

**A Look across Four Years at the Disposition toward Critical Thinking
Among Undergraduate Students¹**

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Abstract

This article examines the critical thinking (CT) dispositions, as measured by the California Critical Thinking Disposition Inventory, of students at a four-year, private, liberal arts, comprehensive university. This paper follows up results first published in 1995. The present findings represent another snapshot of CT dispositions among students who participated in 1996 and during the original investigation in 1992. Longitudinal results about students tested as freshman in 1992 and again as seniors in 1996 are presented. Cross sectional results are reported as well. Questions explored include the relationship between the disposition toward critical thinking, as measured by the CCTDI, and students' major, gender, class level, and grade point average.

¹ Published in The Journal of General Education, (2001). Volume 50, number 1. Pp 29-55.

A Four Year Look at the Disposition toward Critical Thinking Among Undergraduate Students

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Teaching for thinking has always been central to the very concept of a liberal education. The liberally educated person is one who has learned how to draw together knowledge from many different disciplines and makes good judgments about what to believe or what to do. That person who is so well educated that she or he is able to think for him or herself is the person whose mind has been liberated. They are free to think, not just in the sense of having been given permission, but also in the fuller sense of having been given the skills and the deep desire to do so (Schneider & Shoenberg, 1998).

The emphasis on thinking reflected in current approaches to education can be traced back to the philosopher John Dewey who wrote on the centrality of reflective thinking in the educational process (Dewey, 1933). Almost seven decades ago Dewey presented an argument that educators should view the nurturing of the scientific attitude of mind at the core of their endeavors when teaching children (Dewey, 1933). Though the terminology has changed slightly over the years, developing students' critical thinking remains a central goal of the educational process. It is sometimes associated with the work of Perry (1970), the model of Reflect Judgment developed by Kitchner and King (1990), and the works of other cognitive psychologists and intelligence theorists such as Sternberg (1985). Critical thinking has conceptual connections with reflective judgment, problem framing, higher order thinking, logical thinking, decision-making, problem solving and the scientific method.

Efforts to define, teach, and measure CT have intensified throughout the last quarter of a century (Jones, 1993; Kurfiss, 1988; Norris & Ennis, 1989). In 1990, under the sponsorship of the American Philosophical Association, a cross-disciplinary panel completed a two-year Delphi project which yielded a robust conceptualization of CT understood as an outcome of college level education (APA, 1990). Before the Delphi Project there was no clear consensus definition of critical

thinking, although the concepts advanced by Ennis, Paul, Meyer, Lipman, Norris, Swartz, Beyer, Siegal, and Sternberg, among others, were prominent and influential (see Colucciello, 1997 for a review).

Broadly conceived, CT was characterized as purposeful, self-regulatory judgment, a human cognitive process. As a result of this non-linear, recursive process a person forms a judgment about what to believe or what to do in a given context. In so doing, a person engaged in CT uses a core set of cognitive skills – analysis, interpretation, inference, explanation, evaluation, and self-regulation – to form that judgment and to monitor and improve the quality of that judgment. CT is non-linear and recursive to the extent that in thinking critically a person is able to apply CT skills to each other as well as to the problem at hand. For example, one is able to explain one's analysis, analyze one's interpretation, or evaluate one's inference (APA, 1990).

The Disposition Toward Critical Thinking

Any conceptualization of critical thinking that focuses exclusively on cognitive skills is incomplete. A more comprehensive view of CT must include the acknowledgement of a characterological component, often referred to as a disposition, to describe a person's inclination to use critical thinking when faced with problems to solve, ideas to evaluate, or decisions to make. Attitudes, values, and inclinations are dimensions of personality that influence human behavior. The disposition toward critical thinking, as a dimension of personality, refers to the likelihood that one will approach problem framing or problem solving by using reasoning. Thus, the disposition toward critical thinking is the consistent internal motivation to engage problems and make decisions by using thinking (Facione, Facione, & Giancarlo, 1997).

For liberal education as well as for professional preparation at the collegiate level, educators must commit to sharpening students' cognitive skills as well as strengthening their disposition toward CT. Nurturing these skills and dispositions facilitates students' recognition of opportunities to use thinking to resolve problems as well as inclines students toward doing so. A national survey of employers, policy-makers, and educators found consensus that the dispositional as well as the

skills dimension of critical thinking should be considered an essential outcome of a college education (Jones, Hoffman, Moore, Ratcliff, Tibbetts & Click, 1995).

The consensus definition of CT attained by the scholars and teachers who participated in the American Philosophical Association's Delphi project was augmented by an articulation of a description of the ideal critical thinker. Characteristics of this individual included being inquisitive, fair-minded, flexible, diligent, and focused in inquiry (Facione, 1990). It was from the description of the ideal critical thinker that the California Critical Thinking Disposition emerged and was subsequently validated (CCTDI; Facione & Facione, 1992; Giancarlo, 1993).

To date, the most common measures of critical thinking are skills tests (Pendarvis, 1996; Pascarella & Terenzini, 1991; Norris & Ennis, 1989). The California Critical Thinking Disposition Inventory represents one of the first valid and reliable measures of a person's critical thinking disposition. The conceptualization of critical thinking from which the CCTDI was developed is one that recognizes a set of general, discipline-neutral cognitive processes that can be used to describe thinking, problem-solving and judgment (APA, 1990). Some critics of critical thinking skills tests have argued that critical thinking is context-based within particular disciplines. Other critical thinking theorists have responded by arguing that context-based CT tests are inherently confounded with the test takers existing knowledge in a discipline. The majority perspective would seem to call for the distinction between critical thinking skills that are general, and thinking skills that are embedded within a given content area (see Ennis, 1989; McPeck, 1990; and Ennis, 1990 for a more detail discussion of this issue). Typically this argument of context-dependent versus context-neutral critical thinking has been applied to the skill aspect of CT rather than the dispositional aspect of the construct. It is arguably more difficult to apply this objection to the CCTDI given that it is a measure of critical thinking disposition, a relatively stable and enduring aspect of one's personality.

