



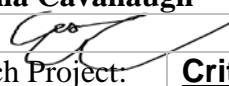
**HOLCOMBE INSTITUTE FOR TEACHING & LEARNING EXCELLENCE  
CLASSROOM RESEARCH AWARD EVALUATION**

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**Please complete this form for the research project that you conducted for the Classroom Research Award. This information will be reviewed in order to evaluate the effectiveness of your research. Your evaluation and supporting documentation will be posted on the HI Website. Use additional paper where necessary.**

**Note: Please submit this form and supporting documentation within 30 days of the completion of your project to Office of Professional Development & Training, B17 - 424, Central. In addition, you will need to attach an electronic copy of the evaluation to an EMAIL and forward to [ProfDevTrng@broward.edu](mailto:ProfDevTrng@broward.edu).**

***MUST BE WORD PROCESSED***

Name:	<b>Gesulla Cavanaugh</b>	Date:	<b>09/10/2010</b>
Signature:			
Title of Research Project:	<b><u>Critical Thinking in an Innovative-Based Global Marketplace: The Obligation to Prepare First Year Students to Compete Successfully</u></b>		
Project Completion Date:	<b>06/2010</b>		

**1. State the problem to be researched.**

As the global marketplace expands, it gives rise to fewer trade barriers, and this consequently forces this new generation to acquire skills that were not particularly relevant in earlier centuries. More companies, because of the increased competition, are placing emphasis on hiring individuals who not only have technical skills, but are efficient, and are able to make decisions, bring innovative ideas to the table, find problems and solutions, and design new ways to implement methods. Students need to develop strong critical and analytical thinking skills as early as possible during college in order to compete successfully with their counterparts in the global marketplace. Critical thinking and analytical thinking skills are not effectively emphasized early enough, do not play a major learning role among a number of students because their major does not require much of these skills, and they are not highly emphasized or structured in the general beginning courses.

It is hypothesized that critical thinking and analytical thinking tools should be introduced and emphasized early in college beginning courses in order to start challenging the students early so that they produce these skills at higher competence upon graduation, additionally for the students to possess stronger and lasting learning outcomes.

Although critical and analytical thinking skills are crucial in a college student's life, and although they are recognized as necessary components for graduating students to be able to compete successfully with their counterparts, many curriculum consider critical and analytical thinking only through what is already embedded in a course content. Although many academic programs state to have incorporated critical and analytical thinking within offered courses, these components rarely stand alone to make a correlated academic impact on student learning. As a result, students will learn minimal analytical and critical thinking strategies and worse, may not place emphasis on them. This results from the fact that these skills are embedded within a course content and are given equal or lesser importance as other topics of which their understanding can be grasped faster (i.e. diversity). Additionally, courses that teach these skills do not specifically target first year students nor those who are 'at risk', and students may take them at any given time during their attendance, and may even risk not taking these courses if they are not part of their degree requirement.

Intertwined in this problem are at risk first year students enrolled in college. Students who are admitted to college with low high school GPA and SAT or ACT scores are immediately seen as ‘at risk’ academically, and may be targeted as not having the ability to think analytically and critically. Many of Broward College students who may be at risk have different academic goals; some attend to acquire an Associate degree, to complete a few classes to be more efficient in the job market, or to complete pre-requisites to attend a university. Broward College is evidently this population’s first contact with the world of higher education; therefore, it should prepare these students within their first year. That population needs to acquire critical and analytical thinking skills, which it will be able to apply regardless of when its members withdraw or graduate from the school.

The purpose of this research project is an attempt to examine the extent to which first year students enrolled in SLS courses think critically and analytically. Because students enrolled in these courses are presumed to have poor academic skills, of which critical and analytical thinking are part of, it is hypothesized that incorporating these skills more directly and vigorously into their initial learning period will be a scholastic benefit.

## **2. Summarize the research findings/results. If applicable, attach copies of evaluation forms and a summary of those forms.**

### *Sample*

The final sample was composed of 40 individuals with 19 subjects in the control group and 21 in the experimental group. The largest age groups for subjects in control and experimental groups were 15-19: 40% and 20-24: 50%. There were 13 males (32.5%) and 27 females (67.5%), with 26 (65%) Black, 11 (27.5%) White, and 3 (7.5%) Hispanic or other. The majority of the subjects 27 (67.5%) reported that they have only been enrolled at Broward College for one semester.

