A Study of the Critical Thinking Skills of Seventh Graders

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Abstract

This paper explores the concept of Critical Thinking (CT). Today's educational environment claims to value CT and yet we are daily remained that many people seem to lack the ability to think critically. This study seeks to answer the question; are we rewarding and encouraging CT in our young adolescent students? What follows is a quantitative study of the current state of CT skills in seventh grade students, and whether there is a link between student achievement in social studies, and their demonstrated level of CT. This study employs a modified version of the Cornell critical thinking test level X to measure CT skills. What we find in this study is that there is no statistically significant ($p > .05$) correlation between participant's social studies class scores and their CT scores.

A Study of the Critical Thinking Skills of Seventh Graders

Critical thinking (CT) has become a buzzword in today's educational environment. Many school districts around the country claim to teach it, yet there is little consensus as to what CT is and how to measure it, let alone teach it. Some experts even question if it can be taught. Choy and Oo point out that "Students may not be able to think critically because their teachers are not able to integrate critical thinking sufficiently into their daily practice" (2012, p. 168) This failure to "integrate critical thinking" in to daily teaching practice and the disconnect between the clear desire by the educational community to instill CT in their students, along with the questions of what makes up CT and how to teach it, if you can at all, has lead me to my research questions. Are teachers teaching CT in the classroom? Are high achieving students better at CT? Is there a correlation between a student's grade and their level of CT? My personal philosophy on the importance of CT has lead me to these questions and are summed up by Morgan and Rasinski when they said that "As critical thinkers, [students] must learn that it can be problematic to rely on a single source for information. Specifically, providing students with opposing views of a particular event [or issue] might also help them better understand why investigating multiple sources is necessary" (2012, p. 587).

There has been very little quantitative research done around how specific teaching methods or techniques affect student CT skills. This is likely, in part, due to the lack of a universal definition of CT. Assuming that CT is a process that includes measurable skills such as inductive and deductive reasoning, observation, credibility assessment, and the identification of assumptions, I want to identify if the Jr. High classroom today is helping or hurting the development of CT. I have chosen Jr. High as the starting point of this

research for two reasons. First, Piaget, as described by Brown and Knowles, "developed a theory about how people make sense of their world." He suggested that Jr. High students are in transition, moving from Concrete Operational thought (understanding what you can see, feel, and touch) to Formal Operational thought (being able to understand more abstract ideas and concepts) (Brown & Knowles, p. 29). Pinkney and Shaughnessy argue, "research suggests that, while nearly all adults and adolescents of western cultures can reason at the Concrete Operational stage, only about one third of US high school graduates are capable of Formal Operational thought. Thus, critical thinking should be taught within the Concrete Operational skills" (2013, p. 346). This cognitive development stage within young adolescents, and the suggestion that not all students will move fully in to the Formal Operation stage, gives teachers a golden opportunity, and duty, to develop the foundation of deeper thinking within our students as we help them move through adolescents and develop in to Formal Operational thinkers. This makes the question of whether or not CT is being taught at this critical stage of development an important one indeed. Secondly, my own personal inclination is towards the young adolescent, and what we are doing as an educational industry to help set the stage for the future success of our students.

Literature Review

Any study into critical thinking (CT) and the ability to teach it requires an in-depth look at how CT is defined. The literature reveals that among academics and other experts there is little consensus as to what constitutes CT. The Oxford dictionary defines CT as "the objective analysis and evaluation of an issue in order to form a judgment" (2013). Brookes and Lin describe CT in a school context as follows, "critical thinking

