

Critical Thinking Skills and Academic Maturity: Emerging Results from a Five-Year Quality Enhancement Plan (QEP) Study

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The QEP that was implemented in this study focused on enhancing students' critical thinking skills. A pretest/ posttest approach was used to assess students' critical thinking progress in freshman level core English and Math courses. An intervention was performed involving intensive instruction and assignments relating to a set of reasoning strategies such as: analytical, analogical, inductive, deductive, and comparative reasoning, among others. When students performed well on assignments by applying the reasoning strategies, it was assumed that critical thinking occurred. However, pre/ posttest results in these classes were often disappointing, and seemed at times to suggest that freshmen are not very good critical thinkers. Whereas, when another critical thinking national assessment, the Collegiate Assessment of Academic Proficiency (CAAP) Exam was given during the sophomore, or junior year, students performed very well. Thus, the hypothesis that critical thinking skills may be impacted by academic maturity began to emerge.

Introduction

It is a requirement for all colleges and universities, which are accredited by the Southern Association of Colleges and Schools – Commission on Colleges (SACSCOC) to establish a five to ten year quality enhancement plan (QEP). The plan must specify a student engagement focus area, and the institution is expected to implement strategies to promote and assess its performance in this area. The institution where this study was conducted is located in the southern United States, and SACSCOC is its accrediting agency.

The Quality Enhancement Plan (QEP) for this institution focuses on enhancing critical thinking (ECT). When this QEP was developed in 2009 and implemented in 2010, the ECT focus was decided upon and buy-in was garnered from the entire academic community, which included administrators, students, faculty, staff, and alumni. At the outset, there were two notable challenges relating to the decision to focus on ECT: 1) it was important to establish what was meant by “critical thinking” in the context in which the term would be used with the QEP; and 2) it was important to know how “critical thinking” would be assessed once it occurred.

Even though use of the term “critical thinking” is becoming more commonplace, a clear definition for what it means has been elusive. Mulnix (2012) noted that one of the difficulties with whether critical thinking can be taught or even measured is widespread disagreement over what critical thinking actually is. Ahern, O’Connor, McRuairc, McNamara, and O’Donnell (2012) shared a similar thought by asserting that the way critical thinking is understood and defined varies quite significantly between disciplines.

For the purpose of this study, critical thinking was defined as the degree to which students were able to apply reasoning strategies, which were taught in classes that were part of the QEP study. Faculty who taught these classes were given a prepared manual, which provided guidance and assignments based on a list of higher-order reasoning strategies. Assignments in these courses were designed to cause students to apply the strategies, which when measured, were used to infer that critical thinking occurred. Some of those reasoning strategies included: analytical, analogical, inductive, deductive, and comparative reasoning.

Two assessment approaches were used to measure the degree to which critical thinking occurred. The first approach was the use of pre/ posttests. The second approach was the use of results from the critical thinking section of a national exam called the Collegiate Assessment of Academic Proficiency (CAAP). These two approaches helped to measure the impact of the critical thinking intervention in QEP designated classes. This study reports on results from these two assessment approaches.

Literature Review

Loughman, Hickson, Sheeks, and Hortman (2008) provided a list of key elements as established by SACSCOC for institutions that are putting together a QEP. These elements included: (1) focus, (2) institutional capability and the initiation and continuation of the plan, (3) assessment of the plan, and (4) broad-based community involvement. Harris (2013) noted that QEP topics may focus on a single educational initiative or may combine several efforts in order to enhance and assess student learning. Katsinas, Kinkead, and Kennamer (2009) concluded that the reaffirmation of accreditation, along with the selection of the QEP works best when all stakeholders of the institution are involved in the planning process.

Flores, Matkin, Burbach, Quinn, and Harding (2012) argued that although higher education understands the need to develop critical thinkers, it has not lived up to the task

consistently. These authors noted that students are graduating with deficient critical thinking skills, and are unprepared to think critically once they are in the workforce. Hammer and Green (2011) claimed that while there appeared to be broad acceptance that university graduates must have the capacity to think critically in an increasingly complex, information-rich world, there remains a gap between aspiration and teaching practice among faculty. Crenshaw, Hale, and Harper (2011) also reiterated this claim by stating that due to lack of faculty familiarity with the concept of critical thinking, compounded by student resistance to putting forth the intellectual labor to taking charge of their own thinking, they are mainly exposed to didactic instruction, which does not prepare them with real-world problem-solving skills.

