COGNITIVE POTENTIAL: HOW DIFFERENT ARE AGRICULTURE STUDENTS?

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Abstract

Given the interest, research, and effort extended to help faculty in colleges of agriculture provide educational discourse at higher cognitive levels over the last few years, one would expect that students enrolled in colleges of agriculture would exhibit higher levels of critical thinking and need for cognition. This study thus aimed to discover if the cognitive potential of students enrolled in colleges of agriculture did in fact differ from students enrolled in other colleges. Findings suggest that students enrolled in agriculture had significantly lower GPA, critical thinking disposition, and need for cognition compared with students not in agriculture. Further research needs to determine how instructors are integrating critical thinking into the classroom, as well as instructors' level of cognition. Recommendations based on the findings include further work to increase college of agriculture students' cognitive abilities to help them be prepared for today's world.

Introduction

Glaser's studies in the 1940s, Facione's research in the 1990s, and the many others over the years who have explored the ideas and philosophical groundings of cognitive processing and critical thinking have all encouraged educators to find ways to engage students in more meaningful, deeper levels of thought. Research on cognition and critical thinking can be found in literature ranging from feminism, humanities, nursing, and business to science and agricultural education. No matter the discipline, the message from the research is the same: Students must be engaged to delve deeper into topics and look critically at knowledge. That message has never been more important than in today's world of information overload, limited resources, and international competition where students must be prepared to employ deeper cognitive processing when faced with ethical, social, economic, and professional issues.

Although the body of knowledge on how to increase student's cognitive abilities is large in breadth, the field of agricultural education, specifically, has focused on furthering cognitive skills in the classrooms of colleges of agriculture for many years. Edgar and colleagues noted in their 10-year look at the *Journal of Agricultural Education* that critical thinking was the sixth most published research topic (Edgar, Edgar, Briers, & Rutherford, 2008). Prolific authors in the field have all chimed in to further our knowledge on how to increase critical thinking skills and dispositions, as well as other variables involved in the cognitive process (Burris & Garton, 2006; Friedel, Irani, Rudd, Gallo, Ricketts, & Eckhardt, 2008; Hedges, 1991; Moore, Rudd, & Penfield, 2002; Myers & Dyer, 2006; Ricketts & Rudd, 2004a, 2004b; Rudd, Baker, & Hoover, 2000; Torres & Cano, 1995). Cognition researchers outside of agricultural education have determined little difference among majors (Broadbear, Jin, & Bierma, 2005). However, it remains

to be seen how much this research has affected students' skills and dispositions in critical thinking and cognition in colleges of agriculture. This study aims to compare students majoring in agriculture with those in non-agriculture disciplines to gauge cognitive impact at four separate universities. With the heavy push by researchers in agricultural education to teach at higher levels, it is important to gauge how well we have progressed in increasing our students' abilities. If students in agriculture are found to be lower, more work may be needed to determine how to further cognitive processing with students in colleges of agriculture.

Theoretical Framework

Critical Thinking

Many different scholars in many different fields define critical thinking in different ways. Facione (1990), who conducted a national Delphi study to ultimately define and frame a concept of critical thinking characterized it as "purposeful, self-regulatory judgment, which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (p. 2). In agricultural education, an often-cited description of critical thinking is the one provided by Rudd et al. (2000). They believed critical thinking was "a reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information, and for which an incontrovertible solution is unlikely" (p. 5).

Just about every academician and every professional with a connection to education would not only claim critical thinking is important, but they would also argue they are indeed critical thinkers themselves. However, critical thinking is not so easily attained. According to VanGelder (2005) and Kuhn (1991), humans are not built with an inborn capacity for being critical. Critical thinking is actually a multi-dimensional concept consisting of skills (i.e., the ability to analyze or make inferences), dispositions (i.e., a tendency to wonder or a character of understanding), and knowledge (i.e., a mastery of pedagogy in agricultural education) (Mason, 2007).