involves participants (students) becoming increasingly involved in a specialized form of argument that has fixed epistemic rules, but whose rules are seldom made explicit" (2010, p. 5). While these definitions seems compelling they do not tell us what skills make up CT, what the "epistemic rules" are, or how those rules or skills apply to the process of thinking critically. Nicholas and Roth (2011) identify three primary approaches to defining CT: the rationalistic approach, the skills approach, and the critical philosophical approach. Some believe, as Ennis (1985) does, that CT centers on decision-making processes. He states that CT is "a form of rational, reflective thinking, focused on deciding on what to believe or do" (p. 46). This definition falls under the rationalistic approach to defining CT, which is "focused on empiricism as the means to reach the desired outcome as a result of the CT process" (Nicholas & Ross, 2011, p. 3-4). The skills approach is similar to the rationalistic approach except it focuses on "formal logic and deductive processes" (p. 4). An example of the skills approach is provided by Shim and Walczak (2012) who state that, "critical thinking encompasses the process of solving problems and making decisions with specific skills and dispositions" (p. 17). Those who hold to the skills approach "treat CT as a generic and independent skill [that] can be taught outside disciplinary context" (Nicholas & Ross, 2011, p. 4). Both the rationalistic, and the skills approach, "focus heavily on rationalistic measurable aspects of CT like logic, analysis, inference, and deduction that lead to a desired conclusion" (Nicholas & Ross, 2011, p. 4). The critical philosophical approach on the other hand "focuses on multiple ways of knowing with the goal to deconstruct established principles and current ways of knowing" (p. 4). "Socrates philosophized on a method for intense, probing questioning aimed at analyzing and evaluating ideas commonly believed to be

true but that often had little to no scientific merit" (Emerson, 2013, p.3). Garside falls in to this camp with his definition of CT as "a controlled sense of skepticism" (1996). The critical philosophical approach focuses on the uncertainty of knowledge and places an emphasis on questioning, wondering, and ambiguity. These traits don't fall comfortably into a measurable scale (Nicholas & Ross, 2011, p. 4). The critical philosophical approach also tends to believe that CT can only be measured within specific disciplinary contexts (Nicholas & Ross, 2011).

Within the three main approaches of defining CT there is also an argument that arises questioning whether creative thinking and critical thinking are: the same thing, two separate entities altogether, or are separate yet inherently connected concepts. Shim and Walczak (2012) quote Ennis (1993) who stated, "creative thinking is generating new ideas or arguments, whereas critical thinking is analyzing or reasoning the pre-existing arguments, and forming informed decisions or views based on this reasoning" (2012, p. 17). Ennis clearly believes that creative thinking is not at all connected to CT. Shim and Walczak walk the line neither confirming nor denying creative thinking and CT's relationship with one another. They systematically point out both sides of the argument and leave it there without adopting either side. Nicholas and Ross sidestep the question altogether never mentioning the argument and only address CT in terms of the various approaches described above.

Aside from the definition question of CT, there is a major trend in the literature that cannot be ignored. Almost all the studies that I have looked at include some component of self-reporting. That is, most studies included a survey or other self-reporting tool that was given to the students who received the treatment to find out how

they felt about how effective the treatment was. This was true for both qualitative and quantitative studies. Shim and Walczak (2012) included a post treatment survey as well as quantitative testing data. Geissler, Edison, and Wayland (2012) conducted a study that relied solely on self-reported results after the treatment had been applied. Nicholas and Roth (2011) conducted a qualitative study that was based on self-reflection and self-reported actions of college faculty. The interesting fact is that regardless of the method, the researchers felt it necessary to validate their claims through self-reporting tools. Shim and Walczak (2012) who claimed they were doing a solidly quantitative study still seemed to feel the need to use self-reporting. They stated, "self reporting has become a widely used method of gathering information" and "researchers generally agree that self-report measures are valid within certain limits" (p. 18). After laying out their claims, they spent the time to justify the use of self-reported data by indicating that there was a connection between self-reported results and quantitative test results. Geissler, et al. (2012) using only self-reported data, attempted to build a quantitative analysis to support their findings. The researchers need to use self-reported data may be a result of an unclear definition of CT. Since they were unclear within their own minds about the definition of CT, they may have felt it necessary to get their students opinions to justify their findings. Whatever the reason for using self-reported data, it is clear that in studies concentrating on ways to improve CT, self-reported data is seen as an important component.