There are differing opinions about the value of implementing critical thinking curricula into the classroom. For example, Cotter and Tally (2009) conducted research which suggested that giving critical thinking assignments did not have a positive effect on formal operational thought or critical thinking skills. On the other hand, Barnett and Francis' research (2012) showed the complete opposite. Results from their study suggested that sections of an educational psychology course in which higher order questioning (critical thinking) was implemented performed significantly better than sections where this approach was not used.

Stein and Haynes (2011) stated that many experts believe it is essential to develop faculty-driven assessment tools in order to engage faculty in meaningful assessment that can improve student- learning. Snyder and Snyder (2008) proposed the idea that actively engaging students in project-based or collaborative activities can encourage students' critical thinking development if instructors model the thinking process, use effective questioning techniques, and guide students' critical thinking processes. Although faculty are expected to be better facilitators of the critical thinking learning environment, Jones (2012) contends that fostering critical thinking requires shifting from a teacher-centered classroom to a critical thinking-centered classroom. According to Jones this involves relinquishing the role of a teacher as the sole disseminator of knowledge, and structuring lessons to allow for student inquiry, research, and collaboration.

Population

The institution where this study was conducted is a small Historically Black College and University (HBCU) with an enrollment of approximately 3200 students, located in the southern United States. As of fall 2012, the freshman class was made up of 47% male and 53% female. The average high school GPA of entering freshmen was 2.76; average verbal SAT score was 428; and average math SAT score was 423 (Institutional Fact Book, 2012). A disproportionate number of these students entered college without the requisite preparation in areas such as reading, writing, and math. This has been a continuing trend, which impacts retention and graduation rates, which in 2012 were 58.4%, and 37% over four years respectively. Students who possessed deficient skills, particularly in reading and writing, were most certain to also lack training in applying higher order thinking skills that were necessary to demonstrate proficiency in critical thinking.

Methodology

The QEP for this institution was approved by the SACSCOC in fall 2009, and implemented during the 2010-2011 academic year. With enhancing critical thinking being the focus, the plan to ensure that most, if not all, students were impacted by critical thinking pedagogy was to select core curriculum classes, which all students were required to take during their freshman year. Freshman English and Math core courses were selected. Faculty teaching these courses engaged in course redesign efforts, and created instructor manuals, which were used to teach the identified reasoning strategies. A student manual was also created with examples and exercises relating to each reasoning strategy that was taught in class. Class sections where these manuals were used were considered to be critical thinking intensive classes.

Institutional Research Board (IRB) approval was sought and received in order to collect data from the courses designated as critical thinking intensive. Students were selected based on their enrollment in Freshman English and Math courses. At the beginning of each semester the students were asked by their professors to sign consent forms so that data from the courses may be used in the QEP study.

During the early stages of implementation, certain sections of Freshman English and Math courses were designated for critical thinking intensive content, while others were not for the purpose of doing comparative analyses of the sections. It was discovered after the first year

that even though students in critical thinking sections routinely performed better than those in sections that were not, there were outlying factors which made it difficult to attribute the difference in performance to the critical thinking intervention. For example, critical thinking intensive sections were smaller because they were labeled during class registration, and once students discovered that they would be taught differently in those sections they tended to avoid them. This led to smaller classes, which in itself may have led to better results without implementing any critical thinking intensive interventions. Additionally, it was discovered that pretest scores for students in critical thinking sections were routinely better on average than the other sections. This meant that better students were choosing critical thinking intensive sections, which may have been impacting results. Finally, the connotation of some sections being labeled “critical thinking” gave the wrong impression about sections, which were not so labeled. Consequently, in spring 2012 semester, all labels were removed and intensive critical thinking content was implemented in all sections.

Pretests were administered at the beginning of each semester in order to determine students’ critical thinking aptitude. Posttests were administered at the end of the semester so that inferences could be made about the impact of critical thinking interventions during the semester. The design of the pre/ posttests was much similar to that of the critical thinking section of the CAAP exam. Students were also required to take the CAAP exam after completion of 45 semester credits. Results from in-class pre/ posttests as well as those from the CAAP exam formed the basis of the results from this study.

Questions

Results were based on the following questions:

1. What was the difference in pre and posttest average scores of students in QEP/ ECT English 2 courses?
2. Were there overall statistically significant differences in pre and posttest scores in QEP/ ECT English 2 courses at the .05 alpha level?
3. What were the differences in pre and posttest average scores of students in QEP/ ECT Math 1 and 2 courses?
4. Were there statistically significant differences in pre and posttest scores in QEP/ ECT Math 1 and 2 courses at the .05 alpha level?