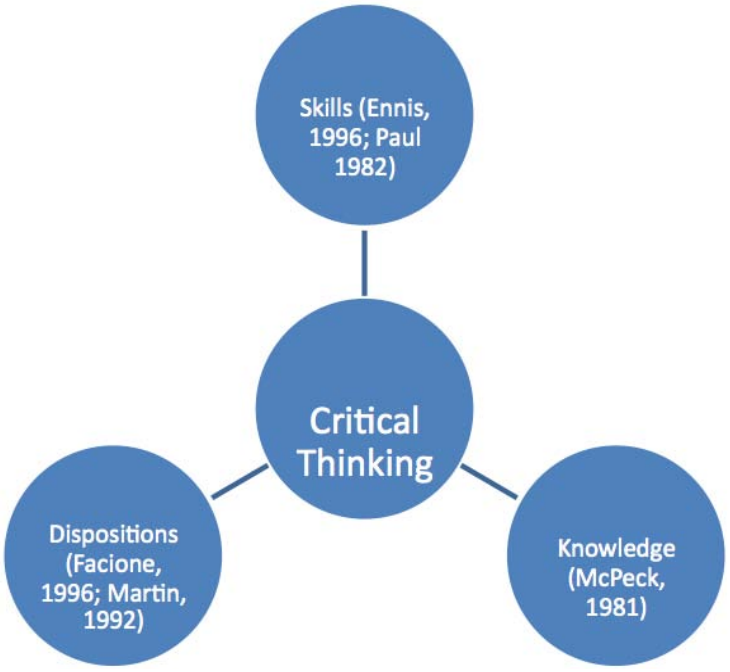

Figure 1. Expert concepts of critical thinking.

Research conducted in agricultural education tends to suggest that the conceptual framework for critical thinking includes skills, dispositions, and knowledge. Conceptually, Facione (1990) agrees that critical thinking includes both skills and dispositions. He believed the requisite critical thinking skills to be interpretation, analysis, evaluation, inference, explanation, and self-regulation. Likewise, he believed that the important critical thinking dispositions were analyticity, self-confidence, inquisitiveness, maturity, open-mindedness, systematicity, and truth seeking. Moore et al. (2002) factor analyzed Facione's disposition suggestions and determined that the respective constructs failed to group together adequately. In response, Irani, Rudd, Gallo, Ricketts, Friedel, and Rhoades (2007) developed a three-component model of critical thinking disposition, which is based on the literature and supported with psychometric analysis: engagement, cognitive maturity, and innovativeness.

It would be hard to argue for a simpler model given the historical and theoretical complexity of critical thinking as an area of study. Consider that critical thinking and its origins date back to Socrates and Plato, Aquinas in the Middle Ages, Bacon and his suggestion for "empirical" study, Descartes and his dictate to discipline the mind, and even to a favorite of many in agricultural education – John Dewey.

> From [Dewey's] work, we have increased our sense of the pragmatic basis of human thought (its instrumental nature), and especially its grounding in actual human purposes, goals, and objectives. From the work of Wittgenstein we have increased our awareness not only of the importance of concepts in human thought, but also of the need to analyze concepts and assess their power and limitations. From the work of Piaget, we have increased our awareness of the egocentric and sociocentric tendencies of human thought and of the special need to develop critical thought, which is able to reason within multiple standpoints, and to be raised to the level of "conscious realization." From the massive contribution of all the "hard" sciences, we have learned the power of information and the importance of gathering information with great care and precision, and with sensitivity to its potential inaccuracy, distortion, or misuse. From the contribution of depth psychology, we have learned how easily the human mind is self-deceived, how easily it unconsciously constructs illusions and delusions, how easily it rationalizes and stereotypes, projects and scapegoats. (Paul, Elder, & Bartell, 2008, p. 19)

Critical thinking has justifiably become an expectant outcome in education. Benefits of heightened critical thinking skill and disposition include improved listening and respect for different ideas, interest in learning, feelings of accomplishment, and nurtured teamwork, communication, and speaking skills (Yang & Chung, 2009). Critical thinking in students is positively and significantly related to leadership development (Ricketts, 2005), grades in school (Burris & Garton, 2006; Ricketts, 2003), and even success in high stakes testing (Williams, Schmidt, Tilliss, Wilkins, & Glasnapp, 2006).

