

Undergraduate Agriculture Student Critical Thinking Abilities and Anticipated Career Goals: Is There a Relationship?

Rick D. Rudd, University of Florida
Lori L. Moore, University of Florida

Abstract

This study attempted to examine the relationship between College of Agricultural and Life Sciences student critical thinking disposition and career choice. The researchers measured critical thinking disposition using the California Critical Thinking Disposition Inventory (Facione, Facione, & Giancarlo, 1996). Demographic data were collected with a researcher-developed instrument. The demographic instrument contained variables identified in similar research conducted with University of Florida's College of Agricultural and Life Sciences students (Rudd, Baker, & Hoover, 1998). A panel of experts in the Department of Agricultural Education and Communication at the University of Florida validated the instrument.

Students in six classes in the spring semester of 2001 were selected for this study. Courses were chosen to specifically focus on students enrolled in the College of Agricultural and Life Sciences. Specific courses chosen for the study were AEB 3341 - Selling Strategically, AEB 3300 - Agricultural and Food Marketing, HUNN 2201 HNRS - Honors Fundamentals of Human Nutrition, HUN 2201 - Fundamentals of Human Nutrition, PLS 3221 - Plant Propagation, and ORH 4804C - Annual and Perennial Gardening.

The study did not find a significant relationship between career choice and critical thinking disposition. It did find a conflict in student disposition by gender with an earlier study.

Introduction and Theoretical Framework

Colleges of Agriculture around the country are constantly changing. New technologies and information have spawned the development of many new majors and career choices for College of Agriculture, Natural Resources, and Life Sciences students across the country. How does this influx of information, and technology coupled with the teaching and learning environment in universities impact student career choice?

There have been a number of scholars in agricultural education attempting to examine factors related to students' career choice. Some are investigating student performance, academic history, certification history, and participation in youth leadership activities as factors that influence a student's career choice. However, no scholars in the field of agriculture have looked at the relationship between a student's disposition toward critical thinking and their anticipated career choice. This study attempted to define students not only in terms of their career goals and their disposition towards critical thinking, but to also look for connections between the two.

Critical Thinking

Attempts to measure, define, and develop critical thinking in educational, psychological, and philosophical circles are goals across disciplines in higher education today. Since the early efforts of Dewey (1933) to teach students to be purposeful in thinking while examining multiple perspectives and consider consequences, teachers have been struggling with teaching students to think in and about their discipline.

According to Ennis (1987) critical thinking is reasonable and reflective thinking focused on deciding what to believe or do. Halpern (1996) defined critical thinking as "...the use of cognitive skills or strategies that increase the probability of a desirable outcome" (p. 5). Other definitions include: the formation of logical inferences (Simon & Kaplan, 1989), developing careful and logical reasoning (Stahl & Stahl, 1991), deciding what action to take or what to believe through reasonable reflective thinking (Ennis, 1991) and purposeful determination of whether to accept, reject, or suspend judgement (Moore & Parker, 1994). In a comprehensive attempt to define critical thinking, Pascarella and Terenzini (1991) compiled the following, "...critical thinking has been defined and measured in a number of ways, but typically involves the individual's ability to do some or all of the following: identify central issues and assumptions in an argument, recognize important relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority" (p. 118).

Significant progress toward a definition of critical thinking was achieved when a group of leading researchers in critical thinking were asked to define critical thinking through a Delphi study in 1990 (Facione). The Delphi group hypothesized that there is a set of intellectual virtues or habits of mind that reflect one's disposition to think critically. These virtues are identified below in the Delphi consensus statement (p. 2):

"The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making

judgements, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit.”

