

UNDERGRADUATE AGRICULTURE STUDENT LEARNING STYLES AND CRITICAL THINKING ABILITIES: IS THERE A RELATIONSHIP?

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Abstract

Much work has been done with students in colleges of agriculture across the country to assess learning styles. Although this work has been an important point of departure for further research, very little research has been conducted outside of describing various populations of students. This study attempted to examine the presence or absence of relationships between student learning styles and student critical thinking dispositions. Preparing students to think critically is a goal of many professionals in higher education. Critical thinking is also a quality sought by employers of college graduates. If relationships exist between a student's learning style and the disposition to think critically, college faculty may be able to facilitate the development of critical thinking skills in students by utilizing this information.

Although the researchers identified significant differences in critical thinking disposition between males and females, there were no significant differences between field independent and field dependent learners. Many of the students in the sample studied had a low disposition for critical thinking (30.5%) while 1.7% of the students studied possessed a high disposition toward critical thinking.

Introduction and Theoretical Framework

Our world is constantly changing. Information on the cutting edge of our discipline just five years ago is likely outdated today. The generation of new information is also accelerating at an alarming rate. The world is solidly entrenched in the information age. How does this influx of information coupled with the teaching and learning environment in universities impact student learning in higher education?

There have been a number of scholars in agricultural education attempting to examine teaching and learning in colleges of agriculture. Some scholars are investigating student performance, preferences for learning, course offerings and degree programs. Other characteristics, such as the student's preferred learning style, level of cognition, and critical thinking ability are also being studied. Although

inquiry into these areas is laudable, few scholars have attempted to "make connections" between areas of inquiry or to draw inferences that can be utilized by faculty members in college classrooms. Knowing that students possess different learning styles is certainly a point of departure for becoming a better teacher. This study attempted to go beyond defining our students as to their preferred learning style to look for connections between learning style, and critical thinking disposition and to begin a search for a functional definition of critical thinking.

Learning styles

The success of education hinges on the adaptation of teaching to the learning differences among the students (Snow & Yallow, 1982). Learning styles of students are often studied at four levels: personality, information processing, social interaction, and instructional methods

(Claxton & Murrell, 1987). Kirby (1979) speculated that several models basically describe two orientations to learning: “splitters,” who tend to be analytical and logical, breaking complex issues into manageable parts, and “lumpers,” who learn through identifying relationships and patterns between parts. Dunn and Dunn (1993) placed learners into analytical and global categories. Analytical learners preferred formal situations with few distractions, while global learners preferred a less formal environment and could work on several tasks at once.

Witkin (1976) identified learners by their ability to deal with “fields,” either independently or as a whole. The fields Witkin used were simple figures embedded in complex figures. By ascertaining an individual’s ability to locate a simple figure within an organized, complex figure, Witkin claimed that learning style could be classified as either field dependent or field independent. Witkin’s (1976) field-dependent learners appear to be aligned with Kirby’s (1979) “lumpers” and the global thinkers identified by Dunn and Dunn (1993), while the field-independent learners seem to be identified with “splitters” (Kirby, 1979) and analytical learners (Dunn & Dunn, 1993).

Field-dependent learners tend to be more social, have a more global perspective, and learn more effectively in a non-formal environment than field-independent learners. Field-independent learners are better able to discern individual components and learn well in formalized settings. Learning style goes beyond cognition into the psychological realm of learning (Witkin, 1976). Witkin also noted in a review of literature that there seemed to be a relationship between careers selected by individuals and their learning style. He found that field-independent learners tended to be attracted to careers that required the use of their analytical skills (mathematics, engineering, biological sciences), whereas field-dependent learners preferred careers that required interpersonal skills (social sciences, elementary

school teaching, management).

Several instruments have been developed and used to assess individual learning styles (Claxton & Murrell, 1987; Cox & Sproles, 1988). The Group Embedded Figures Test (GEFT) has been widely utilized in agricultural education to measure learning style (Baker, et al, 1996; Cano, Garton & Raven, 1992a; Cano, et al, 1992b; Cano, et al, 1991; Cano & Metzger, 1995; Raven, et al, 1995; Torres & Cano, 1995) and was selected by the researchers as the instrument for this study. The GEFT is designed to determine learning style by assessing the ability of a person to locate simple figures within complex figures. The ability to locate such figures is one characteristic of field-independent learners.