### *Variables and Examination*

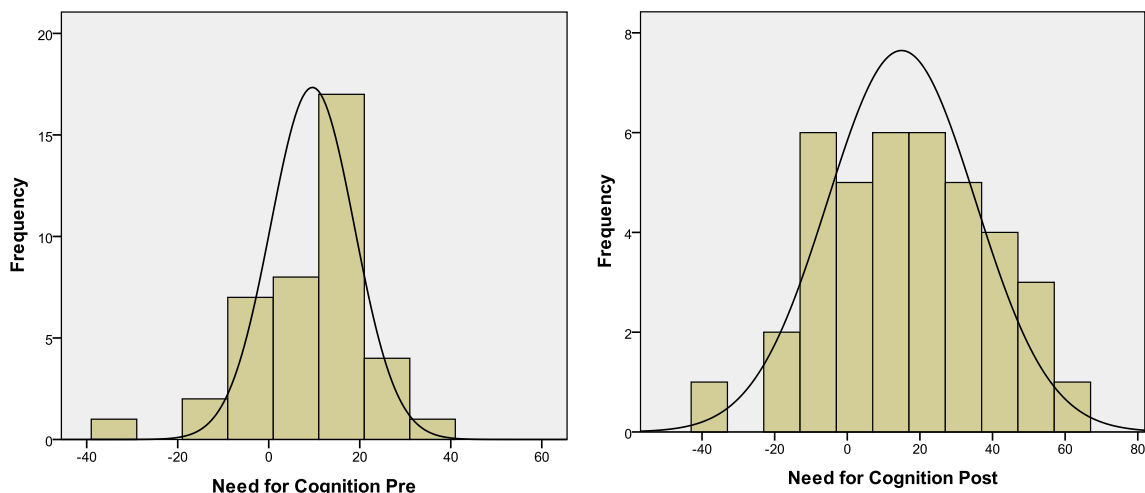
The Cornell Critical Thinking examination was administered at baseline for both groups and after. The test evaluates subjects on 5 components: induction, deduction, observation, assumption, and credibility. The Text Book Critical Thinking and Logic Examination was given at baseline and thereafter to the experimental group, but only after to the control group. The article analysis, which involves subjects summarizing a scholarly article, was given at baseline and after to both groups. Both groups also had to analyze a statement during lecture, and were to be involved in an argumentative debate at the end of the course. Additionally, the professor rated the subjects based on their overall performance, interest, and understanding in class. The professor’s rating is only subjective, however it was meant to see if the subjects’ interest and understanding interacted with their scores regardless of group. The professor rated the subjects on their level of understanding of college/academic work, on their interest level in academia/the course, and their interest level in critical thinking. Lastly, an improved score was determined if the subject attained improved scores substantially from any two of the following tests: Cornell Critical Thinking Examination, Text Book Critical Thinking and Logic Examination, and Article Analysis.

### *Results*

In examining subjects who improved their scores at the end of the semester, 26 (65%) overall did not improve their scores, while 14 (35%) had improved scores. For the control group, 18 subjects (94.7%) did not improve scores, while 1 (5.3%) had improved scores. In the experimental group: 8 (38.1%) did not improve scores while 13 (61.9%) had overall improved scores.

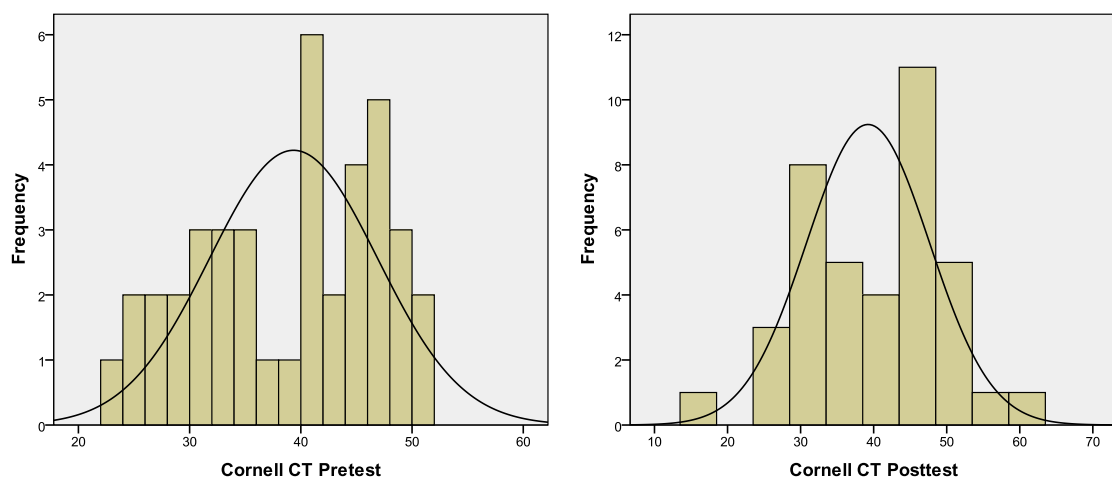
Between group differences and within group differences were examined for variables of interest. In this report, only relevant differences to the study will be reported, mainly focusing on statistically significant variations. Several variables were examined in this study to better understand students’ interest in critical thinking and logic, to examine student’s ability to learn critical and analytical thinking and logic and to apply the relevant information to their coursework. The first test administered to subjects was The Need for Cognition scale (NCS–