Null Hypothesis ($H_0: \mu_1 < \mu_2$)

There is a statistically significant difference in pretest and posttest scores in QEP/ ECT English 2, and QEP/ ECT Math 1 and 2 courses.

Results

Results over the past five years have been mixed and somewhat surprising in the sense that while student performance on in-class pre/posttests have not been good, their performance on the critical thinking section of the national CAAP exam has been increasingly encouraging. In cases where there was a statistically significant difference between pre and posttest scores, the difference was found to be due to the fact that average pretest scores were so low that moderate or significant improvement in posttest scores may have impacted the measure of statistical significance.

In some cases where pretest and posttest scores were relatively good, if the average margin of improvement was not very wide, statistical significance was not shown. These results have sparked numerous course redesign and pedagogy adjustments.

Following spring 2012 semester the pre/ posttest was no longer administered in English 1, because faculty observed that some students were struggling with deficiencies in college level reading and writing. Therefore, they deemed it better to address those deficiencies first before moving on to higher-order thinking activities. All of the courses identified in this paper have been renamed to conceal their identities. The following tables summarize pre/ posttest results over the five-year period (mid-point) of the QEP.

Table 1 provides a summary of results in English 1 classes. As mentioned earlier the critical thinking intensive content that was implemented in this course at the start of the QEP was discontinued at faculty's request to make way for the pressing need to improve deficiencies in reading and writing. It was hoped that with the posttest being the same as the pretest, results would be higher; however, average mean scores remained consistently moderate over the two-year period. There were also no statistically significant differences at the .05 alpha level between pre and posttest scores during any of the semesters except spring 2012, when pretest averages were low when compared to moderate improvement on the posttest.

Table 1: Pre-and-Post Test Results for English 1

Item	Fall 2010		Spring 2011		Fall 2011		Spring 2012	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	99.0	99	11.0	11	147	147	35	35
Mean Scores	78.6	76	73.2	74.0	80.6	74	74.05	67
Stand. Dev.	9.75		8.58		13.9			
P(T<=t) 1-tail	0.00		0.40		0.00		.005	
t Critical 1-tail	1.98		1.81		1.64		1.69	
P(T<=t) 2-tail	0.00		0.80		0.00		.01	
t Critical 2-tail	1.66		2.23		1.96		2.03	
ttest	0.28		-0.1		0.44			

Tables 2 and 3 summarize results from English 2 classes. This course is the second required English course in the core curriculum sequence and has also been renamed for the purpose of this article. Average pretest versus posttest results was encouraging during the earliest semesters of implementation. However, fall 2012 gave reason for concern. Low posttest results in fall 2012 may have been due to inadvertent use of different pre and posttests that semester. This may be borne out in the fact that average results the following semester, spring 2013, were better.

Table 2: Pre-and-Posttest Results for English 2 (Fall 2010 – Spring 2013)

	Fall 2010		Spr '11		Fall 2011		Spr. '12		Fall 2012		Spr. '13	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	41	41	36	36	38	38	171	171	134	134	249	249
Mean Scores	80	75	80.8	76.2	82.8	84	75.2	74	61.01	68.49	74.3	71.2
Stand. Dev.	11		11.8		9.68				15.96		2.41	
P(T<=t) 1-tail	.00		0.01		.24		0.04		1.6E-06		.00	
t Critical 1-tail	2.02		1.69		1.7		1.65		N/A		1.64	
P(T<=t) 2-tail	0.00		0.02		0.5		.08		3.1E-06		.00	
t Critical 2-tail	1.68		2.03		2.0		1.97		N/A		1.96	
Ttest	0.44		0.40		-0.1				.35		.21	
Pearson Corr.											.54	

Results in fall 2013 were once again very concerning. It was hoped that these results were not an indication of waning enthusiasm for the QEP by both faculty and students. As a result, steps were taken to reinforce the importance of the QEP at faculty meetings, and a new approach to testing was implemented. Apparently, faculty and students were beginning to feel inundated with testing. Therefore it became necessary to combine items from the QEP’s critical thinking test with other tests that were being used for institutional purposes. This approach yielded

significantly better results in fall 2014 and spring 2015 as noted in table 3. In each case, test of the P value $<.05$ indicated that the null hypothesis must be rejected. Results from the P value test seemed to support the finding of no statistical significance. Test of Pearson’s Correlation showed a positive correlation between pre and posttest scores in English 2 in spring 2015.