The self-reporting debate leads into the question of how to measure CT. As mentioned above some researchers feel self-reporting data is either the only or at least a good way of measuring CT. Nicholas and Roth on the other hand suggest that using "a

combination of formative and summative forms of assessment" and combining that "with observation, listening to, and challenging students' thought processes" (2011, P. 11) was the only accurate way of measuring CT. Nicholas and Roth come to the conclusion that regardless of the subject area being taught, CT can only be measured by observing the process of CT as the students engage in it. This has led Nicholas and Roth to the conclusion that multiple-choice tests are an inadequate measure. Shim and Walczak use some self-reporting but also utilize other empirical measures such as Collegiate Assessment of Academic Proficiency (CAAP), and the National Survey of Student Engagement (NSSE). Other methods used to "test" for CT include the California Critical Thinking Skills Test, the Watson-Glaser Critical Thinking Assessment, and the Cornell Critical Thinking Test. As a rule, those that fall under the rationalistic approach to defining CT tend to feel that observation is a critical component to measuring CT. Those that fall under the skills approach tend to accept the use of multiple choice institutional testing such as described above. Those that accept the critical philosophical approach tend to fall in line with the rationalistic approach in arguing that you must observe the action of CT in process in order to measure it, but they also tend to question whether putting a level of proficiency on CT is even possible.

As it pertains to my research study, the key ideas I draw from the literature are that: CT is difficult to define outside of one of the three approaches, how CT is measured will depend upon which of the three approaches someone subscribes to, and, researchers seem to think self reporting is an important component to critical thinking research. For the purposes of my research I will be accepting the skills-based definition of critical thinking and I will attempt to use one of the listed multiple-choice measuring tools in

order to establish a baseline level of CT in my test subjects. At this time I am unconvinced that self-reported measures will provide any benefit to my specific research.

Methodology

My goal is two fold, first I want to evaluate whether or not students are currently being taught to think critically, and second, I want to find specific ways to help teachers improve the critical thinking skills of their students. With this in mind, I conducted a quantitative study that measured the current level of CT in a population of seventh grade students. Then, I compared the student's grade within one of their core academic classes to their level of CT as determined by their performance on a modified version of the Cornell critical thinking test level X. I am assuming for this study that critical thinking is made up of five measurable skills: Inductive reasoning, Deductive reasoning, Observation, Credibility assessment, and Identification of assumptions. The Cornell critical thinking test, level X, measures all five of these skills. I am using level X because it "is aimed at students in grades 4 – 14. Level X is a 71-item multiple-choice test" (Ennis, Millman, and Tomko, p. 1). Due to time constraints and scheduling difficulties I was forced to modify the test by omitting 19 questions, bringing the total of multiple-choice items down to 52. The omitted items were strategically chosen in order to minimize any negative effect on the tests reliability. A balanced number of items were omitted from each section. See appendix A for a full list of questions that were omitted. I chose a convenience sample of 126 seventh grade students from five separate class periods at Kenmore junior high school that I was student teaching in. Of the 126 students that participated in the study, the data for 13 students was thrown out due to lack of information. Two cases involved students not identifying themselves (no name on their

answer sheet), making it impossible to verify final class grade and gender. 11 were unable to finish the test in the allotted time. To include these students would have resulted in a skewing of the scores for one or more categories of the assessment. All five periods were the same class, Washington State history and geography. All participants were between the ages of 12 and 14 years old. I administered the modified Cornell critical thinking test level X to all classes on the same day giving each group exactly 35 minutes to complete the test. The test was given 5 weeks before the end of the school year. I collected the overall class grades for all the students at the end of the semester. I then scored each test and compiled the data along with the students final grades for the second semester into an excel spreadsheet to analyze the data.