Critical Thinking

Critical thinking is a common “buzz phrase” in educational, psychological and philosophical circles today. Much work has been completed in the name of critical thinking in education to date that not only leaves one wondering how it is measured, but also leaves one without a cognizant definition of critical thinking. Part of this ambiguity lies in the existence of multiple definitions for critical thinking.

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).

Some progress toward a workable 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:

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. (p.2)

In a closely related definition, Burden and Byrd (1994) categorize 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. Although there is a clear relationship between the two, many would argue that the concepts are separate and unique.

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).

For the purpose of this study the authors posit the following definition of critical thinking: Critical thinking is 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.

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 prizing 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 9 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 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.

Purpose And Objectives

Are there relationships between the way a student learns and how a student thinks? Is student success in an academic setting related to their ability to think critically in and about the subject? Does a student's learning style influence the ability of a student to think critically?

Attempts to understand students in higher education programs in colleges of agriculture have been limited in breadth and depth. Although a wealth of knowledge exists about learning styles of agricultural students', little has been done to examine the relationship that learning style has with other student characteristics beyond demographics. The overall purpose of this study was to explore the relationship between learning style, and student disposition toward critical thinking.

The specific objectives of this study were to:

1. determine selected student demographic information
2. determine student disposition toward critical thinking
3. determine student learning styles, and
4. compare student learning styles, student disposition toward critical thinking, and selected student demographic information.

Methods

Students in four classes in the spring, summer, and fall semesters of 1998 were selected for this study. Courses were chosen to specifically focus on students enrolled in the College of Agriculture and Life Sciences. The Effective Oral Communication class (AEE 3030) was selected to represent a broad base of students for comparison. Since AEE 3030 (or an equivalent oral communication course) is a college requirement, students from multiple majors enroll in the course. The number of social science students in AEE 3030 was not sufficient to make comparisons between social and biological science agriculture majors. To ensure a mix of social science and biological science students, the researchers also collected data from three courses that had a majority enrollment of social science agriculture majors. The classes selected were, AEE 4500 (Program Planning and Development AEE 3200 (Methods of Teaching Agriculture) and AEE 4504 (Curriculum and Program Planning).

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 Agriculture 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.

The GEFT differentiates between field dependent and field independent students with a series of simple figures concealed within 18 complex figures. The national average for the GEFT is 11.4 (Witkin, Oltman,, Raskin, & Karp, 1971) out of a possible score of 18. For the purpose of this study, individuals and groups scoring the national average and above were classified as "field independent," while those scoring below the national average were classified as "field dependent."

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 174 students participated in the study. The average age of the participants was 22 years (**SD** = 2.9). The sample included 110 (65%) females and 60 (35%) males (eight students did not report their gender). A total of 20 majors were represented in the sample.

The mean total score of the CCTDI for the sample was 294.8. Scores ranged from a low of 219 to a high score of 379. Three students (1.7%) were classified as holding a strong disposition for critical thinking with scores of 350 or higher. There were 53 (30.5%) students who scored in the weak disposition for critical thinking range (below

280). Males scored an average of 288.1 while females scored 297.8. This gender difference was significant ($\alpha = .03$). Gender differences were significant in three of the CCTDI constructs with females scoring significantly higher than males in the truth seeking, maturity, and open mindedness constructs (Table 1).

CCTDI Means of College of Agriculture and Life Sciences majors varied from a low of 27.17 for Agricultural Education and Communication students ($n=14$) to a high of 31.7 (n=9) for Microbiology and Cell Science students (Table 2). The Group Embedded Figures Test classified 45 students as field dependent learners and 91 as field independent learners (42 students chose not to complete the GEFT). Males scored an average of 13.44 on the GEFT while females scored 12.52 (overall average = 12.88). The gender difference in GEFT scores was not significantly different ($\alpha = .23$) (see Table 3). Social science students ($n=62$) scored 12.57 while biological science students ($n=30$) scored 13.53. The difference in scores was not statistically significant ($\alpha = .37$).

Comparisons of critical thinking total scores and construct scores with Field Dependent and Field Independent learners revealed no significant differences. Field dependent students ($n=45$) scored an average of 292.54 while field independent students ($n=91$) posted a mean score of 296 ($n=91$) of the CCTDI. There were no significant differences between majors or between social science and biological science students in either the GEFT or the CCTDI. Age was not a significant variable in GEFT or CCTDI score.