Factor analysis of the CCTDI reveals seven distinct elements. In their positive manifestation, these seven bipolar characterological attributes are named truthseeking, open-mindedness, analyticity, systematicity, critical thinking (CT) self-confidence, inquisitiveness, and maturity of judgment (Facione, Giancarlo,

Facione & Gainen, 1995). As one might imagine, there are negative manifestations of each of these dispositional attributes. The antithesis of the ideal would be a person who habitually approached problem solving being intellectually dishonest, intolerant, inattentive, haphazard, mistrustful of reason, indifferent, and simplistic. While the positive characteristics are clear assets, the vices are perhaps even more obvious liabilities for scholarship, commerce, and civilized society.

The present study represents findings from a university-wide assessment project established to measure critical thinking dispositions and student educational outcomes at a private, four-year, liberal arts university. The central focus of the assessment study was to identify whether the positive characterological attributes of critical thinking increase in strength as a function of the undergraduate educational experience. To approach this question, critical thinking dispositions were assessed in 1992 among a group largely consisting of in-coming freshman students, and then again four years later in 1996 among a sample of largely seniors (see Facione, Giancarlo, Facione & Gainen, 1995 for a discussion of the preliminary findings from the 1992 assessment year). A secondary focus of the project was the exploration of differences in critical thinking dispositions across gender, class level, GPA and discipline.

Methods

Participants

A total of 1117 students, 438 males and 647 females, participated in the present study in either 1992 or 1996. A total of 147 students participated in both years of the study. Table 1, below, presents the demographic characteristics of the samples from both years as well as for the students who constitute the longitudinal sample. Demographic characteristics are presented for each year of the study independently. As can be seen in Table 1, subjects for the 1992 sample were predominantly freshman, while the sample in 1996 was predominantly seniors. Additionally, in each year of the study more females participated than males.

Table 1
Sample demographics from 1992 and 1996: Sample sizes by category

	1992 Sample	1996 Sample	1992/1996 Overlap
Gender			
Males	310	185	57
Females	404	333	90
Gender Unknown	9	23	
Class Level			
Freshmen	536	28	--
Sophomores	82	18	--
Juniors	58	132	(1)
Seniors	22	310	(146)
Class Level Unknown	25	53	--

Note. Columns labeled 1992 Sample and 1996 Sample present independent sample demographics. The column labeled 1992/1996 Overlap refers to the number of subjects who participated in both years of the study. These participants constitute the longitudinal sample. Class level for these participants reflects class standing in 1996.

Subject Recruitment

The 1992 sample was recruited from individuals participating in the freshman student orientation program offered the day before the start of fall quarter classes. All students, representing a diverse array of academic majors, who chose to participate in the program were recruited for the present study. This program was chosen due to the fact that it provided the most direct access to the entire freshman class at this university.

The 1996 sample was recruited using convenience sampling. Students with upper-division standing were the targeted population in this second wave of data collection. Surveys were administered in selected courses with high likelihood of upper-division student enrollment. In addition, subjects were recruited from tables strategically placed where students from different disciplines and organizations congregated, as well as from tables placed in front of the campus student center where seniors could obtain their cap and gown for commencement.

Setting

The present study was conducted at a private, Catholic, comprehensive university that enrolls approximately 8000 students, half of whom are graduate students and the other half are traditional age undergraduates. Character development, with the main focus on leadership and ethical decision-making, is a

global educational purpose of the university. Progression from freshman to senior status in four years is typical at this university, where the majority of students are enrolled full time, retention is very high, and relatively few students are admitted as transfers. Over the past ten years, the four-year graduation rate has been over 70%, the freshman to sophomore retention rate over 90%, and the percentage of the graduating class who entered as first time freshman has been over 80%.

The educational emphasis at the undergraduate level at the university is to ground academic majors in a strong, demanding, and robust liberal arts and sciences curriculum. The great majority of freshmen and sophomores reside on campus; and there are active residence life, campus ministry, community service, and recreational programs available to all undergraduates. Thus the undergraduate experience is shaped by a combination of student affairs co-curricular activities as well as academic study and course work.

The university where this study was conducted does not require students to take a critical thinking course. There is no proficiency requirement in critical thinking. There has not been a campus-wide effort to define critical thinking or to emphasize critical thinking in various academic programs. Surveys of faculty reveal that as a whole, faculty members widely endorse the view that they should teach in ways that would strengthen critical thinking skills and nurture critical thinking dispositions. Furthermore, many faculty would claim that they do teach in these ways, however this assertion has not been independently investigated. This university, like many other universities, articulates in its strategic plan the educational outcome goal of creating an educational environment that promotes rigorous inquiry, creative imagination, reflective engagement, and social conscientiousness.

Instrumentation to Measure the Disposition toward Critical Thinking

The California Critical Thinking Disposition Inventory (CCTDI; Facione & Facione, 1992) is a 75-item attitudinal measure, which is intended for use with college-aged students. Item prompts were theoretically derived from the description of the ideal critical thinker articulated by the American Philosophical Association sponsored Delphi Project (Facione, 1990) and subsequently validated to

create the CCTDI. The CCTDI uses a 6-point Likert-type response format, ranging from 1 (Strongly Agree) to 6 (Strongly Disagree). The CCTDI reports scores on seven scales: Truthseeking, Openmindedness, Analyticity, Systematicity, Critical Thinking Self-Confidence, Inquisitiveness, and Maturity of Judgment. Completion of the CCTDI requires approximately twenty minutes.