Table 3: Pre-and-Posttest Results for English 2 – (Fall 2013 – Spring 2015)

	Fall 2013		Spr. '14		Fall 2014		Spr. '15	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	115	115	348	348	153	153	175	175
Mean Scores	51.8	16.3	49.65	47.97	78.8	71.9	76.71	72.3
Stand. Dev.	19.6		11.46		9.39		7.30	
P(T<=t) 1-tail	0.96		0.09		0.00		0.00	
t Critical 1-tail	0.00		1.64		1.65		1.65	
P(T<=t) 2-tail	1.66		0.18		0.00		0.00	
t Critical 2-tail	0.00		1.96		1.96		1.96	
Ttest	.96		0.03		.63		.26	
Pearson Corr.	.09		.34		.44		.53	

Tables 4 and 5 give results from sections of the Math 1 course. This course is the first required Math course in the core curriculum and has been renamed for the purpose of this article. There were no statistically significant differences at the .05 alpha level between pre and posttest scores in any of the semesters. In some cases such as fall 2012 thru spring 2015, average pretest and posttest scores were extremely low. Test of the P value $<.05$ indicated that the null hypothesis should be rejected in all cases except spring 2012, when there was a borderline result of .055 on the posttest. In most cases, P value tests seemed to support the finding of no statistical significance. Tests of Pearson’s Correlation also consistently indicated no correlation between pre and posttest scores.

Table 4: Pre-and-Posttest results for Math 1 from fall 2010 – Spring 2013

Item	Fall 2010		Spring 2011		Fall 2011		Spring 2012		Fall 2012		Spring 2013	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	87.0	87	54.0	54.00	104	104	83	83	144	144	72	72
Mean Scores	70.8	54	75.5	54.40	72.8	50	58.13	54.7	56.71	41	53	41
Stand. Dev.	19.9		19.5		18.75				16.15		18.53	
P(T<=t) 1-tail	0.00		0.00		0.00		.055		.00		0.00	
t Critical 1-tail	1.66		2.01		1.645		1.66		1.64		1.67	
P(T<=t) 2-tail	0.00		0.00		0.00		.111		.00		0.00	
t Critical 2-tail	1.98		1.67		1.96		1.99		1.96		1.99	
Ttest	0.65		0.79		0.82				.71		.56	
Pearson Cor.							.399		.38		.44	

Table 5: Pre and posttest results for Math 1 from fall 2013 – Spring 2015

	Fall 2013		Spr. '14		Fall 2014		Spr. '15	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	105	105	91.00	91.0	81.	81.00	44.00	44.00
Mean Scores	49	41	37.38	29.09	39.04	29.20	42.07	27.82
Stand. Dev.	13.75		14.54		15.24		16.43	
P(T<=t) 1-tail	0.00		0.00		0.00		0.00	
t Critical 1-tail	1.64		1.66		1.66		1.68	
P(T<=t) 2-tail	0.00		0.00		0.00		0.00	
t Critical 2-tail	1.96		1.99		1.99		2.02	
Ttest	.44		.40		.44		.70	
Pearson Corr.	.24		.06		.01		.50	

Results from Math 2 classes are summarized in Tables 6 and 7. The Math 2 course is not a requirement in the core curriculum, except for students majoring in Science, Technology, Engineering, and Math (STEM) areas. Once again, there were no statistically significant differences at the .05 alpha level between pre and posttests scores in any semester. In some cases average pretest scores were extremely low and even though posttests scores showed improvement, the results indicated that many students were failing. Test of the *P* value <.05 seemed to support the finding of no statistical significance as it indicated in all cases that the null hypothesis must be rejected. These results were also accentuated by tests of Pearson’s Correlation, which consistently indicated that pretest scores were not reliable predictors of how students would perform on the posttests.

Table 6: Pre-and Posttest results for Math 2 from fall 2010 – Spring 2013

Item	Fall 2010		Spring 2011		Fall 2011		Spring 2012		Fall 2012		Spring 2013	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	37	37	39.0	39	33.00	33	44	44	57	57	59	59
Mean Scores	76.2	61	73.6	47.9	43.9	31.5	59.16	30.29	39.7	22.3	29.6	22.7
Stand. Dev.	20.8		59.5		19				18.11		12.4	
P(T<=t) 1-tail	0.00		0.03		0.00		7.4E-12		0.00		.00	
t Critical 1-tail	1.69		2.02		1.69		1.68		1.67		1.67	
P(T<=t) 2-tail	0.00		0.06		0.01		1.5E-11		0.00		.00	
t Critical 2-tail	2.03		1.69		2.04		2.02		2.00		2.0	
Ttest	0.65		0.30		0.45				.65		.40	
Pearson Cor.							.211		.32			