SF; J. T. Cacioppo, R. E. Petty, & C. F. Kao, 1984) which examines an individual's interests in critical, analytical, and logic thinking (Culhane et al, 2006). An individual with a high score on the Need for Cognition is presumed to produce more productive thoughts, should provide more highly structured explanation to given information, while individuals with low scores are more likely to avoid cognitive effort (Culhane et al, 2006). Bost (2007) reported that "high scorers indicate that they readily engage in thinking about topics as they are presented, enjoy the thinking process, and are motivated to apply their thinking skills with little prompting. Such people are likely to be able to process and systematize information, sorting out the irrelevant from the important (Cacioppo & Petty, 1982, 1984). In an educational context, these personality traits and learned skills—particularly the ability to process information efficiently—can be linked with greater academic achievement".



**Figure 1. Histogram of Need for Cognition Pre & Post Tests for Control & Experimental Groups:** Figure shows frequency distribution: Pre test : mean: 9.2. SD: 12; Post test: mean: 16.48. SD: 22.96.

The majority of the subjects in both groups had low initial need for cognition (see distribution of scores in fig. 1); total scores for the Need for Cognition test can range from -72 to +72. For the control and experimental groups together, Need for Cognition pre test percentages were as follow for each tripartite: from -72 to -24: 1 (2.5%); from -25 to +23: 34 (85%); from + 24 to +72: 5 (12.5%). For the Need for Cognition post test, from the bottom to top tripartite: 1(2.6%), 21 (53.8%), 17 (43.6%) consecutively. Additionally, for the Cornell Critical Thinking test (fig. 2) which comprises a maximum score of 76, 10 (25%) subjects scored at or above 46 in the pre test, while 14 (36.2%) scored at or above 46 in the post test.