The Truthseeking scale on the CCTDI measures intellectual honesty, the courageous desire for best knowledge in any situation, the inclination to ask challenging questions and to follow the reasons and evidence wherever they lead. Openmindedness measures tolerance for new ideas and divergent views. Analyticity measures alertness to potential difficulties and being alert to the need to intervene by the use of reason and evidence to solve problems. Systematicity measures the inclination to be organized, focused, diligent, and persevering in inquiry. Critical Thinking Self-Confidence measures trust in one's own reasoning and in one's ability to guide others to make reasoned decisions. Inquisitiveness measures intellectual curiosity and the intention to learn things even if their immediate application is not apparent. Maturity of Judgment measures judiciousness, which inclines one to see the complexity in problems and to desire prudent and timely decision making, even in uncertain conditions (Facione, et al., 1995).

For each of the seven scales a person's score on the CCTDI may range from a minimum of 10 points to a maximum of 60 points. Scores are interpreted utilizing the following guidelines. A score of 40 points or higher indicates a positive inclination or affirmation of the characteristic; a score of 30 or less indicates opposition, disinclination or hostility toward that same characteristic. A score in the range of 31-39 points indicates ambiguity or ambivalence toward the characteristic. An overall score on the CCTDI can be computed by summing the seven scale scores. Overall CCTDI scores may range from a minimum of 70 points to a maximum of 420 points. Similar interpretative guidelines are used when looking at overall CCTDI scores: A total score of 280 points or higher indicates a positive overall disposition toward critical thinking, whereas a total score of 210 or lower indicates the negative disposition averring critical thinking. Cronbach's alpha internal reliability indices of the seven scales that make up the CCTDI range from .71 to .80. Alphas in this range are highly acceptable and have been replicated in

sample after sample with this tool (Facione, Facione & Giancarlo, 1998). A stability coefficient of $r = .561$ for the overall CCTDI scale was obtained from an aggregate sample of 276 undergraduate nursing students (Facione & Facione, 1997).

The CCTDI has been found to correlate with measures of personality and academic achievement. In a sample of 198 undergraduates, the CCTDI was positively correlated with ego-resiliency and openness to experience (Giancarlo, 1993). In a study of 365 Latino high school students a shortened version of the CCTDI was found to correlate positively with measures of biculturalism, modernity, and was negatively correlated with male students' level of traditional sex-role beliefs (Giancarlo, 1996). In the same study of Latino high school students the disposition toward critical thinking was positively correlated with mathematical, verbal and written achievement, as well as the level of high school math course attained (Giancarlo, 1996). The relation between the CCTDI and measures of academic achievement has been demonstrated among college students as well. A meta-study of baccalaureate nursing programs using the CCTDI indicated that the CCTDI subscales and overall scale scores correlate significantly with the ACT and SAT-Verbal (Facione & Facione, 1997).

Procedure

Data collection in 1992: The Pretest

Pretest data collection was conducted during fall quarter of 1992. This was accomplished as part of the freshmen student orientation program on the day before the start of fall quarter classes. Undergraduate orientation group leaders, most of who were sophomores, were trained in the administration of the CCTDI. These individuals had completed the CCTDI themselves as part of their own preparation and training to lead the orientation groups of new freshmen.

Data gathering was completed before the new students were introduced to the concept of critical thinking and before classroom instruction by college faculty had begun. Relying on the new freshmen to be willing participants in whatever exercises and activities were included in the orientation program planned for them by their new university, no special incentives or inducements of any kind were offered these students in 1992 to complete the CCTDI.

Data collection in 1996: The Posttest

The posttest data was collected during spring quarter of 1996 with the help of undergraduate research assistants. The goal for this second phase of data collection was to seek the participation of seniors in general to maximize the potential for capturing data again in 1996 for students who completed the CCTDI in 1992. So as not to heighten awareness that might create a Hawthorne effect, participants from 1992 were not targeted with personal requests in 1996. Because of the large number of freshmen who completed the CCTDI in 1992, data collection in 1996 focused on students of upper division standing.

Data collection in 1996 occurred in courses where faculty had agreed to provide class time for the project, as well as at tables set up around campus. The study was introduced as a survey of undergraduate students' attitudes. The expression "critical thinking" was not used, nor does it appear on the CCTDI. Seniors completing the CCTDI in 1996 were compensated with a discount coupon toward graduation cap and gown rental. Students who had already completed the CCTDI in another course that quarter were asked not to complete the CCTDI a second time.

Collection of Demographic Characteristics

In addition to responses on the seventy-five items of the CCTDI, the answer sheets also asked for students' Social Security Numbers (SSN), their year in school, their gender, and their major. The social security numbers were used to create a master list of all students who completed the CCTDI in either 1992 or 1996 to match pretest and posttest scores and to acquire relevant demographic and academic information from students' academic transcripts.

Results

There were two research questions posed in the present study. The primary question was did students' critical thinking dispositions change over the four years of undergraduate education? The secondary research question was would significant differences in the critical thinking dispositions be found among students representing different demographic or academic groupings?