In a closely related definition, Burden and Byrd (1994) categorized critical thinking as a higher-order thinking activity that requires a set of cognitive skills. In a 1987 comprehensive review of existing literature, Beyer posited that critical thinking requires a set of skills and approaches to be effective. Beyer's (1987) critical thinking skills include:

1. Distinguishing between verifiable facts and value claims
2. Distinguishing relevant from irrelevant information, claims, and reasons
3. Determining factual accuracy of a statement
4. Determining credibility of a source
5. Identifying ambiguous claims or arguments
6. Identifying unstated assumptions
7. Detecting bias
8. Identifying logical fallacies
9. Recognizing logical inconsistencies in a line of reasoning
10. Determining the strength of an argument or claim

In an effort to clarify the process of critical thinking, Paul (1995) wrote that critical thinking is a unique and purposeful form of thinking that is practiced systematically and purposefully. The thinker imposes standards and criteria on the thinking process and uses them to construct thinking.

Critical thinking skills in colleges of agriculture have not been widely studied. Torres & Cano (1995) found a moderately positive relationship between a student's ability to think critically (as determined by the Developing Cognitive Abilities Test) and the student's learning style. Torres and Cano proposed a conceptual framework for addressing cognitive ability, however a working definition of critical thinking was not addressed. Whittington, Stup, Bish, and Allen (1997) conducted further inquiry in agricultural education related to critical thinking. In their attempt to address cognitive discourse provided by professors, the researchers attempted to equate critical thinking with levels of cognition. In a college-wide study at the University of Florida, Rudd, Baker, & Hoover (2000) found that about one-fourth of College of Agriculture and Life Sciences students possessed low critical thinking dispositions while only two-percent possessed high critical thinking dispositions. The researchers also found that women were significantly higher in their overall critical thinking ability, intellectual maturity, truth seeking, and open mindedness.

Although thinking critically utilizes higher-order thinking, critical thinking and higher-order thinking are not equivalent terms. Critical thinking is not a "catch-all" category for higher-order thinking. It is one of a family of closely related forms of higher-order thinking. Other forms include problem solving, creative thinking, and decision-making (Facione, 1990).

In their college-wide study, Rudd, Baker, and Hoover (2000) defined critical thinking as:

"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).

This definition of critical thinking was used for the purposes of this study.

The California Critical Thinking Disposition Inventory (CCTDI)

The CCTDI consists of seven sub-scales or constructs and an overall CCTDI total Score. The recommended cut score for each scale or construct is 40 and the suggested target score is 50. All scores range up to 60. Persons who score below 40 on a given scale are weak in that critical thinking dispositional aspect, persons who score above 50 on a scale are strong in that dispositional aspect.

Level of education appears to be a significant variable in determining CCTDI score. Preliminary research comparing undergraduate students with graduate students indicates that across all scores the graduate students show a marked increase. For example, 60% of the undergraduates scored below the Truth-Seeking construct scale of 40, where only 26% of the graduates scored below 40 (Facione, Sanchez, Facione, 1994). Comparisons between undergraduates (e.g. freshmen vs. seniors) have not been made in colleges of agriculture.

In recording a 50, a person is demonstrating consistent strength in that dispositional aspect. Inversely, scoring below 40 indicates that, on average, the person responds in opposition to the critical thinking dispositional aspect measured by a given scale.

Just as scores of less than 40 shows weakness, an overall CCTDI score of less than 280 shows serious overall deficiency in the disposition toward critical thinking. An overall score of 350 or more is a solid indication of across-the-board strength in the disposition toward critical thinking. However, an overall score of 350 is rare. People tend to have both strengths and weaknesses. Facione et. al. (1994) found that 6% of undergraduate students scored 350 or higher, indicating a high disposition for critical thinking. Over 22% of the undergraduate students scored below 280, characterizing them as deficient in critical thinking disposition. The following descriptions of the CCTDI constructs are from the CCTDI test manual (Facione, Facione, & Giancarlo, 1996)

Analyticity is a construct consisting of 11 items from the CCTDI. This construct targets the disposition of being alert to potentially problematic situations, anticipating possible results or consequences, and prizes the application of reason and the use of evidence even if the problem at hand turns out to be challenging or difficult. The analytically inclined person is alert to potential difficulties, either conceptual or behavior, and consistently looks to anticipatory intervention, reason giving, and fact-finding as effective ways to resolve matters.