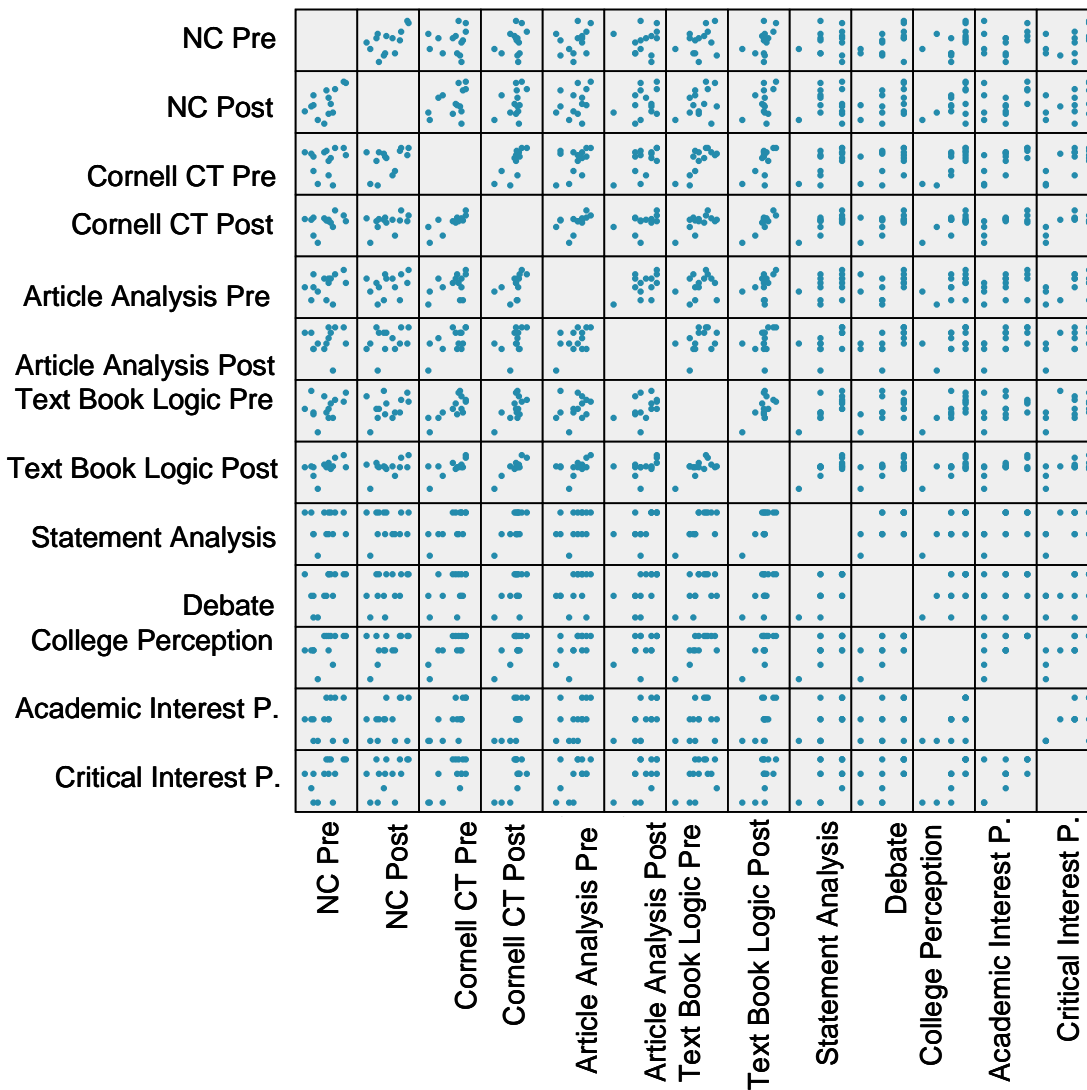
**Figure 2. Histogram of Cornell Critical Thinking Pre & Post Tests for Control & Experimental Groups:** Figure shows frequency distribution for both groups; Pre test : Mean 38.38, SD: 8.17; Post test: Mean 40.15, SD: 9.74.

For the control group Need for Cognition pre test : 2 (10.6%) individuals scored at the bottom of the top tripartite; while 10 (55%) scored at the top tripartite in the post test. For the experimental group pre test 3

(14.3%), and post test 7 (33%) scored at the bottom and middle of the top tripartite. For the Cornell Critical Thinking pre test, 1 (5.3%) subject in the control group had a score of 46 or above, while 2 (11.2%) subjects in the same group scored 46 or above in the post test. However, for the experimental group, 9 subjects (43%) scored 46 or above in the pre test, and 12 (57%) had a score of 46 or above for the post test.

Another component introduced to subjects after teaching the experimental group additional critical and analytical thinking and logic, is the argumentative debate. Subjects were given a topic chosen by the professor and the class was divided into two groups. One side was to argue for the argument while the other side had to argue against it. Students were instructed not to be concerned about their actual standpoint on the subject matter, but to know how to back up an argument, to provide enough evidence and to be able to refute points made by the other side. Subjects in the experimental group were taught topics such as identifying fallacies in statements, inductive and deductive reasoning, relevant, adequate, and truthful statements (credibility), assumption, sound arguments, and logically sound arguments. Students were rated on 3 scales regarding their ability to make standpoints, support statement, and refute an argument “No ability, some ability, and good ability”. There were no statistically significant differences between the two groups in terms of the argumentative debate.

Fig. 3 shows correlation between the independent variables. Nevertheless, only relevant and statistically significant correlations are reported here, with the inclusion of some variables not shown in the figure. The reported variables are statistically significantly correlated with each other with reported Spearman’s rho only: Need for Cognition pre test with post test (.425), and with argumentative debate (.381); Need for Cognition post test with professor’s perception of student’s academic understanding (.391), with professor’s perception of student’s interest in academic work (.359), with professor’s perception of student’s interest in critical thinking (.414), and with argumentative debate (.349). Deduction within the pre test, was correlated with the Cornell Critical Thinking pre test overall (.812). The Cornell pre test was correlated with the Cornell post test as well (.692). Deduction in the post test was also correlated with the Cornell post test (.864). More importantly, group was correlated with article analysis post test (.404), with Cornell post test (.382), and with the Text Book Critical Thinking and Logic post test (.638). Text Book Critical Thinking Logic post test was also correlated with the Cornell Critical Thinking post test (.598), statement analysis (.596), professor’s perception of student’s academic understanding (.515), professor’s perception of student’s interest in academic work, (.366) and professor’s perception of student’s interest in critical thinking (.500).