With the seemingly impactful nature of critical thinking, it is reasonable that every educator claims to foster and utilize critical thinking. It would also be helpful if this were the case. In fact, Chang and Yang (2006) conducted a teacher education study and found that teachers need to be proficient users of critical thinking if students are also to adopt the practice.

According to West, Bross, and Snyder (2007), teachers' proficiency paired with student growth is necessary for the development of critical thinking. Do all educators in education insist on active learning or try to incorporate a measure of service learning? Burbach, Matkin, and Fritz (2004) determined that active learning improves critical thinking, and Joseph, Stone, Grantham, Harmancioglu, and Ibrahim (2007) discovered that one of the positive attributes of service learning was improved cognition.

Educators seeking to develop critical thinking have much to consider. They need to make sure they are both infusing critical thinking into the curriculum and that they are overtly teaching thinking strategies (Case, 2005; Friedel et al., 2008. Educators also need to encourage students to concentrate on critical thinking development over the long haul (Bartlett & Cox, 2002). Critical thinking development takes continued focus.

Need for Cognition

However, some areas needed for critical thinking cannot always be taught. Cognition, for example, is something that develops over time based on experiences and environment. Cacioppo and Petty (1982) described cognition as an individual's inclination to think through events holistically, while one's need for cognition (NFC) is their inclination to elaborate on events and think about them as they search for a reality. The NFC has been related to intelligence (Cacioppo & Petty), academic performance, course grades (Leone & Dalton, 1988; Sadowski & Gulgoz, 1996), learning style (Haugtvedt, Petty, & Cacioppo, 1992), and to critical thinking dispositions (Friedel, Rhoades, Ricketts, Stedman, & Irani, 2008). However, it has been found that gender has no effect nor is it related to abstract or verbal reasoning (Cacioppo, Petty, & Morris, 1983).

Need for cognition has been shown to be a tendency that develops through one's experiences and endeavors requiring cognitive thought. Researchers have noted that those who are high in their need for cognition will think more in depth about arguments presented to them and will see weaker arguments as unfavorable (Cacioppo & Petty, 1982; Haugtvedt et al., 1992). Those who are lower in NFC will scrutinize communication less and will tend to avoid anything that requires effortful, cognitive work. Much research has looked at how NFC can change one's attitude, and it has been noted that for those low in NFC, their attitude can change because of a simple cue. Those who are higher in NFC will change their attitude based on the merit of the relevant arguments presented to them (Haugtvedt & Petty, 1992).

A Call for Higher Level of Thinking

Higher order thinking skills, which require students to engage in problem solving and critical thinking processes, have been a research staple in the agricultural education literature over the years. To reiterate, it has been found that students who develop higher levels of cognitive thinking will do better academically. According to Whittington (1995), to foster more cognitive thinking in students, it must be fostered in the instructors. The ability to demonstrate higher levels of thinking and problem solving during class can depend heavily on the instructor. In 1993, Whittington and Newcomb explored the cognitive level teachers in a college of agriculture aspired to teach at and what level they were actually teaching. They noted that although these instructors had positive attitudes toward and aspirations to teach and test at higher levels of cognition, they were not meeting those goals. Many instructors were conducting the course at lower levels of cognition. Researchers concluded that some instructors might not fully understand the long-term effects of using higher-level cognition in the classroom and the changes that must be made to their curriculum to engage students at that level. Whittington echoed the findings in 1995, noting that although instructors wanted to engage students at all levels, they tended to mostly have discourse at a lower level. In fact, instructors in this study conducted discourse at a lower level 98% of the time.