Self-confidence is a construct consisting of nine items from the CCTDI. This construct refers to the level of trust one places in one's own reasoning process.

Critically thinking self-confident persons trust themselves to make good judgements and believe that others trust them as well, since they believe that others look to them to resolve problems, decide what to do, and bring reasonable closure to inquiry.

Inquisitiveness is a construct consisting of 10 items from the CCTDI. The inquisitive person is one who values being well-informed, wants to know how things work, and values learning even if the immediate payoff is not directly evident.

Maturity is a construct consisting of 10 items from the CCTDI. The maturity scale addresses cognitive maturity and epistemic development. CCTDI scoring gives preference to those disposed to approach problems, inquiry, and decision making with a sense that some problems are ill-structured, some situations admit of more than one plausible option, and many times judgments based on standards, contexts, and evidence which precludes certainty must be made.

Open-mindedness is a construct consisting of 12 items from the CCTDI. This construct targets the disposition of being open-minded and tolerant of divergent views with sensitivity to the possibility of one's own bias. The open-minded person respects the rights of others to holding differing opinions.

Systematicity is a construct consisting of 11 items from the CCTDI, targeting the disposition to being organized, orderly, focused, and diligent in inquiry. No particular kind of organization, e.g. linear or nonlinear, is given priority on the CCTDI. The systematic person strives to approach specific issues, questions or problems in an orderly, focused, and diligent way, however that might be accomplished.

Truth-seeking is a construct consisting of 12 items from the CCTDI, representative of those eager to seek the truth, who are courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's interests or one's preconceived opinions. The truth-seeker would rather pursue the truth than win the argument.

Total Score is a measure consisting of the 75 items from the CCTDI.

The CCTDI is used extensively in military science, law enforcement, allied health, engineering, and business (Facione, Facione, & Giancarlo, 1996). The researchers did not find evidence of CCTDI use in colleges of agriculture. Since the instrument had been used with populations of college students in other science-based majors the instrument was deemed appropriate by the researchers for the purpose of identifying agriculture students' disposition to think critically.

Career Choice

Studies have been conducted in agricultural education in an effort to identify factors that influence an individual's career choice. Fraze and Briers (1986) examined the relationship between a student's career choice and their level of participation in FFA activities. However, in terms of career choice, their study was limited to whether or not the student entered or did not enter agricultural occupations. Their study found that students who actively participated in FFA activities were more likely to enter into agricultural professions than those who had low levels of participation. Their study also showed that students who actively participated in a variety of FFA activities were more likely to enter choice agricultural careers than those who participated actively in one FFA activity.

Baker and Hedges (1991) conducted a study to determine what influence factors such as academic history in the professional education portion of their agricultural education program, cumulative grade point average, and certification history had on graduates' career choices. In their study, the authors defined career choice in terms of whether or not a graduate entered the teaching profession. Their study showed that those who entered the teaching profession were significantly different in terms of their certification status and the grade they received in their student teaching.

Each of these studies attempted to identify factors that influence career choice decisions, but none went beyond looking at students' previous experiences. Studies have been conducted in other fields to address the influence of the disposition a student possesses to think critically on their career choice. Walsh (1996) conducted a study comparing practice and non-practice disciplines. She categorized students' career choices in the field of nursing, education, and business as practice disciplines while students choosing careers in English, history, and psychology were classified as non-practice disciplines. This study showed differences among majors in five of the seven constructs of the CCTDI: Truth-seeking, Open-mindedness, Confidence, Inquisitiveness, and Maturity.

According to Facione, Sanchez, Facione, & Gainen (1995), "the seven CCTDI dispositional scales are discipline neutral, yet each can be readily interpreted within the liberal arts and sciences as well as professional disciplines" (p. 6). The findings of the Walsh study support this assertion. A student's disposition towards critical thinking may therefore influence his or her decision on a career. There has been no research conducted that tries to examine the relationship between these two variables for students enrolled in a College of Agriculture.

