of .63.

Table 6
A Comparison of Teachers' Total Cognitive Behavior by Teacher Type

Teacher Type	*f*	*M*	*SD*	*t*	*p*
Agriculture	9	17.31	2.12	0.50	.63
Science	9	16.78	2.40		

Conclusions, Implications, and Recommendations

It is concluded from the data that agriculture and science teachers have very similar attitudes toward teaching at higher levels of cognition. It is also concluded that both groups have a favorable attitude toward teaching at higher cognitive levels. The implication of a slightly favorable attitude score is limited variability in the cognitive level of instruction.

Both agriculture and science teachers exhibit lower-order (knowledge and comprehension) teaching behaviors the vast majority of the time (83% and 84%, respectively). This conclusion is consistent with Cano and Metzger (1995) who found secondary horticulture teachers taught at lower-levels of cognition 84% of the time. At the college level, lower-order behavior was found 61% (Ball & Garton, 2005), 98% (Whittington, 1995), and 80% (Whittington, et al. 1997).

It is recommended that secondary agriculture and science teachers increase the cognitive level of instruction. "Only through thinking can you change whatever it is about you life that needs changing. Only through thinking can you take command of you future" (Elder & Paul, 2004, p. 6). Paul and Elder (2004) contend that the instructor must develop activities and assignments that require students to use higher order thinking skills. Agriculture and science should be the vehicle to learn not only content, but also thinking.

Newcomb, McCracken, Warmbrod, and Whittington (2004) stated that material must have meaning. If students are to learn higher-order thinking skills, the students must understand the meaning of the skills. Specifically identifying the skills and their purpose will assist in transferring these skills to other situations and contexts. In addition, students must be aware of their progress. Teachers should not only connect the behavior but also assist the students in understanding their success. Applying the work of Newcomb et al. to cognitive development, it is recommended that teachers reflect and discuss, with students, their higher-level cognitive behavior to assist in the development of students' higher-order thinking skills.

The cognitive weighted behavior of agriculture and science teachers in each of the six levels of cognition, are not different. Additionally, the total cognitive weighted behavior was not different. Therefore it is concluded that agriculture and science teachers are not exhibiting different behavior in Agricultural Science II and Biology. Biology and Agricultural Science II were compared because of the similar biological science content within each course. If cognitive behavior is not different between the two programs, what is the cognitive advantage of having both programs? If agriculture teachers do not utilize the opportunities present within an agriculture program to increase higher-order thinking, the future of agricultural education could be at question.

It is recommended that in-service instruction of higher-level behavior should be developed and conducted. If higher-order thinking is a goal of secondary education, then the development and support of teachers' abilities to develop students should be the goal of teacher preparation programs. This conclusion is supported by Whittington (1998) who found that intervention with professors increased higher-level discourse. Additionally, it has been found that professional development of teachers can influence student performance (Wenglinsky, 2000). Experimental design should be used to further understand what professional development has the most impact on teachers' cognitive behavior. Whittington (1998) studied the effects on intervention on college professors, similar studies should be conducted with high school teachers. Ball and Garton (2005) found that teacher development professors are not modeling higher-level behavior. Additionally, it is recommended that pre-service instructional methods reflect the in-service practices of teaching higher-level behavior to build cognitive behavior and attitude prior to entering teaching.

Johnson, Wardlow, and Franklin (1997) found that hands-on activities did not significantly increase cognitive achievement, however, Wenglinsky (2000) did report a positive relationship. Additionally, Wenglinsky found that students whose teachers had "received professional development in higher-order thinking skills outperformed their peers" (p. 8). Activities such as research papers and cooperative learning groups have also been found to increase higher-order thinking (Herrington & Oliver, 1999; McGregor, 1994). These facts in combination with the findings imply that if teachers are going to help students develop cognitively, they must use different activities and become involved in professional development opportunities.

Many agriculture educators would speculate that teaching and learning are not at their best during the months of March, April, and May, due to the high number of out of school activities (e.g., FFA convention, state and district events, track and golf meets, etc). If cognitive behavior is predominately at lower-levels during spring semester, and very similar between the two disciplines, it could be due to the time of year. A similar study should be conducted during the fall semester which typically includes different activities.

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