Several studies over the years have noted these concerns and indicated that instructors may feel that they do not have the time or experience needed to rethink lesson plans and assessments to engage students at higher levels of thinking. Researchers have continually encouraged faculty in colleges of agriculture to present workshops and seminars to assist other faculty in learning the techniques needed to reach these higher levels of cognition (Whittington, 1995; Whittington, Stup, Bish, & Allen, 1997; McCormick & Whittington, 2000; Miller & Pilcher, 2001; Ewing, Carnes, & Whittington, 2006). Numerous academicians have heeded this call and presented workshops, seminars, and teaching and learning groups to help colleagues in their

colleges rethink how they prepare and teach courses to hit at these higher levels of thinking. However, it has yet to be researched how effective these calls have been in actually increasing cognitive thinking in students in colleges of agriculture. If college instructors aspire to teach at higher levels of thinking to engage their students, and if they are receiving help in preparing their classes as such, it could be assumed students would be benefiting. It is important to understand how students in colleges of agriculture are faring in terms of their cognitive potential compared with students outside of such colleges. Are they similar, are they better, or are they worse? To continue improving education in colleges of agriculture, we must know the answer.

Research in higher-level thinking has provided evidence that these skills are domain specific (Huitt, 1998). That is, one can exhibit high levels of critical thinking in one domain of knowledge and not be able to transfer those skills to another. This presents a difficulty in consistently measuring cognitive skills of students in colleges of agriculture because the diversity of agriculture incorporates many different domains. However, one can measure students' disposition towards thinking and their desire for thinking outside the context of a knowledge domain (Facione, Giancarlo, Facione, & Gainen, 1995). Further, dispositions and desires for thinking are fostered through the practice of thinking (Tishman & Andrade, 1996).

Given the interest, research, and effort extended to help faculty in colleges of agriculture provide educational discourse at higher cognitive levels, it is important to see how students in colleges of agriculture are exhibiting levels of critical thinking and need for cognition compared with those in other colleges. No current research has compared such groups. The disposition and desire to use higher level thinking skills are necessary for the employment of those skills (Norris, 1994), which suggests that the measurement of these cognitive attitudes provide indication of the potential in learning cognitive skills. Does the cognitive potential of students enrolled in colleges of agriculture differ from students enrolled in other colleges? Many would argue they do, but until now it has yet to be tested.

Purpose

Based on the research in the field of education and agricultural education on the need to further students' cognitive development and skills (Whittington, 1995; Whittington, Stup, Bish, & Allen, 1997; McCormick & Whittington, 2000; Miller & Pilcher, 2001; Ewing et al., 2006), this study aims to discover how far agriculture educators have come in improving our students' disposition to using critical thinking compared with students not majoring in colleges of agriculture. The study also seeks to determine if differences exist between students' need for cognition and grade point average (GPA) among students based on their enrollment in a college of agriculture.

The outlined theoretical framework served as the guiding structure in which the researchers developed the following null hypotheses to be tested:

H_{01} There is no difference in critical thinking disposition between students who are agricultural majors and those who are non-agricultural majors.

H_{02} There is no difference in need for cognition between students who are agricultural majors and those who are non-agricultural majors.

H_{03} There is no difference in grade point averages between students who are agricultural majors and those who are non-agricultural majors.

Methods

This quantitative study sampled participants from four service courses taught in colleges of agriculture at four land grant universities. The researchers selected leadership courses, which traditionally have had students from a variety of majors, academic ability, and class rank. One course was selected at each of the large universities. Each course was offered as an elective for most students enrolled. Direct administration of instrumentation measuring

critical thinking, need for cognition, and selected demographics resulted in 317 respondents. Because of the nonrandom sample, results cannot be generalized past these courses and these universities. However, this study incorporated what was conceptualized as a slice in time (Oliver & Hinkle, 1981) sampling of students. This type of sampling (convenience) has been justified by Gall, Borg, and Gall (1996).