There are several potential threats to validity that must be considered. First, I am using a nonrandom convenience sample to select students for the study. By choosing a convenience sample I am limiting my ability to generalize the results of the study. I am also at greater risk of having one higher performing class, or one lower performing class that can skew the results. Second, since the classes were drawn from my student teaching experience, one of the classes was the first class of the day and one was the last class of the day. One was the class just before lunch and one was the class just after lunch. These factors may affect the student's performance and make it difficult to compare results from class to class. Third, and perhaps most significantly, I am using a modified assessment tool in the Cornell critical thinking test level X. By modifying the test to accommodate my timing and scheduling difficulties I am compromising the validity of the assessment as a whole. While I have made every effort to minimize this risk it should

be noted that future studies should utilize the complete and unedited version of the Cornell critical thinking test.

I believe this methodology is appropriate for my research questions because it can potentially provide concrete data on the current level of critical thinking within a typical Jr. High school setting. It can also shed light on whether schools are rewarding students that think critically with good scores or not. As my research questions deal strictly with finding current student performance levels in the five above listed skills, and how these levels compare with overall student scores for a core academic class, I will not be including self-reported surveys in my research, as they are unnecessary.

Results

Of the 113 valid tests, male students accounted for 48, and female students accounted for 65. The 113 students represent a good cross section of achievement. In table 1 below we see the final class grade frequency break down. The percentage of students on the low end of the spectrum, receiving a D+ or below was at 15.9%. While the percentage of students at the upper end of the spectrum, receiving an A- or above, was at 14.1%. This places 69.9% of the class in the middle of the spectrum, receiving a C- to B+. We can conclude from this information that this is a well-balanced sample.

Table 1

Frequency Table

Final Grade	Frequency	Percent	Valid Percent	Cumulative Percent
F	4	3.5	3.5	3.5
D-	4	3.5	3.5	7.1
D+	10	8.8	8.8	15.9
C-	13	11.5	11.5	27.4
C	14	12.4	12.4	39.8
C+	17	15	15	54.9

B-	7	6.2	6.2	61.1
B	17	15	15	76.1
B+	11	9.7	9.7	85.8
A-	6	5.3	5.3	91.2
A	10	8.8	8.8	100
Total	113	100	100	

In an attempt to check the validity of the modified version of the Cornell critical thinking test I ran a Pearson Correlation test. This test reveled that all the questions had a statistically significant ($p < .01$) correlation with one and other. Table 2 below shows that with the exception of observation/Assumptions and Credibility/Assumptions, which had a weak ($r = .288$) yet still significant ($p < .01$) correlation, all of the other sections showed a moderate to strong correlation with each other. This suggests that the modified Cornell critical thinking test maintained its validity despite the omitted questions.

Table 2

Correlation Table

		Induction Score	Deduction Score	Observation Score	Credibility Score	Assumptions Score
Induction Score	Pearson Correlation	1	.455**	.520**	.520**	.335**
	Sig. (2-tailed)		0	0	0	0
	N	113	113	113	113	113
Deduction Score	Pearson Correlation	.455**	1	.391**	.391**	.715**
	Sig. (2-tailed)	0		0	0	0
	N	113	113	113	113	113
Observation Score	Pearson Correlation	.520**	.391**	1	1.000**	.288**
	Sig. (2-tailed)	0	0		0	0.002
	N	113	113	113	113	113
Credibility Score	Pearson Correlation	.520**	.391**	1.000**	1	.288**
	Sig. (2-tailed)	0	0	0		0.002
	N	113	113	113	113	113
Assumptions Score	Pearson Correlation	.335**	.715**	.288**	.288**	1

Sig. (2-tailed)	0	0	0.002	0.002	
N	113	113	113	113	113
**. Correlation is significant at the 0.01 level (2-tailed).					