Pretest-Posttest Results

Two data sets resulted from this study. A total of 147 students, 57 males and 90 females, completed the CCTDI in both 1992 and 1996. Thus, the first data set, hereafter referred to as the "Pre-Post" data set, is comprised of these 147 students. Across all seven CCTDI scales as well as the overall scale, means for these students' scores were consistent or higher in 1996 than in 1992. Mean scores for both years are presented in Table 2, below. The increases in mean scores from 1992 to 1996 were statistically significant for Truthseeking, $t = (146) 5.60$, $p < .001$, CT Self-Confidence, $t (146) = 4.13$, $p < .001$, and the CCTDI Overall Score, $t = 3.12 (146)$, $p < .002$. Thus, there is evidence to suggest that critical thinking dispositions either sustained or increased in strength over the four-year period of the undergraduate education at this university.

Table 2
Pretest - Posttest Mean Differences from 1992 to 1996 on the CCTDI (N=147)

CCTDI SCALE	MEAN 1992	S.D. 1992	MEAN 1996	S.D. 1996	T VALUE	SIGNIFICANCE LEVEL
Truthseeking	35.70	5.62	38.50	6.28	5.60	$p < .000$
Openmindedness	45.51	5.28	45.49	6.40	.068	N.S.
Analyticity	43.54	5.12	44.05	5.53	1.006	N.S.
Systematicity	40.56	6.53	41.23	6.36	1.10	N.S.
CT Self-Confidence	42.39	5.96	44.48	5.76	4.13	$p < .000$
Inquisitiveness	48.57	5.67	48.86	5.55	.602	N.S.
Maturity of Judgment	45.44	6.26	46.44	6.26	1.73	N.S.
DI Overall	301.62	26.19	309.05	27.47	3.12	$P < .002$

Inspection of Table 2 reveals that a mean score change of two or three points in Truthseeking and CT Self-confidence resulted in an increase that was determined to be statistically significant. To further investigate the meaningfulness, or practical significance of individual changes over the four years, each of the 147 students' scores were assigned to one of three categories for each of the seven CCTDI scales. The first category was students who showed a Positive dispositional attribute, meaning that their score was either 40 points or higher on that attribute scale. The second was students who were Ambivalent in their inclinations on a given characteristic, meaning that the CCTDI scale score was between 31 and 39 points. Finally, the third category was students who showed a Negative dispositional attribute, meaning that their score on a given CCTDI scale was 30 points or lower.

Above 40, between 31 and 39 and below 30 are recommended cut-off points used when interpreting the CCTDI (Facione & Facione, 1992). Students' scores were categorized for both years in which the CCTDI was completed.

Because all of the three categories could be, and in fact were, represented in each of the two years of assessment, there were nine possible combinations from pretest to posttest that a given student might reflect. For example, some students on a give scale may have been categorized as Ambivalent in both 1992 and 1996, whereas other students may have been Ambivalent in 1992 and moved to Positive in 1996. An analysis of the precise categorical shifts, for example the percentage of students who had a positive (above 40 points) score in 1992 and maintained their positive score in 1996, was subsequently performed to identify where the preponderance of change in scores took place. All nine possible combinations of score categories are presented in Table 3, below, revealing the percentages of improvement, maintenance or decrease in CCTDI scores between 1992 and 1996. The first three columns represent maintenance meaning those students who remained in the same category, be it Positive, Ambivalent or Negative, across both assessment years. The middle three columns represent the percentages of students increasing in category and the final three columns represent those students who decreasing in category. The percentages of students from Table 3 who maintained, increased or decreased in their category assignment across the four years of the study are summarized in Figure 1 for each of the seven scales of the CCTDI.

Table 3 shows that when shifts occurred the shifts represented only modest increases or decreases in scores rather than dramatic shifts up or down across two categories. Dramatic shifts would be from positive to negative or from negative to positive. In the columns corresponding to these dramatic shifts the percentage of students is no higher than 1.4 for any scale. Further support comes from the fact that only two scales, Truthseeking and CT Self-confidence, resulted in statistically significant changes in mean scores. Table 3 also shows that for Inquisitiveness, Openmindedness and Maturity of Judgement, 75% or more of the students scored above 40 points in 1992 and maintained that strong disposition in 1996. These findings help to explain why we do not see significant improvements over time for

these scales - for a substantial number of students there is little room for increase on these dimensions of the CT disposition. For the Truthseeking scale on the other hand, only 16.3% of the students scored over 40 points in 1992 and maintained that strong endorsement of the disposition in 1996. A higher percentage, 27.2% were ambivalent in Truthseeking in 1992 but increased to endorse this dimension strongly in 1996.

Table 3
Percentage of Students Shifting to and from Positive, Ambivalent or Negative Endorsement of the CCTDI Scales from 1992 to 1996

VARIABLE	P→P	A→ A	N→ N	N→ A	A→P	N→P	P→A	A→N	P→N
Truth-seeking	16.3	29.9	4.1	10.2	27.2	1.4	6.1	4.8	0
Open-mindedness	74.8	3.4	0	0	10.2	0	9.5	1.4	0
Analyticity	68.7	4.8	0	0	13.6	0	11.6	.7	.7
Systematicity	38.8	14.3	.7	4.1	21.8	1.4	15.6	2.0	1.4
CT Self- Confidence	66.0	8.8	0	.7	15.6	1.4	6.8	.7	0
Inquisitiveness	90.5	1.4	0	0	2.7	1.4	2.7	0	.7
Maturity of Judgment	74.8	1.4	0	1.4	12.2	.7	.8.8	0	.7

Note. This table indicates the change from 1992 to 1996. A "P" indicates a positive score 40 or higher, an "A" indicates an ambivalent score between 31 and 39 points, and a "N" indicates a negative score of 30 points or lower. The first letter refers to the score in 1992 and the second letter refers to the score in 1996.