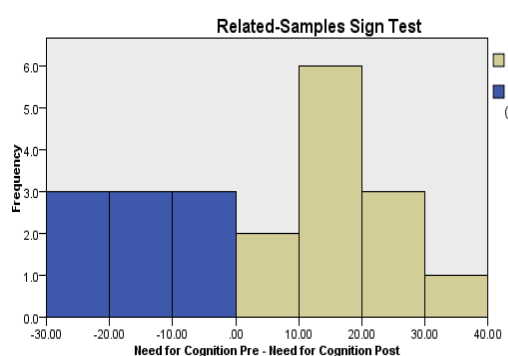
**Figure 3. Correlation of independent variables.** Note: None of the variables were highly correlated, and VIFs were within normal limits, therefore there was no problem with multicollinearity.

Logistic regression was conducted to find out if any of the independent variables were good predictors of group (control or experimental), and if any of the variables were good predictors of an improved score. An improved overall score was determined as either 1 or 0 if the subject improved in two of either the Cornell Critical Thinking examination, the article analysis, or the Text Book Critical Thinking and Logic examination. None of the variables placed in the models were statistically significant and therefore were not good predictors of group. Though, group seems to be a good predictor of improved score ( $p = 0.003$ ,  $OR = 29.25$ ). It appears that being in the experimental group increased the odds of having an improved score by 29.25.

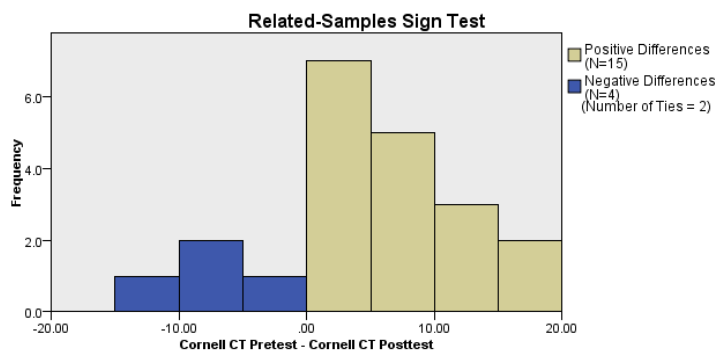
<b>Grouping Variable:</b> Control or Experimental	Deduction Cornell CT Pre test	Cornell CT Post test	Deduction Cornell CT Post test	Article Analysis Post test	Text Book Critical & Logic Post test
Mann-Whitney U	124.500	105.500	119.500	86.500	49.500
Wilcoxon W	314.500	276.500	290.500	239.500	220.500
Z	-2.040	-2.357	-1.968	-2.391	-3.935
Asymp. Sig. (2-tailed)	.041	.018	.049	.017	.000

**Figure 4. Z- scores and Significance for selected variables.**

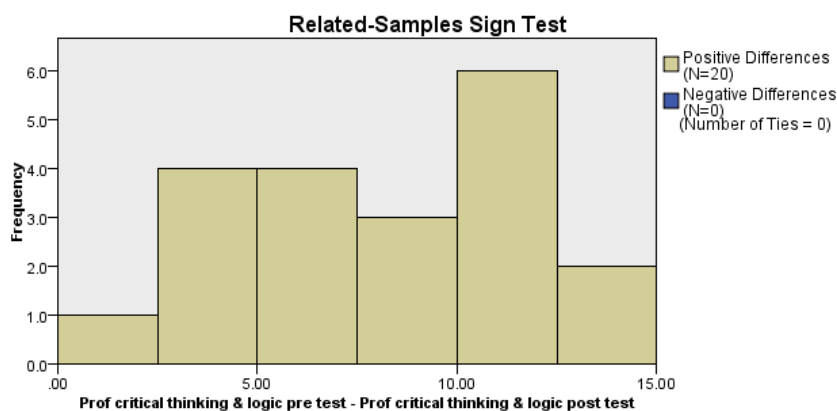
To examine whether the means for the different examinations were the same for the control and experimental group, a Wilcoxon Mann-Whitney analysis was conducted. The results (fig. 4) suggest that there is a statistically significant difference between the underlying distributions of the Deduction section pre test scores of the control group and the Deduction scores of the experimental group ( $z = -2.040$ ,  $p = 0.041$ ); between the Cornell Critical Thinking post test scores ( $z = -2.357$ ,  $p = 0.018$ ); Deduction section post test scores ( $z = -1.968$ ,  $p = 0.049$ ); Article analysis post test scores ( $z = -2.391$ ,  $p = 0.017$ ); and the Text Book Critical Thinking and Logic post test ( $z = -3.935$ ,  $p = 0.000$ ). The means for the variables not reported were not statistically significant between the control and experimental groups. These results are consistent with the Related-Samples Wilcoxon Signed Ranks test performed separately for each sample to determine if the subjects from each group improved on a particular test that was given at baseline and after. Using the Wilcoxon Sign Test, it was determined that the median difference between Need for Cognition pre test and Need for Cognition post test for the experimental group was equal to zero ( $p = 0.578$ ). Thus, there is no statistically significant difference between Need for Cognition pre and post tests for the experimental group (fig. 5A). However, there was a difference between the distribution of the Cornell Critical Thinking pre and post tests ( $p = 0.046$ ) (fig. 5B), a significant difference for article analysis pre and post ( $p = 0.016$ ), and for Text Book Critical Thinking and Logic exam pre and post ( $p = 0.000$ ) (fig. 5C).