Using norms data provided by Ennis et al. (1985, p. 8-9), within the testing manual we can compare our test group to others that have been tested based on the original test. Table 3 shows the mean results for four "norm groups" (XG, XI, XJ, and XO) who have been used to establish normal CT ranges for Jr. High students, as well the overall mean for our test group (ZA). By comparing our test group to others we can further judge the validity of the modified version of the test. It is important to note that each of these "norm groups" were tested back in the 1980's and thus represent a different generation of students to that of our group. So, while it would be tempting to use the data to compare our group to others around the country, we are unable to do so with any confidence. Instead we can simply infer from the mean scores if our modified test is valid, based on the established norms. From the data it would seem that our modified version of the test is indeed inline with established norms. Our mean is right in the middle of the pack, as seen in table 3. See appendix B for a description of each of the "norm groups".

Table 3

Norm Table

Group	Mean
XG	57.90%
XI	40.10%
XJ	46.80%
XO	56.60%
ZA	48.40%

While there were slight differences in the scores between male and female participants there appeared to be no statistically significant ($p > .05$) difference overall. Figure 1 shows the average scores for each of the five sections of the test: overall, for males, and for females. Similarly, while there was some variation there was no statistically significant ($p > .05$) difference from one class period to another. It would seem from the data that it makes little difference if you take the test first thing in the morning or just before or after lunch.