Instrumentation

Two instruments testing cognitive potential were used in the study along with questions on gender, age, major, and GPA. The UF-EMI, a 26-item instrument, gauged student critical thinking disposition through three constructs: engagement, cognitive maturity, and innovativeness (Irani et al., 2007). The combined score of the rating scale (i.e. Likert) instrument can range from 26 points (a low critical thinking disposition) to 130 points (a high critical thinking disposition). Instrument developers report an overall reliability of .92 (Irani et al.). Cronbach's alpha was run post hoc in this study and found an overall reliability of .92. The UF-EMI also asked questions regarding students' demographic information and GPA. Because of university IRB guidelines, actual GPA was not able to be collected, so self-reported GPA was used.

A student's ―tendency to engage and enjoy effortful cognition" was measured with the Need For Cognition Scale (Cacioppo, Petty, & Kao, 1984, p. 306). Cacioppo and colleagues' 18-item instrument utilizes five-point rating scales. An overall summation of items is calculated for the need for cognition score, which has a possible range of 18 points (indicating low NFC) to 90 points (indicating high NFC). Researchers who developed the NFC reported a Cronbach's alpha reliability coefficient of .90 (Cacioppo et al., 1984). In this study, post hoc reliability was calculated and determined as .84.

Data Analysis

Researchers analyzed data with the Statistical Package for the Social Sciences (SPSS). Means and frequencies were calculated on demographic variables including age, gender, GPA, total NFC score, and total EMI score. Because of the exploratory nature researchers used independent sample *t*-tests to test the hypotheses identified by this study.

Results

Selected demographics of the 317-person sample were identified using questions from the UF-EMI. Participants ranged in age from 18 to 35 years with a mode of 21 years. The plurality of the sample was female (56.2%, n = 178). The majority of students in the four courses were seniors (n = 156, 49%), followed by juniors (n = 116, 37%), sophomores (n = 35, 11%), and freshman (n = 10, 3.2%). Only 13% (n = 42) indicated being part of an honors program, and the overall mean GPA for all participants was 3.24. Participants of this study reported being in a variety of 57 majors, which ranged from food science to English. The top number of majors included animal science (n = 33, 10%), construction systems management (n = 29, 9%), and family youth and consumer sciences (n = 23, 7%). Students' academic majors were coded to distinguish whether or not they were affiliated with a college of agriculture at their respective university. Findings indicated that 178 students (56.2%) had majors found in a college of agriculture, whereas 139 students (43.8%) were working toward a degree not related to agriculture. The demographic information gathered on these participants indicated that most of these students were traditional undergraduate students and predominately juniors or seniors.

The first hypothesis proposed in this study was that there was no difference in critical thinking disposition between students majoring in agriculture and students not majoring in agriculture. Critical thinking disposition scores, as measured by the UF-EMI, for this sample of undergraduate students ranged from 48 to 130 with a mean of 100.19 points. A two-tailed independent sample *t*-test was conducted to determine if critical thinking disposition scores differed between students in agricultural academic majors and students not in agricultural academic majors. Levene's Test for Equal Variance was performed to test for equal

variance between the two groups. The results indicated to reject the null hypothesis ($F = 5.43$, $p = .02$) and concluded that these two groups of students were not equal in variance. Therefore, the researchers interpreted the *t*-statistic calculated by SPSS when equal variances are not assumed. A significant difference was found ($t = 3.85$, $p = .00$) among total critical thinking disposition scores between students enrolled in an agricultural academic majors ($M = 97.81$) and non-agricultural academic majors ($M = 103.25$). Considering the difference is approaching a medium effect size (Cohen's $d = .43$) (Cohen, 1977), the null hypothesis was rejected, and it was concluded the two groups are significantly different in their critical thinking skill disposition. That is, students enrolled in a college of agriculture have significantly lower levels of critical thinking disposition than those students not enrolled in a college of agriculture. (Table 1).