Table 7: Pre-and Posttest results for Math 2 from fall 2013 – Spring 2015

	Fall 2013		Spr. '14		Fall 2014		Spr. '15	
	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Observations	35.0	35.0	21.00	21.0	52.	52.00	24.00	24.00
Mean Scores	43.40	30.0	59.76	28.19	43.43	29.66	42.83	29.67
Stand. Dev.	16.60		26.07		25.47		14.08	
P(T<=t) 1-tail	0.00		0.00		0.00		0.00	
t Critical 1-tail	1.69		1.72		1.67		1.71	
P(T<=t) 2-tail	0.00		0.00		0.00		0.00	
t Critical 2-tail	2.03		2.08		2.01		2.07	
Ttest	.60		.79		.81		.67	
Pearson Corr.	.22		.25		-.03		.29	

As mentioned earlier, proficiency in critical thinking was also assessed at this institution using the critical thinking section of the Collegiate Assessment of Academic Proficiency (CAAP) exam. Students were required to take this portion of the exam and receive a scaled score in at least the top 56th percentile in order to meet the institution’s proficiency requirement. Students were contacted and prompted through Banner, which is the student management system, to take the exam when they earned 45 semester credits. This is after they have completed their sophomore year as a college student and are presumably more academically mature. There are 32 items on the critical thinking section of the CAAP exam.

Table 8, shows critical thinking scores on the CAAP exam. In those cases in the table where the indication “No data” is shown, those semesters pre-date policy changes, which later required the data to be kept. These scores were higher on average than scores on course-embedded pre/ posttests. The percentage of students who receive the requisite critical thinking score in the top 56th percentile improved from as low as 48% to as high as 65%. It is also worth noting that in many instances a significant number of students scored above the national average

in critical thinking. These results begged for further analysis as to why they were so much better than course-embedded assessments. It appeared that since students took the course-embedded assessments when they first entered college as freshman, while they took the CAAP exam after completing 45 credit hours, which is at the end of the sophomore year, this may have played a role in their improved performance. In other words, this difference may have been attributed to academic maturity.

Table 8: CAAP Results

Collegiate Assessment of Academic Proficiency (CAAP) Critical Thinking Summary										
Criteria	Fall 2010	Spr. 2011	Fall 2011	Spr. 2012	Fall 2012	Spr. 2013	Fall 2013	Spr. 2014	Fall 2014	Spr. 2015
No. of students tested	97	131	83	100	68	20	70	23	99	114
Scores Range	47 – 70	46-68	47 – 70	50-72	50 – 68	54-67	49-72	48-71	48-73	48-72
Avg. Scaled Scores	58.29	57.15	57.9	58.3	58.54	60	58.96	59.04	57.70	58.30
No. in top 56 th percent	Data not collected	Data not collected	Data not collected	Data not collected	33 (48.5)	13 (65)	43 (61.4)	13 (56.5)	53 (53.54)	59 (52%)
No. above nat'l avg.	Data not collected	Data not collected	Data not collected	Data not collected	28 (41)	12 (60)	35 (50)	9 (39)	27 (27.3)	51 (45%)
** Highest possible score = 72; as of fall 2014 highest possible score = 73										

Implications of Results

Results addressing the research questions in this study revealed that on average students performed poorly on the critical thinking pre/ posttests which were administered when they first entered this institution as freshmen. However, results from the critical thinking section of the CAAP exams, which were administered after the sophomore year, showed better results on average.

Another concern relating to students in this study was their level of seriousness and the attention they were likely to give to the course-embedded pre/ posttests, especially since they did not

factor into their grades, whereas meeting the critical thinking requirement on the CAAP exam was a prerequisite for graduation.

Overall, the findings from this study seemed to comport with the sentiment that incoming freshman students often lack college preparedness. Boser and Burd (2009) reported that as many as 66% of students leave high school unprepared for the rigors of college and the workplace. These authors also postulated that approximately 33% of college freshmen require remediation. While this study seemed to support those results it also seemed to provide hope that with persistence students can improve their academic performance.

Students in this study demonstrated that with time and academic maturity their performance, particularly in critical thinking improved. This means that if students can get beyond the point of simply being infatuated about being in college, to a point of seriousness about why they are there, and toward a focus on graduation, their performance can improve significantly. Factors, which speak to the issue of academic maturity are worthy of further examination, but they are believed to be significant contributors to the results observed so far in this QEP study.

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