A.



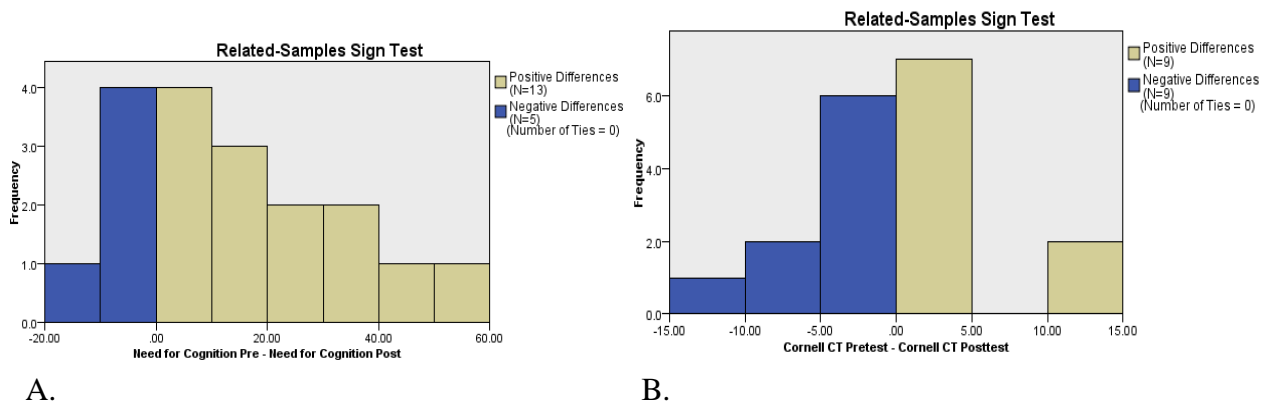
B.



C.

Figure 5. A, B, C. Related-Sample Sign Tests for the Experimental Group.

For the control group (fig. 6A), Need for Cognition pre and post tests ( $p = 0.018$ ) distributions were significantly different. For the Cornell Critical Thinking pre and post tests, there was no significant difference ( $p = 0.844$ ), and there was no significant difference between article analysis pre and post ( $p = 0.106$ ).



A. B.  
**Figure 6. Related-Sample Sign Tests for the control Group.**

**Summary**

The Cornell Critical Thinking examination was the main evaluation tool during this study. It was determined that although the experimental group tested higher than the control group at baseline, there was a statistically significant difference between the distribution of the two groups in the pre and post test. Meaning, the experimental group did significantly better in the post test. Regarding the argumentative debate, it is possible that some students are more eloquent than others regardless of group, and take instructions well; therefore this may have affected the students’ ability to be involved in a argumentative debate. The experimental group did not do better in terms of supporting a statement, refuting arguments, and making a strong point. Interestingly, the control group had a higher mean of Need for Cognition at the end of the course, while those in the experimental group had an overall lower need for cognition or did not improve at all. It was observed that some students in the experimental group whom the professor rated as having low interest in critical thinking, actually had a lower score in the Need for Cognition post test. During the trial, some students in the experimental group expressed their frustration regarding the critical thinking lecture and examination, they admitted that the lecture and exams “were too hard” to understand. Although the professor explained to the students of the necessity of this type of lecture such as assistance in standardized exams such as the MCAT, FCAT, LSAT, etc, some students still did not see the need to learn induction, deduction, and other reasoning topics. A number took the idea with pleasure and some who were exposed to similar lecture during high school welcomed the lectures and expressed high interest in it. One student said one time, while some were complaining, that this is what individuals learn in school ‘up North’, and that if they knew the importance of this lecture they would not take it lightly. She even went on to say that in the future those complaining will be surprised to realize that they needed to learn this information. It is possible that some information meant for the experimental group, (although not significantly) may have slightly been discussed with the control group, because of demand from students in the control group, such as explaining induction, deduction, supporting arguments, reasoning, and credibility of source. The extent to which this may have affected the results is not known, but it is not presumed to have significantly affected the scores of the individuals in the control group.