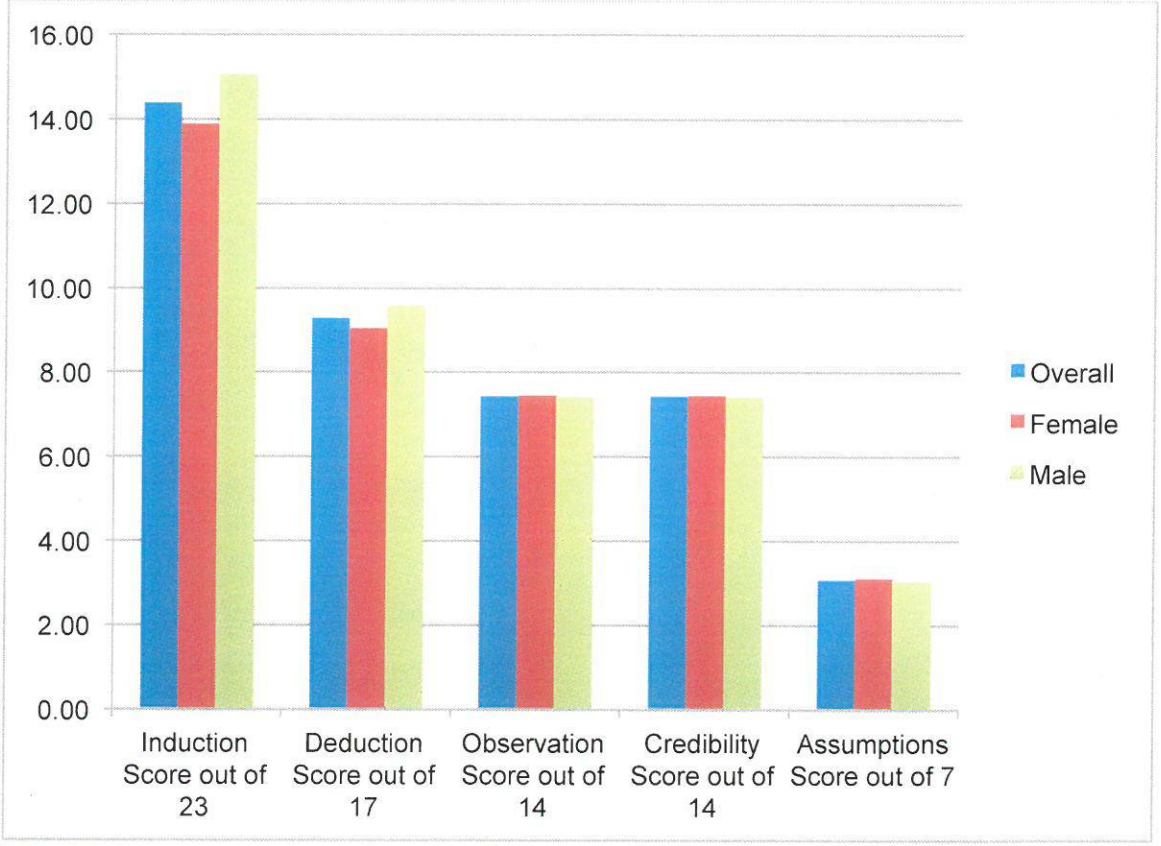

Figure 1. Average score for each section of assessment.

Looking at each section individually we find that induction was clearly the strongest category for the students in this study. The average score was 62.2% with the top score 95.7% and a low score of 26.1%. This was also the section with the most questions. Coming in second was deduction with an average score of 54.6% and a top

score of 94.1% and a low score of 17.6%. Observation and credibility were measured using the same questions on the test and therefore their scores are identical, representing third place. The average observation and credibility score was 53.2% with a top score of 85.7% and a low of 7.1%. Assumptions were by far the most difficult section for this group of students. The average score for this section was 44.0% with one student pulling off a top score of 100.0% but two students coming in with 0.0%.

Finally when comparing test performance with student class grades the study showed no statistically significant correlation. Figure 2 below shows the score break down based on final grade. As you can see students with an F in the class consistently preformed below the other groups but beyond that there is little consistency from one grade category to the other.