Purpose and Objectives

Are there relationships between how a student thinks and the career field they choose? Are students with high dispositions for critical thinking more likely to choose one career over another?

Attempts to understand students in higher education programs in colleges of agriculture have been limited in breadth and depth. Although much knowledge exists about career choices

of agricultural students', little has been done to examine the relationship that this choice has with other student characteristics beyond demographics. The overall purpose of this study was to explore the relationship between career choice and student disposition toward critical thinking.

The specific objectives of this study were to:

1. determine student gender and anticipated career goal,
2. determine student disposition toward critical thinking,
3. examine the relationship between student gender, anticipated career goal, and critical thinking disposition.

Methods

Students in six classes in the spring semester of 2001 were selected for this study. Courses were chosen to specifically focus on students enrolled in the College of Agricultural and Life Sciences. Specific courses chosen for the study were AEB 3341 - Selling Strategically, AEB 3300 - Agricultural and Food Marketing, HUNN 2201 HNRS - Honors Fundamentals of Human Nutrition, HUN 2201 - Fundamentals of Human Nutrition, PLS 3221 - Plant Propagation, and ORH 4804C - Annual and Perennial Gardening.

Demographic data were collected with a researcher-developed instrument. The demographic instrument contained variables identified in similar research conducted with University of Florida's College of Agricultural and Life Sciences students (Rudd, Baker, & Hoover, 1998). A panel of experts in the Department of Agricultural Education and Communication at the University of Florida validated the instrument.

Critical thinking disposition data were collected using the CCTDI (Facione, Facione, & Giancarlo, 1996). The California Critical Thinking Disposition Inventory (CCTDI) consists of 75 Likert-type questions that represent seven critical thinking constructs. The developers report an overall reliability (Chronbach's α) of .90 and scale reliability scores from .72 - .80. Total scores range from 75-450.

This study is limited in that the sample is not random and the results can only be used to describe the students who participated in the study.

Results/Findings

A total of 344 students participated in the study. The average age of the participants was 21.82 years ($S D = 4.87$). The sample included 196 (57.6%) females and 144 (42.4%) males (four students did not report their gender). A total of 17 anticipated career choices were included.

The mean total score of the CCTDI for the sample was 293.31. Scores ranged from a low of 220 to a high score of 387. Six students (1.74%) were classified as holding a strong disposition for critical thinking with scores of 350 or higher. There were 115 (33.43%) students

who scored in the weak disposition for critical thinking range (below 280). Males scored an average of 294.22 while females scored 292.75.

There was no significant difference ($p=.62$) between males and females in the total CCTDI score. However, gender differences were significant in four of the CCTDI constructs. Males scored significantly higher than females in the truth seeking, inquisitiveness, and maturity constructs while females score significantly higher than males in the open mindedness construct (Table 1).

Table 1.
CCTDI Total and Construct Scores for Selected College of Agriculture and Life Sciences Students (n=340).

Construct	Sample Mean	Male Mean	Female Mean	F-Value	Probability
Truth-seeking	36.69	37.51	36.09	5.050	.025
Open-mindedness	41.54	40.59	42.24	8.873	.003
Analyticity	45.14	45.36	44.97	.336	.562
Systematicity	40.81	40.53	41.02	.533	.466
Self-confidence	43.33	42.76	43.74	2.061	.152
Inquisitiveness	42.19	43.02	41.58	4.682	.031
Maturity	43.46	44.24	42.89	4.424	.036
Total	293.37	294.22	292.75	.248	.619

There were a total of 17 career choice responses on the demographic instrument. Responses were categorized as either bench or social science careers. Respondents who provided no answer, other, or undecided as a response were classified as such. CCTDI means for career choice classification varied from a low of 289.06 (n=108) for those students who provided no response to the career choice classification to a high of 302.10 (n=20) for those students who answered 'other' to the career choice classification question (Table 2). Students whose career choice that could be classified as a social science had a mean CCTDI score of 291.40 while those whose career choice could be classified as a bench science had a mean score of 297.51.