Table 1
Differences in Critical Thinking Disposition by College Affiliation

Major	*M*	*SD*	*t*	*df*	*p*	*Cohen's d*
Agriculture majors ($n = 178$)	97.81	13.73	3.85	313.71	.00	.4043
Non-agriculture majors ($n = 139$)	103.25	11.42				
All students ($n = 317$)	100.19	13.03				

Note. Critical thinking disposition was measured by the UF-EMI with 26 items. The possible range for total critical thinking disposition was 26, indicating a low level of critical thinking disposition, to 130, indicating high level of critical thinking disposition.

The second hypothesis identified in this study was that there is no difference in need for cognition between students who are agricultural majors and those who are non-agricultural majors. The NFC scale was used to determine students' need for cognition. For this group of students, scores ranged from 24 to 83 points ($M = 60.44$). To test the second hypothesis, researchers performed a two-tailed *t*-test. Levene's Test for Equal Variance was calculated to determine if the assumption of equal variance between these two groups was met. There was no significant difference ($F = 1.51$, $p = .22$), indicating a failure to reject the null hypothesis and equal variances can be assumed. Results of the *t*-test indicated a significant difference ($t = 2.96$, $p = .00$) between these students who were categorized by either being enrolled in a college of agriculture ($M = 58.99$) or not enrolled in a college of agriculture ($M = 62.29$). These findings provided evidence to reject the second null hypothesis and conclude that among these students, those enrolled in a college of agriculture have significantly lower NFC scores than those not enrolled in a college of agriculture. It should be noted that the difference had a small effect size (Cohen's $d = .34$) (Table 2).

Table 2
Differences in Need for Cognition by College Affiliation

Major	*M*	*SD*	*t*	*df*	*p*	*Cohens's d*
Agriculture majors (*n* = 178)	58.99	10.36	2.96	315	.00	.34
Non-agriculture majors (*n* = 139)	62.29	9.08				
All students (*n* = 317)	60.44	9.95				

Note. Need for cognition was measured by the NFC with 18 items. The possible range for total need for cognition was 18, indicating low need for cognition, to 90, indicating high need for cognition.

The third hypothesis of this study stated that there is no difference in grade point averages between students who are agricultural majors and those who are non-agricultural majors. A self-reported GPA was collected from participating students during test administration of the UF-EMI. Among these students, GPA ranged from 1.9 to 4.0 with a mean of 3.24 on a 4.0 scale. A two-tailed *t*-test was utilized to test this hypothesis. Again, Levene's Test for Equality of Variances was used to determine if equal variances among the two groups' grade point averages could be assumed. The test suggested that there was no significant difference (F = .21, p = .65) and it was concluded to fail to reject the null hypotheses and assume equal variance for these scores. The *t*-test performed to test the third hypothesis in this study indicated a significant difference (t = 3.37, p = .00) in GPA between students enrolled in a college of agriculture (M = 3.16) and students not enrolled in a college of agriculture (M = 3.33) at these four land grant universities. From these findings, it was concluded that participating students enrolled in colleges of agriculture had significantly lower self-reported GPA than students not enrolled in colleges of agriculture (Table 3).

Table 3
Differences in Self-reported GPA by College Affiliation

Major	*M*	*SD*	*t*	*df*	*p*	*Cohens's d*
Agriculture majors (*n* = 178)	3.16	0.44	3.34	315	.00	.39
Non-agriculture majors (*n* = 139)	3.33	0.44				
All students (*n* = 317)	3.24	0.45				

Note. Grade point average was determined as a self-reported average on a 4.0 scale.

Conclusions/Recommendations

Although the study cannot be generalized past these four universities, it is important to note that the students represented a variety of ages, class ranks, and majors in and out of agriculture. This study is limited by the fact that all four universities were large research-one land grants and the courses used were leadership courses. It could be argued that because students selected to take a leadership course, they may be different from their peers. Although students in agriculture were lower in their cognitive abilities, it is also important to note that the overall averages for critical thinking disposition and need for cognition for both groups were not low on the scales and were moderate to high.