From Figure 1, below, we can conclude that for all seven scales of the CCTDI the vast majority of students maintained their level of endorsement for the dimensions of the disposition toward critical thinking from Time 1 to Time 2. When looking specifically at the percentages of increase and decrease on each scale we see that for four of the seven scales there were substantially more students who increased in their endorsement than decreased. Interestingly, the largest percentages of decrease in scores came on the Systematicity scale and the Analyticity scale. By comparing the percentages in Figure 1 to those in Table 3 however, we can ascertain that the decrease in endorsement was from strongly positive to more ambivalent rather than to a stance of total opposition. Also in both cases the percentages of students who moved from ambivalent to positive was

higher than the percentages moving from ambivalent to negative. Overall these findings suggest that the relative intensity of endorsement on the CCTDI scale domains varied over the four years, with Systematicity and Truthseeking being the scales with the highest percentage of shift.

Figure 1

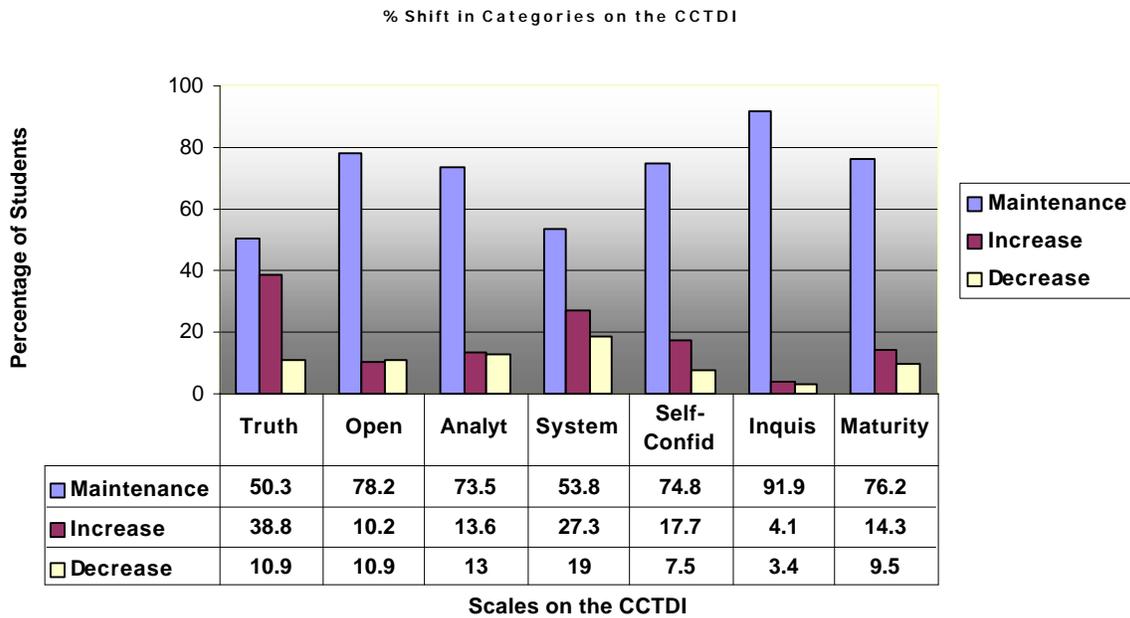


Figure 1. Percentage of students maintaining, increasing or decreasing in category (Positive, Ambivalent or Negative) from 1992 to 1996.

What do these changes over time say about this university? This university appears to provide an atmosphere that nurtures and supports the students' already strong intellectual curiosity or at least that it is not so sterile of an environment so as to lead students to lose interest. These findings suggest that over the four years spent at this institution, students came to endorse more strongly the ideal of putting aside personal biases in the pursuit of good evidence and reason. What about the findings regarding systematicity and analyticity that would suggest that a fair percentage of students felt less organized, diligent and focused, and less inclined to apply reasons and evidence at the end of their college years than at the beginning? This question is not readily answered with these data. It could be hypothesized that this may be a setting where these dispositions are not being as

actively nurtured say as some of the other domains assessed with the CCTDI. On the other hand, perhaps over the course of four undergraduate years, students' focus is less on issues of deliberate concentration and organization as these activities become more comfortable. Similarly, these results may reflect students' awareness of environmental expectations for behavior and thus they are spending less of a concerted effort on the reasoning process. Questions such as this require additional investigation to better understand declines in CT dispositional characteristics.

Cross-sectional Results

To answer the second research question about the relationship of CT dispositions to gender, class-level, discipline area, and GPA, a larger second data set was comprised of the scores of all students who answered the CCTDI combined across the 1992 and 1996 data collection phases. To ensure that no student was represented more than once in this larger data set, only the senior year (1996) scores for the 147 students who completed the CCTDI in both 1992 and in 1996 were used. To check the decision to include the 147 students' 1996 data, the cross-sectional analyses were run without these students' scores in the data set. Regardless of the presence or absence of these students' scores, the findings were identical.

CCTDI Difference between Males and Females

The first variable to be examined in the cross-sectional data was gender. Males and females were compared across the seven scales of the CCTDI as well as the overall score. The mean scores for both males ($N = 438$) and females ($N = 647$) in this data set were below the 40-point mark for Truthseeking, but were between the 40 and 50 point range for all other scales. Statistically significant sex differences in CCTDI scores were found for the Overall CCTDI scale score, $t(1080) = 1.923$, $p < .055$, as well as for the Openmindedness scale, $t(1080) = 6.541$, $p < .000$, and Maturity of Judgment scale, $t(1083) = 4.140$, $p < .000$. For these scales the females scored significantly higher than males in this sample. Further analyses of the proportion of Positive, Ambivalent and Negatively disposed students revealed

that females were more highly concentrated in the Positive category for these scales. Females and males did not differ in the proportion of negatively disposed students on these scales. There was no significant difference in scores for males and females for the other scales of the instrument. In conclusion, females in this sample were significantly higher in Openmindedness and Maturity of Judgment, thus driving the gender difference in the overall scale score, but males and females were notably similar in their respective endorsement and valuation the disposition toward CT.