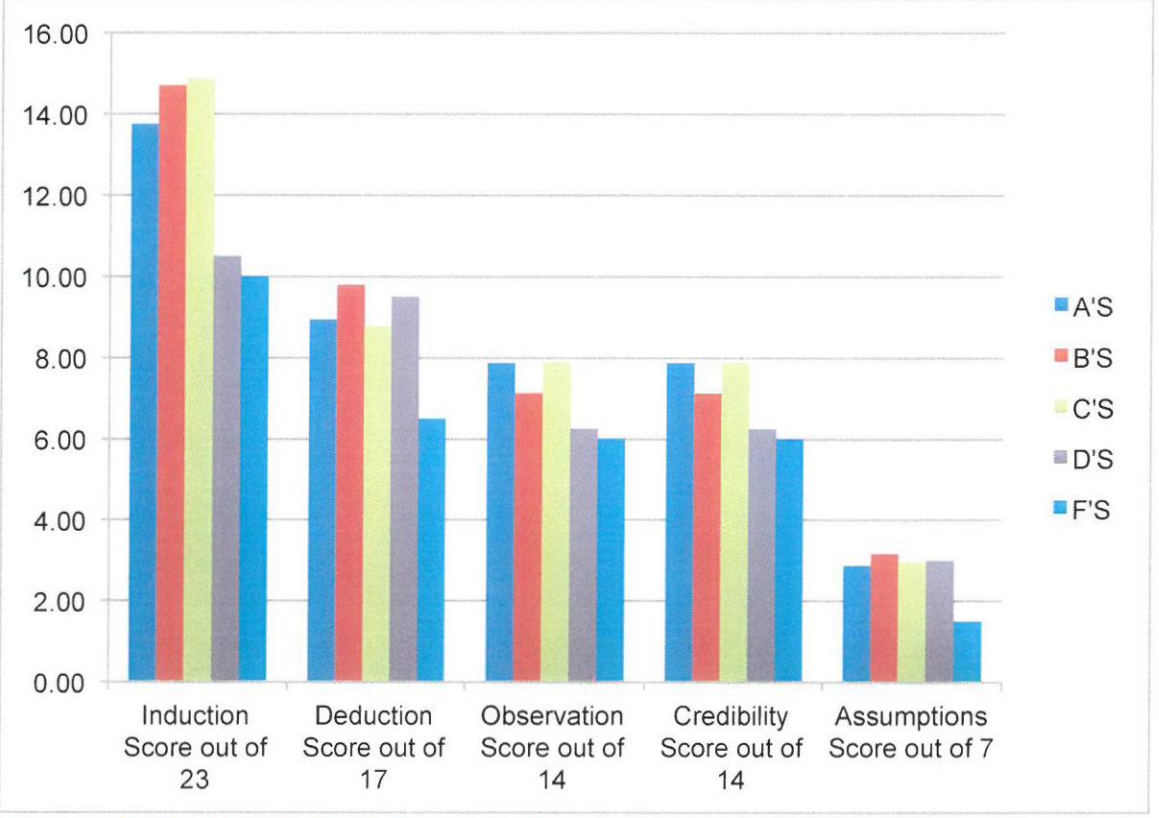

Figure 2. Test break down based on class grade.

On the same Pearson Correlation test used above to evaluate the validity of the modified test, there was a very weak ($r = .113$, $p > .05$) correlation with the induction score and the final grade for the class. Correlation with deduction and final grade was even weaker ($r = .079$, $p > .05$). Observation and credibility were also very weak ($r = .130$, $p > .05$). Assumptions and final grade was weak as well ($r = .111$, $p > .05$). These numbers did not improve much when evaluated by gender, with one notable exception. For both sexes, the assumptions score changed considerably. The change was still not statistically significant ($p > .05$) but it is interesting just the same. The males showed a negative correlation with a score of $r = -.238$. While the females showed the opposite with a score of $r = .270$.

Discussion

This study has attempted to answer the questions; are teachers teaching CT in the classroom? Are high achieving students better at CT? Is there a correlation between a student's grade and their level of CT? The first thing we need to remember is that for this study we have assumed a skills approach to CT. Specifically we have identified five skills that we believe make up CT: inductive and deductive reasoning, observation, credibility assessment, and the identification of assumption. The results above give us some things to think about. The big news for this study is clearly that there seems to be no correlation between the test group's level of achievement in their social studies class and their ability to think critically as tested by our modified Cornell critical thinking test. Looking at figure 2 above we can see some interesting trends. First C level students did better or equally as good as the A level students in three of the five categories. As a mater of fact, A level students did fairly poor overall, only being able to tie for first place

in two categories, observation, and credibility. We also see that the D level students did particularly well in the deduction category, coming in at a close second place right after the B level students. Looking at figure 2 and seeing the correlation study scores listed above we can say with confidence that, at least within this group of students from this particular class, CT is not tied to student performance. We must remember that we are not evaluating each student's cumulative GPA for all classes. This means that it is entirely possible that there is a correlation between CT and other subject area classes. As far as it goes, this study has some major implications for the social studies department within this school at the very least. If a student can achieve an A in social studies and yet can not demonstrate a high level of achievement on a CT test then it stand to reason that the class is not designed to rewarded or encourage the five CT skills being measured. This begs the question, what kind of thinking and skill sets are being rewarded?

Some good news from this study might be that there was not a significant difference between the male and female results. This suggests that there is no gender gap, or bias within this school setting when it comes to these five CT skills. The next question to ask would be how these gender results compare to the population in general. It would also be interesting to see if there are differences based on other factors such as country of origin, or ELL status.

Based on these results, my classroom is going to look different in the future. First I want to connect overall class achievement to CT. I plan on doing this by implementing a couple of suggestions that I came across as I did my research for this study. The first is to incorporate a slightly modified version of the "six hats activity" that was developed by Gary L. Geissler, Steve W. Edison, and Jane P. Wayland of the University of Arkansas,

in to my lessons. The technique identifies six categories of thinking and assigns a different colored metaphorical hat to each (see appendix C). The students have to argue from the perspective of their hat. This makes students think about the topic in a way they may never have before. Another technique I will incorporate in to my lessons is the use of "minute papers" at the end of selected class sessions as described by LaPoint-O'Brien of Franklin Pierce University (2013). Minute papers are short written analysis done by the student at the end of a given lesson. The students are presented with a prompt and are then given several minutes to write an analysis based on the prompt and the lesson that was taught. They end the minute paper by asking an insightful question on the topic at hand. The papers are then evaluated based on the rubric in appendix D.