Conclusions

This population of students in the College of Agriculture at the University averaged 22 years of age were predominantly female (65%) (the College of Agriculture at the University of Florida has a current enrollment of 55% female and 45%

male). Students in the sample represented 20 different majors.

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. Students scored above 40 in five of the seven construct areas (open-mindedness, analyticity, systematicity, self-confidence, and inquisitiveness). Two constructs, intellectual maturity and truth-seeking, were identified as "weak" critical thinking disposition aspects with students scoring below 40 points.

Students were mostly field independent in their learning style (67%). This finding differs slightly with previous work done by Rudd, Baker, and Hoover (1998) who found that 57.8% of their sample of students in the University of Florida College of Agriculture were field independent. The absence of gender differences in GEFT scores is consistent with Rudd et. al. (1998).

There are significant gender differences in critical thinking disposition with females having a greater disposition to think critically as judged by the CCTDI total score and the constructs of truth-seeking, open-mindedness, and maturity. Although there was a small difference in male and female GEFT scores, no significant difference was found.

When compared to baseline data for undergraduate students compiled by Facione et. al. (1996), there were three times fewer students with a high disposition and 50% more students with a low disposition toward critical thinking. There are no correlations between CCTDI total score or critical thinking constructs and learning style. The results of this limited sample also show that there are few differences that exist in critical thinking disposition or learning style between college majors. Age does not appear to have a bearing on ones disposition toward critical thinking.

Table 1. CCTDI Total and Construct Scores for Selected College of Agriculture Students (N=174)

Construct	Population <u>M</u>	Male <u>M</u>	Female <u>M</u>	<u>F</u> -value	Probability
Truth	36.1	34.95	36.76	-2.00	.05
Open Mind	43.8	40.65	43.97	-3.03	.00
Analytical	43.6	43.81	43.46	.41	.68
Systematicity	39.8	39.48	39.89	▪ .35	.73
Self-Confidence	42.4	42.33	42.26	.07	.94
Inquisitiveness	45.1	44.75	45.57	▪ .83	.41
Maturity	44.0	42.08	45.16	-3.55	.00
Total	294.8	288.1	297.8	-2.19	.03

Table 2. CCTDI Means by College Major^a for Selected College of Agriculture Students (N=150)^b

Major	<u>n</u>	% of Sample	CCTDI Score <u>M</u>	<u>SD</u>
Agricultural Education and Communication	14	9.33	271.71	34.18
Agricultural Operations Management	5	3.33	296.00	34.87
Animal Science	13	8.70	297.62	29.00
Food and Resource Economics	9	6.00	294.22	28.90
Human Resource Development	55	36.67	294.22	25.96
Microbiology	9	6.00	317.00	16.00
Nutrition and Dietetics	15	10.00	294.40	25.35
Other majors	30	20.00	295.20	28.95

^aMajors represented by 5 or more students. ^b24 students did not report a major

Table 3. GEFT Scores by Gender for Selected College of Agriculture Students (N= 136)

	Total	Female	Male
GEFT Score	12.88	12.52	13.44
SD	4.53	4.53	4.54

^a38 students did not complete the GEFT

Implications

- The reader is cautioned not to apply the results of this study beyond the limited sample studied.
- This information should be shared with faculty to facilitate instruction in the college. Many of the students studied (30.5%) have a low disposition to think critically and only 1.7% have a high disposition for critical thinking. If this is true the college desperately needs to design instruction to better develop critical thinking skills in our students.
- Gender is a significant variable in a student's disposition to think critically in this sample. Why does this difference exist? More research is warranted to identify variables that can account for these differences.
- It is important to recognize the absence of a relationship between critical thinking disposition and learning style so that learning style is not associated with the ability of these students to think critically.
- Although one would expect older, more advanced students to have better developed critical thinking skills than younger, less experienced students, there appears to be no connection between age and the disposition to think critically. Is this a function of chronological age or the environment in which students are learning? If the disposition to think critically can be developed over time, is the University of Florida and the College of Agriculture doing its part to develop this skill? Given this baseline data, more research is warranted with agriculture students at the University of Florida and others in colleges of agriculture to examine the degree to which students are disposed to critical thinking.
- More research is needed to determine if interventions such as course design, instructional methodology, and teaching students specific

critical thinking skills can improve student disposition toward critical thinking,

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