However, agriculture majors in this study did score significantly lower on critical thinking dispositions than their non-agriculture major counterparts. Studies have been conducted to determine critical thinking differences between majors within related disciplines (Ricketts, Pringle, & Douglas, 2007; Broadbear et al., 2005), but this is the first known study of its kind to determine critical thinking differences between students majoring in a college of agriculture and those majoring in other fields. Given the strong science underpinnings of many agricultural disciplines and specific attention given to developing critical thinking at the respective universities, it is important students in such majors are given opportunities to foster growth in this area. Research is needed to help understand what experiences and opportunities are offered to students in non-agricultural programs that develop higher cognitive processing. Could the nature of agricultural students staying amongst each other on campuses cause them to not have as broadening experiences as their non-agriculture counterparts?

Research should also be conducted that determines the extent of overt and infused focus on the development of critical thinking in the respective colleges of agriculture. Are faculty incorporating active learning strategies and service learning activities, which are known to develop critical thinking (Burbach et al., 2004; Joseph et al., 2007)? Research should also determine the critical thinking skills and dispositions of faculty members in colleges of agriculture. Chang and Yang (2006), Whittington (1995), and researchers in teacher education would agree—faculty need to be proficient users of critical thinking if students are going to adopt it.

Agriculture majors in this study scored significantly lower on NFC as well. This finding was not surprising when taken with the other findings of this study. Research has shown that NFC is related to academic achievement and critical thinking disposition (Friedel et al., 2008, Leone & Dalton, 1988; Sadowski & Gulgoz, 1996). An individual's need for cognition is developed through experiences, which require them to engage in deeper cognitive thought (Cacioppo & Petty, 1982). It could thus be assumed that if these students had lower NFC, they may have been exposed to fewer situations that require deeper cognition than the non-agriculture students. As with critical thinking needs in the classroom, it is important that we understand how teachers are requiring this deeper thought in their classrooms. Whittington (1995) noted that many instructors feel they are giving their students these experiences, when in reality they are not. It is important that we continue to work with these instructors to ensure they are infusing activities that require critical thinking and deep cognition of the subject. It is also important that we explore the differences in experiences outside the classroom to see how students in agriculture differ from their peers "across campus."

Agriculture majors also had significantly lower GPA than non-agriculture majors. It is improbable that instructors in colleges of agriculture grade harder, or inflate grades less. Rather, it is more feasible that these students are struggling more academically. Granted, a significant amount of science is included in a degree in agriculture, but the majority of the participants were juniors and seniors, so the assumption can be made that the majority of core competencies had been met. Other researchers have noted the relationship between critical thinking and grade point average (Ricketts, 2003; Torres, 1993). Therefore, the finding that agriculture students had lower critical

thinking dispositions and lower GPA, makes sense. However, this ought to be a concern if graduates of colleges of agriculture are to be competitive with non-agriculture majors. Faculty and academic administrators should consider an organized effort to improve critical thinking and need for cognition. This effort should improve the academic success of college of agriculture students.

It is important to note that GPA used were self-reported rather than actual GPA obtained from the students' respective universities. Student self-reported items may be inflated because of students overestimating their performance to be perceived as better, also known as the halo effect. However, research has indicated that the halo effect is constant across students and schools (Pike, 1999). Therefore, if values reported in this study were less than authentic, there was no advantage given to either students enrolled in colleges of agriculture or students not enrolled in colleges of agriculture.

Further research is needed to further explore the cognitive differences between students in colleges of agriculture and those not in colleges of agriculture. Further studies should be conducted at other universities and in other courses to see if findings are similar to this study. Research is also needed to explore if differences exists within majors in colleges of agriculture to see if there are differences between social science students and those in the natural sciences. As indicated earlier, studies must be conducted with instructors in colleges of agriculture to determine their cognitive ability and their level of infusing critical thinking into their courses. Much research has been done in the field of agriculture education to encourage such integration into courses, but it is obvious that more work is still needed, theoretically and practically.

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