More importantly, the reported statistically significant z scores for Cornell Critical Thinking post test scores ( $z = -2.357$ ), Article analysis post test ( $z = -2.391$ ), and the Text Book Critical Thinking and Logic post test ( $z = -3.935$ ) indicate that the means of the experimental group were much higher than those of the control group, suggesting that the experimental group learned the information taught and was able to apply it in the examinations. A few of the independent variables were correlated with each other, which is important to know the relationship among the variables. As far as now, it is recommended that none of the means of examination be removed, since none were highly correlated with each other to the extent that they would cause multicollinearity. Each means of examination allows further evaluation of the students and gives a different perspective on how they apply the information. The analysis of a scholarly paper was completely different from the Text Book Critical Thinking and Logic, in that it strictly allowed the students to analyze the published work of selected researchers. To my opinion, the second article was much harder to understand than the first article, and while

scoring the students, I was quite impressed with their responses; nonetheless, I did not expect to see any difference between the scores of the students in the experimental group and those in the control group, however after conducting the statistical tests, it was suggested that the experimental group did better significantly. Students learned how to examine results and evidence that provided support for the results; they also determined if there were any fallacies or any correction that needed to be made to the study.

The results from this study suggest that the experimental group learned critical thinking, logic, and analytical thinking to an extent that was limited to this course and the amount of time. They were able to show positive outcome (learning) through improving scores in the Cornell Critical Thinking examination, the Text Book Critical Thinking and Logic examination, and through the article analysis. During the debate, both groups did almost similarly. I even believe that the control group did better, although not significantly. I believe that this had to do with the amount of time the groups had to prepare. The control group had more time to prepare than the experimental group. The experimental group had to learn an extra amount of information with critical thinking in addition to the regular class material that had to be learned; class time to prepare for the debate was limited, while the control group had more time free of critical thinking lectures to get together in class, to have more days to prepare, and more meetings with group members. Although I do not know the effect of time on students' preparation in this case, this factor could have also been intertwined with students' interest in being involved in the argumentative debate, ability to think logically, process information and relate it to others, and ability to express oneself in front of an audience.

Students should be encouraged to think critically; they should be encouraged to increase their interest to be involved in activities that promote critical and analytical thinking, and logic application. It is proposed that, as suggested by Bost (2007), that students be prompted to be engaged in activities that promote critical thinking. There should be a curriculum that intertwines the academics with multiple logic activities that may be enjoyable which would eventually push the students to learn the information, and to engage in critical thinking activities. The professor observed that a lot of the students had no background in critical and analytical thinking and logic. It was also observed that only 1 student was strongly exposed to such information (and that student was still in high school, in dual enrollment and a high achiever), at most 2 other students were familiar with subjects concerning critical, analytical thinking, and logic. This shows that the students are not learning the information in high school, and although it would be helpful that they have this background to sort out information, and to be able to do better academically, we cannot put that responsibility solely on high school. The students should be able to be exposed to this information during their admission in college, in the hope that they are being prepared to move to the university level, to enrolled in a 4-year degree program, to take standardized exams, and to begin a scholarly career. For future study, it would be beneficial to see the academic and long term goal achievements of the students who were exposed to critical, analytical, and logic thinking while taking the student life skills course (I do believe that these should go hand in hand).