There was no significant difference ($p=.10$) in the mean CCTDI score of the bench science and social science career classifications. Comparisons of critical thinking total scores and construct scores between bench and social science career classifications revealed a significant difference in the open-mindedness construct ($p<.00$) and the self-confidence construct ($p=.04$) (Table 3). Respondents in the social science classification (n=87) had a mean open-mindedness construct score of 40.18 and respondents in the bench science classification (n=117) had a mean construct score of 42.65. Respondents in the social science classification had a mean self-confidence construct score of 42.55 and respondents in the bench science classification had a mean construct score of 44.35.

Table 2.

CCTDI Means by Career Choice Classification for Selected College of Agricultural and Life Sciences Students (n=344).

Career Classification	n	% of Sample	Mean CCTDI Score	SD
Bench Science	117	34.0	297.51	27.59
Social Science	87	25.3	291.40	24.67
Other	20	5.8	302.10	23.38
Undecided	12	3.5	289.67	37.14
No Response	108	31.4	289.06	26.94
Total	344	100.0	293.31	26.99

Table 3.

CCTDI Construct Means by Social and Bench Science Career Choice Classification (n=344).

Construct	Bench Science Mean	Social Science Mean	Significance
Truth-seeking	36.92	36.61	.69
Open-mindedness	42.65	40.18	.00
Analyticity	46.15	44.66	.07
Systematicity	41.65	40.80	.34
Self-confidence	44.35	42.55	.04
Inquisitiveness	42.34	42.20	.87
Maturity	43.44	44.28	.29

Conclusions

This population of students in the College of Agricultural and Life Sciences at the University averaged 22 years of age and consisted of slightly more females (57.6%) than males. Students in the sample represented 17 different career choice responses.

The total CCTDI scores indicated that 1.74% of the students in this sample had a strong disposition for critical thinking and 33.43% had a weak disposition for critical thinking. These results are consistent with those of Rudd, Baker, & Hoover (2000). In their study, 1.7% of participants had a strong disposition for critical thinking and 30.5% had a weak disposition for critical thinking.

The CCTDI revealed that the students surveyed scored below 50 in all construct areas indicating that, as a whole, these students do not possess a strong disposition toward critical thinking in any construct. This conclusion is consistent with that of Rudd, Baker, & Hoover (2000). Students scored above 40 in six of the seven construct areas (open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity). One construct, truth-seeking, was identified as having "weak" critical thinking disposition aspects with students scoring below 40 points in that construct. Rudd, Baker, & Hoover also found students to exhibit "weak" critical thinking dispositions in the area of truth-seeking.

There are significant gender differences in critical thinking disposition with males having a greater disposition to think critically within the constructs of truth-seeking, inquisitiveness, and maturity and females having a greater disposition to think critically within the construct of open-mindedness. There were no significant differences between males and females in the CCTDI total score. These findings do not support the findings of Rudd, Baker, and Hoover (2000) who found that females have a greater disposition to think critically as judged by the CCTDI total score and the constructs of truth-seeking, open-mindedness, and maturity.

Students choosing bench science careers scored higher than students choosing social science careers in total score and were significantly higher in the constructs of open-mindedness and self-confidence.

Implications and Recommendations

Although there were some differences noted, the practical differences between the two populations were minor. This set of participants does not indicate any significant ties between career choice and critical thinking disposition other than the finding of significant difference in open-mindedness and self-confidence. Perhaps the education and experience of those students seeking a bench science career would provide them with superior preparation for considering other points of view before making decisions.

The conflicting gender finding suggests the need for additional research to be conducted examining the relationship between gender and critical thinking dispositions of students in colleges of agriculture. Because the findings of the current study both support and conflict with the findings of previous research in agricultural education (Rudd, Baker, & Hoover, 2000), the validity of the CCTDI for use with college of agriculture students should be questioned. Additional research is needed to investigate the scale reliability of the CCTDI for use with college of agriculture students.

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