Women and men, as groups, were equally challenged when it comes to Truthseeking as indicated by the mean scores below the 40-point mark. The positive inclination to pursue reasons and evidence wherever they lead, to ask courageous questions, and to set aside one's personal biases or interests is, by every study we have seen so far around the world, a difficult habit of mind for human beings to cultivate (Facione & Facione, 1997; Facione, Facione, Giancarlo, 1998). The cognitive developmentalist Jean Piaget described knowledge acquisition as a process of assimilation and accommodation (Piaget, 1970). Piaget explains that humans first attempt to understand new information in terms of their existing knowledge, a process Piaget termed assimilation. When this is not successful, we then will modify or add to our existing knowledge stores, or in other words, accommodate to achieve understanding. Applying this framework to the context of truthseeking, it is understandable that a person's inclination would first be to hold to existing epistemologies and points of view rather than suspend them in pursuit of reasoned evidence and truth.

Class Level Differences on the CCTDI

The findings from the 147 students in the Pre-Post data showed gains over the four-year educational experience in regards to CT dispositions at this university for all scales of the CCTDI. These gains were statistically significant for Truthseeking, CT Self-Confidence, and the overall disposition toward CT as represented by the Overall CCTDI score. In addition to this four-year look at differences as the same students moved from being freshmen to being seniors, the

Cross-sectional data provides another opportunity to examine differences by class level.

Differences across the four class levels were investigated for the seven scales of the CCTDI as well as the Overall CCTDI Score. As was explained above, the purpose of this campus self-study was to investigate changes in critical thinking dispositions over the years of the university experience. The samples targeted in 1992 included the in-coming freshmen cohort, whereas in 1996 the desire was to maximize the participation of seniors. For this reason, the representativeness of sophomores and juniors in this cross-sectional data set is suspect. It was decided for purposes of cross-sectional analyses to combine freshman and sophomore data as well as junior and senior data and proceed with analyses examining differences among lower division and upper division students. It is important to note there was no scale on which the mean for any one class level fell into a different category, positive, negative or ambivalent, than the means for the other three classes. More variance is evident among the students within each class than between the class levels.

Mean scores across all seven of the CCTDI scales were higher among upper division students (N=522) than lower division students (N=517). The pattern of scores was similar across these two groups; Mean scores for Truthseeking were below 40 points for both lower- and upper-division students, whereas the remaining CCTDI scale scores were between 40 and 50 points on average for both groups. These differences were statistically significant at the $\alpha = .05$ level for all scales of the CCTDI including the overall scale score, except for Openmindedness. Mean differences across the scales were in the range of one to two points, with the mean difference in Overall CCTDI score six points higher for the upper division students than lower division students. To gauge the practical significance of the differences found, scores on the CCTDI scales were once again converted to category, Negative, Ambivalent or Positive, using the same cut-off score criteria as explained in the above discussion of the Pre-Post sample.

Table 4, below, shows the percentages of students in each of the three categories of endorsement, displayed separately for lower-division and upper-division students. As can be seen from this table, despite highly similar mean

scores for each of the CCTDI scales, there are substantially more upper-division students (40.4%) strongly endorsing truthseeking than lower-division students (25.5). This difference is statistically significant, $\chi^2(2) = 30.648$, $p < .000$. Likewise, though not to the extent of being statistically significant, we see higher percentages of positively inclined upper-division than lower-division students for the CT Self-confidence, Inquisitiveness and Maturity of Judgment scales. In addition, the percentage of students positively endorsing Openmindedness ($\cong 85\%$) and Inquisitiveness ($\cong 90\%$) are so high as to make finding significant differences in means less likely. Overall, this more descriptive examination of the data supports conclusions regarding individual students and groups of students rather than average student performance. To the extent that universities such as this one would like to increase the disposition toward critical thinking among all of its students, the data of greatest interest are the data that represent the attitudes of proportions of the student body, and how those attitudes change over time.

Table 4
Percentages of students in each category of endorsement on the seven CCTDI scales.

CLASS STANDING	CCTDI scales							
	CATEGORY	Truth	Open	Analyt	System	Self Confid	Inquis	Maturit y
Lower Division	Negative	19.5	1	0.4	7.4	2.5	1.4	1.2
	Ambivalent	54.9	12.2	19.1	32.5	20.9	9.1	17.4
	Positive	25.5	86.5	80.5	60.2	76.6	89.6	81
Upper Division	Negative	11.5	1.3	1.5	7.1	1.7	0.8	0.8
	Ambivalent	48.1	13.6	19.5	30.1	16.5	6.3	14.8
	Positive	40.4	85	78.9	62.8	81.8	92.9	84.5

Discipline Cluster Differences on the CCTDI

Within academia as well as in the critical thinking literature there is speculation as to whether demonstrable differences exist between students representing different academic disciplines. These conjectures often are based on the general realization that there are important epistemological differences represented in the array of academic fields as well as differences between professional practice programs and traditional liberal arts programs (Schneider & Shoenberg, 1998). To explore this, the many academic majors offered at the

university were clustered into one of seven broader disciplinary clusters. The names of the discipline clusters and the numbers of students from this study representing each cluster appear in Table 5, below.