#### References

- Bost, A. (2007). The need for cognition scale. Retrieved on July 23, 2010 from <http://www.liberalarts.wabash.edu/ncs/>.
- Cacioppo J.T., Petty, R.E. (1982). The need for cognition. *Journal of Personality and Social Psychology*, 42, 116–131.
- Cacioppo J.T., Petty, R.E., Kao, C.F. (1984). The efficient assessment of need for cognition. *Journal of Personality Assessment*, 48, 306–307.
- Culhane, S.E., Morera, O.F., and Watson, P.J. (2006). The assessment of factorial invariance in need for cognition using Hispanic and Anglo samples. *Journal of Psychology*, 140 (1), 53-67.

**3. Describe the methods you used to evaluate the effectiveness of your project. Include quantitative and/or qualitative evidence.**

The researcher used six different types of examinations to test whether or not the students learned the material taught and their interest in the material. To increase the validity of each exam, which were scored independently of each other, an additional score was taken, which was a combination of scores from 3 different evaluation instruments as mentioned in the summary of results above. The Cornell Critical Thinking Examination is a critical thinking test that has been proven to be valid (documents attached). The researcher used text book examples from 2 critical thinking books (*Critical Thinking: A Concise Guide* by Tracy Bowel & Gary Kemp; *Critical Thinking: An Introduction to the Basic Skills* 3<sup>rd</sup> Ed. By William Hughes) , and also evaluated the students on their ability to analyze scholarly articles, students were rated on their ability to argue their standpoint, and were scored on their ability to analyze a statement.

Scores were entered in SPSS, and various procedures (Histogram, Q-Q plots, correlation, VIF values) were used to test the normality of the sample and other problems such as multicollinearity before comparing means and analyzing the data for predictors. The researcher also measured students' interest in academia and in critical thinking, through qualitative means (observation), the students were rated for their interest from 0-2; 0- with no interest, 1- with some interest, and 2- with high interest. This variable, although subjective and qualitative, correlated with the post test of Need for Cognition scale.

The data was cross examined, and triangulation, a qualitative process, was taken into consideration to increase validity.

**5. If applicable, identify what prevented you from achieving your original, expected findings.**

Time was a factor during this study. I believe I was limited on time, and was not able to strongly emphasize on the chosen subjects that promote logic and understanding. Because of this, the students learned inductive reasoning, deductive reasoning, fallacies, statement, argument, logic, credibility, to only an extent and not in great depth. It is not possible to go too much in depth with all the chosen topics, as this is not a philosophy course; however, my purpose was to give the students something tangible as well as additional tools to think critically, analytically, and logically in order to be a successful student. Some students were not particularly interested in the subject matter, which I believe affected their ability to concentrate and to learn the material. In the future, it is possible that increasing their Need for Cognition through games and other activities will be helpful before starting to teach them critical thinking. The material was heavy, and if the students were not exposed to it prior or during high school, some may shut down if they are not able to understand it or are not able to apply it.

**6. Explain in detail how you intend to share the results of this research with the Broward College community.**

I intend to share this information at the Broward College conference, as is expected of me. I wish to present the information to the faculty, staff, and individuals involved in curriculum development and in student success. If possible, and if given the opportunity, I would like to serve as a guest speaker at the different campuses to discuss my findings in order to encourage mainly SLS instructors to take on the challenge. It is believed that an SLS course that incorporate these tools will better equip the student for a stronger academic career.

**7. Describe ways in which faculty from other disciplines could apply your research and its results in classroom practices, in future studies, and/or for student success?**

Faculty from other disciplines can readily use and apply this research to give their students the desire and the tools to think more critically, logically, and more strategically, as a result, students will be able to sort out information easier and apply what they have learned. I have already explained to my students that competition is rising, and unless they can bring some brain to an organization, they will not be able to survive. They understand

that nowadays companies are barely looking for individuals with technical skills, but are more interested in individuals who have the knowledge and who can advance the company with innovative ideas. Innovative ideas come from individuals who are thinkers, who can strategize and who think logically. Students from any discipline need these tools. For instance, students involved in biological research need to apply logic, analytical, and critical thinking, to know how to advance through a procedure; they also need to know how to interpret data and results. The same goes for students in history; a wealth of information is given, they need to be able to sort through the information and decide what is relevant, and what to do with the information. Faculty should at least take a few components of critical, analytical thinking, and logic to teach their students. Subjects such as inductive, deductive reasoning, fallacies, observation, and credibility will be encountered by the students at various times during their academic career therefore they need to put these into application. For instance, when they perform a search online for a research project for class, students need to evaluate the credibility of the source and need to make a conscious decision about the validity of the information that was given to them. It is the responsibility of the professor then to teach them about sorting through information, assessing credibility, in order to make a valid conclusion.

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AND**

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