Recommendation for future study would include repeating this study using the complete Cornell critical thinking test level X, and comparing the participants full cumulative GPA instead of just the final grade for one class. Although, it would also be interesting to compare the participant groups scores in each core subject area in order to see if one area is more successful than others in rewarding and encouraging CT skills. I plan to implement single technique changes as mentioned above while incorporating a pre and post test to see what techniques are most helpful in building CT skills in young adolescents.

If all we do as teachers is reward the student that can look up information and repeat it back at us, or the student that can follow directions well, or the well organized student that can remember what worksheet is due when, then we fail to educate. Instead all we are doing is creating a generation that will be unable to make up its own mind about the issues that face them in the future.

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Appendix: A

Omitted Questions From Cornell Critical Thinking Test Level X

9 questions from the Induction and Deduction sections:

13, 17, 53, 55, 59, 64, 68, 72, 75.

10 questions from the Observation and Credibility sections:

30, 33, 40, 41, 42, 43, 44, 45, 46, 47.

3 questions from the Assumptions section:

68, 72, 75.

(Note that some questions overlap in to multiple categories)

Appendix: B

"Norm Groups" Descriptions

XG All the student in the seventh and eighth grades in a central school in upstate New York. A slight attempt was made to teach the students some of the basic ideas assessed by the test before administering it (Mean IQ = 108; N = 110)

XI Eighth-grade students from a suburban school in Ohio (Mean IQ = 115; N = 77)

XJ Same group as XI, two months later, after receiving some instruction in semantics, logic, and study skills (N = 77)

XO Seventh-, eighth-, and ninth-grade students in a large city in Southern California, selected for their representativeness (range of ability, socio-economic background, ethnicity) of the city's schools (N = 200)

Appendix: C

The Six Hats Color Breakdown

White – neutral and objective, this hat asks, "what do we already know and what information do we still need?"

Red – deals with feeling, hunches, and intuition; this hat asks the question, "how do we feel about the topic?"

Black – devil's advocate, or, why it won't work/can't be done; this hat challenges the viability of the topic.

Yellow – optimist, this hat asks, "How can we make this work?"

Green – creativity, this hat focuses on new ideas and alternatives.

Blue – manager, this hat facilitates, sets the agenda, and keeps all the others on task

Appendix: D

Minute Paper Scoring Rubric

The rubric used to score the student's minute papers will be given to each student in order for them to fully understand what is expected.

Consistently does all or almost all of the following: Accurately interprets evidence, statements, and questions. Identified the arguments, thoroughly analyzes and evaluates major alternative points of view. Draws warranted conclusions. Explains assumptions. Fair-mindedly follows where evidence and reasons lead.	4
Does most or many of the following: Accurately interprets evidence, statements, and questions. Identified the arguments, thoroughly analyzes and evaluates major alternative points of view. Draws warranted conclusions. Explains assumptions. Fair-mindedly follows where evidence and reasons lead.	3
Does most or many of the following: Accurately interprets evidence, statements, and questions. Identified the arguments, thoroughly analyzes and evaluates major alternative points of view. Draws warranted conclusions. Explains assumptions. Fair-mindedly follows where evidence and reasons lead.	2
Consistently does all or almost all of the following: Offers biased interpretations of evidence, statements, questions, information, or the points of view of others. Fails to identify or hastily dismissed strong, relevant counter-arguments. Ignores or superficially evaluates obvious alternative points of view. Argues using irrelevant reasons and unwarranted reasons. Regardless of evidence or reasons, maintains or defends views based on self-interest or preconceptions. Exhibits close-mindedness or hostility to reason	1