Table 5
Percentage of Cases in each Discipline Cluster Represented in the Cross-sectional Data

DISCIPLINE CLUSTER	Code	Cases	Percent
Natural / Physical Sciences	1	138	12.4 %
Mathematics, Computer Science, Engineering, DIS	2	155	13.9 %
Business Administration and Communication	3	341	30.5 %
Humanities, Letters, and Languages	4	80	7.2 %
Fine / Performing Arts	5	22	2.0 %
Social / Behavioral Science and Liberal Studies	6	241	21.6 %
Undeclared	7	69	6.2 %
Unknown / Missing data	--	71	6.4 %

Note: DIS = Decision Information Sciences

Notice that one of the discipline clusters in the present study is “Undeclared”. This discipline cluster is comprised largely of freshmen and sophomores. Recognizing that such categories such as Undeclared are predominantly lower division students, to say that undeclared students are significantly different in their disposition toward CT would be confounded in that they are just beginning their college experiences. For this reason, undeclared students were omitted from the analyses of discipline. Students from Category 5, Fine / Performing Arts, were also omitted due to insufficient sample size. For the examination of discipline differences, students scores were converted once again to the categories of Positive, Ambivalent, and Negative endorsement of the disposition toward critical thinking.

Chi-square analyses were performed to identify any discipline differences in proportion of students across the three levels of endorsement. Significant differences were found for four of the seven CCTDI scales. No significant differences by discipline were found for the Analyticity, Systematicity, or CT Self-confidence scales. For the Truthseeking scale, the distribution of percentages for the Business Administration and Communications majors were more heavily concentrated in the Negative Category (25.8%) as compared to the 13% on

average for the other discipline clusters. On the other hand, the Humanities, Letter and Languages majors were more heavily concentrated in the Positive category (46.3%) as compared to the 35% on average for the other discipline clusters. The proportion of students Ambivalent toward Truthseeking was comparable across all discipline clusters ($\bar{x} = 50\%$), but only 25.2% of the Business / Communications cluster were categorized as positively disposed toward Truthseeking.

For the Openmindedness scale, there were more Mathematics, Computer Science, Engineering, DIS (Cluster 2) students categorized as Ambivalent (24.8%) as compared to the 12% on average ambivalence across the other discipline clusters. The discipline clusters were all comparable in the percentages of Negatively disposed students ($\bar{x} = 1.3\%$). The higher proportion of ambivalence among Cluster 2 students meant a lower proportion of Positively disposed students in this cluster (74%) compared to the 86% on average for the other clusters. A notable difference in the proportion of Positively disposed students was found for the Humanities, Letters and Languages, where the proportion was a very high 96.3%.

For the Inquisitiveness scale, there were less positive (87%) and more Ambivalent (11%) Business / Communications students than other discipline clusters (93% Positive on average and 5% Ambivalent on average). Again, comparable proportions were found for the Negatively disposed category ($\bar{x} = 1\%$ across all clusters). Finally for the Maturity of Judgment scale, Business / Communication students (Cluster 3) and Cluster 2 were both less Positive ($\bar{x} = 76\%$ between them) and more Ambivalent ($\bar{x} = 21\%$) than the other three discipline clusters ($\bar{x} = 88\%$ Positive and $\bar{x} = 11\%$ Ambivalent). In line with the findings for Openmindedness and Inquisitiveness, the clusters did not differ in proportion of negatively disposed students ($\bar{x} = 1\%$).

Overall, these discipline analyses show a shift toward a higher proportion of ambivalence among Business / Communication majors, and Math / Computer Science / Engineering majors for some dimensions of the disposition toward critical thinking as compared to other discipline areas. Alternatively, there appears to be an opposite shift toward a higher proportion of Positive endorsement among Humanities / Letters / Languages for some dimensions of the disposition toward CT.

The general finding of no apparent differences in the proportion of Negatively disposed students across nearly all of the scales of the CCTDI is encouraging. To nurture an ambivalent person so that they come to positively endorse the disposition toward CT is arguably less challenging than to attempt to sway a person ardently opposed to approaching problem solving through reasoning. Because this study used discipline clusters as opposed to individual discipline areas the findings must be interpreted with caution. It remains to be seen whether these findings can be replicated in other data sets. Certainly the implications of these findings merit further investigation.

The Relation between GPA and the Disposition toward Critical Thinking

The average GPA in the Combined data set was 3.02 with a standard deviation of .46. The mean GPA for males was 2.98 ($N = 300$, $SD = .50$). For females the mean GPA was 3.04 ($N = 453$, $SD = .44$). This difference in average GPA between males and females was statistically significant.

Positive correlations between GPA and CT would suggest that a stronger disposition toward critical thinking was recognized and rewarded by the faculty as reflected in higher grades. Correlational analyses between GPA and the CCTDI revealed the following. Four CCTDI scales were found to be significantly correlated with GPA: Openmindedness $r = .153$, $p < .000$, Analyticity, $r = .102$, $p < .005$, Systematicity, $r = .093$, $p < .011$, and Maturity of Judgment, $r = .090$, $p < .014$. The Overall CCTDI score was also significantly correlated with GPA, $r = .107$, $p < .003$. Non-significant results were found for Truthseeking, CT Self-Confidence and Inquisitiveness.

Discussion

The present study investigated whether the disposition toward critical thinking would increase as a function of the four-year undergraduate experience. It was found that critical thinking disposition scores either remained stable or increased among the 147 students who completed the CCTDI in both 1992 and again in 1996. Statistically significant increases in mean differences were found for Truthseeking, CT Self-Confidence and in the Overall CCTDI score. It was also found that the average scores for the Openmindedness and Inquisitiveness scales were

high, above 45 points on a 60 point scale, in 1992 and stayed high in 1996. Without much room for improvement in scores in these two scales, statistically significant gains would be difficult to demonstrate. This point however should not diminish the importance of demonstrating the stability of high scores over time among this longitudinal sample. These students were strongly disposed toward approaching problems with open, tolerant and curious minds and they maintained these mental inclinations throughout their college years.

When looking at the proportions of students in the pre-post sample whose scores increased, maintained or decreased over time on the scales of the CCTDI, we see significant numbers of students increasing in Truthseeking. A question to ask is whether these gains represent the culmination of the undergraduate college experience, or whether they are a function of developmental changes characteristic of young adulthood. Age was not investigated in the present study; thus the developmental question is not addressed directly. However, the findings of this study replicate a similar result for Truthseeking and CT Self-Confidence obtained in an aggregate sample of 171 undergraduate students from baccalaureate nursing programs (Facione & Facione, 1997). In that study of nursing students age was investigated in relation to the CCTDI. The authors concluded that although age was correlated with a number of the CCTDI scales, only in the case of Truthseeking was the correlation substantial enough ($r = .225$) to assert that age accounts for more than just a nominal portion of individuals' scores (Facione & Facione, 1997). Further research into this developmental question is needed to elucidate the pattern of growth in critical thinking dispositions.

In addition to longitudinal results, the present study reports cross-sectional findings from an aggregate data set consisting of individuals who participated in either the 1992 or 1996 phase of the study. The first variable investigated was gender. It was found that females in this study scored significantly higher than males in the overall disposition toward critical thinking as well as Openmindedness and Maturity of Judgment. There were significantly more females than males positively endorsing these scales. Despite these differences, there was a more general finding of sameness across the majority of the CCTDI scales. Recalling the three categories described above, Positive, Ambivalent, and Negative, on no scale

did the mean for one sex fall in a different category than the mean of the other sex. The statistical axiom seems to apply here: there is more variance on critical thinking dispositions among men and among women than there is between the two groups.

Class level differences as well as discipline cluster differences were also investigated in the present study. Class level analyses revealed the general finding that upper division students scored higher on average than lower division students on the scales of the CCTDI. These differences were statistically significant for all scales of the CCTDI except Openmindedness. A notable exception to the general finding of a linear increase in mean scores from freshmen to seniors was the fact that sophomores scored consistently high on average on the CCTDI scales. As was mentioned above, the sophomores in the present study were orientation advisors and were not necessarily representative of sophomores on this campus or in general. Future studies interested in class level differences should utilize a more representative sampling technique than was employed in the present study.

Discipline cluster differences were investigated by comparing the proportion of students categorized as Positive, Ambivalent or Negative in their disposition toward CT. Overall, the discipline clusters did not differ significantly on most of the scales of the CCTDI. Business / Communications and to some extent Math / Computer Science / Engineering majors were significantly more ambivalent and less positive on the Truthseeking, Openmindedness and Inquisitiveness scales. On the other hand, Humanities / Letters / Language majors were more positively inclined toward Truthseeking and Openmindedness than the other major clusters. We again caution against the over-interpretation of these findings. We clustered disciplines rather than studying them independently and though attention was paid toward achieving a diverse sample, no explicit sampling technique was employed to ensure a representative sampling of academic majors.

Finally, critical thinking dispositions in relation to GPA were also investigated in the present study. It was found that four of the CCTDI scales were significantly correlated with GPA. None of these correlations exceeded $r = .10$, which leads to the conclusion that the disposition toward critical thinking is not factoring largely in the assignment of grades at this university. Given the fact that faculty members

widely endorse the educational value of the disposition toward CT, further conversation is warranted as to whether the disposition toward critical thinking should be reflected in GPA. It is important to remember that being disposed to think critically is conceptually different than being skilled at thinking critically. Perhaps it is the skill dimension of critical thinking that should be reflected in GPA. Studies looking at the relation between critical thinking skills, as measured by the California Critical Thinking Skills Test (CCTST; Facione, 1990) and GPA have found correlations ranging between .235 and .596 (Facione & Facione, 1997). These findings do however show that only a small amount of the variance in GPA can be explained by thinking skills. Thus the conversation about GPA and critical thinking is broadened. The question perhaps should be to what extent should GPA reflect students' CT skills in combination with their CT dispositions?

Limitations of the Current Study

This study represents the fruits of an institutional research assessment project, not unlike many self-assessments currently being carried out at universities across the country. It was conducted with as much scientific rigor as is possible with any field research study. Controlled experimental design features such as repeated measures, random subject sampling, or cross-national comparisons to "identical" universities were not feasible. Furthermore, the goal of this study was not to evaluate a formal curricular intervention program. Nevertheless, useful information can result from on-site, self-assessment processes. These findings are presented as support for the claim that change in students' disposition toward critical thinking can be investigated and documented within a university context. More research into the potential disciplinary differences in the disposition toward CT is needed. Future studies should be crafted to follow students from specific majors throughout their years in college to investigate the role of the college experience on the development of the disposition toward CT.

Developing the disposition toward critical thinking in students remains a most important part of the global objective of providing an education that is character building. Character is built, as we all know, not only by demanding and rewarding it, but by modeling it. We close then by encouraging all those who contribute to a

student's undergraduate experience, whether in the classroom or in other campus programs and activities, to reflect upon how they might model truth-seeking, open-mindedness, maturity of judgment, and the other elements the disposition toward critical thinking.

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