

# Quantifying Assessment Of Undergraduate Critical Thinking

Michael Grant, University of Colorado Boulder, USA  
Marshall Smith, University of Colorado Boulder, USA

## ABSTRACT

*Enhancing students' critical thinking capabilities stands as the top goal of undergraduate education, according to faculty from many universities. We assessed the change in critical thinking skills with a sample of 176 students enrolled at either the University of Colorado Boulder (UCB) or Colorado College (CC) by employing the Critical-thinking Assessment Test (CAT) developed with collaboration and support from the National Science Foundation. Students' critical thinking progress was compared by assaying skills during the first and last weeks of the term in classes that expressly emphasized: (1) critical thinking, or (2) civic engagement, or (3) where, according to the class instructors, neither was a point of major emphasis. CAT scores improved significantly for students at both institutions, in different undergraduate students' critical thinking skills has been promin*

ent on the list of major objectives for higher education for many years (e.g., Bailin & Siegel, 2003; Mayweg-Paus, Thiebach, & Jucks, 2016; Kivunja, 2015). According to the Higher Education Research Institute's (HERI) faculty survey, "Full-time faculty with undergraduate teaching responsibilities overwhelmingly agree (99.1%) that developing students' ability to think critically is a "very important" or "essential" goal". In fact, since the HERI Faculty Survey first introduced this question in 2004, nearly a

alternative interpretations for data or observations, recognizing new information that might support or contradict an hypothesis, explaining how new information can change a problem; (3) **Learning and Problem Solving** skills to



changes in teaching methods as well as changes by university administrations. Despite the considerable resources



With those important caveats in mind, we see evidence that CC students generally began at a higher level of critical thinking skills, compared to UCB students, but still showed significant improvement for all class types. UCB students began at lower levels of critical thinking skills relative to CC students, but showed comparatively more improvement

**Table 4.** UCB Total Scores, Dunnett-Tukey-

All combinations showed positive change from beginning to end of the term with four of the six cells showing statistically significant improvement in their critical thinking scores. These students showed demonstrable improvement in critical thinking skills as measured by CAT over the course of a single term which, in the case of Colorado College, means improvement over a single course studied for only 3.5 weeks.

**Analysis of Student Performance on Individual CAT Questions**

In this section we shift the focus to our analyses of student performance on several individual questions of the Critical-thinking Assessment Test. Each question of the CAT probes a particular aspect of critical thinking. We first present an overview of the changes in student performance for all students on individual questions. Then we present an analysis of student performance on individual questions by class type from the beginning to the end of the term.

**Table 8.** Change in Mean Score as Percentage of Maximum Possible Points From Beginning to End of Term on Each Question for All Students. (Rounded to integers)

	Question Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
% change	18	22	6	4	1	-1	-8	13	3	11	16	5	8	18	7

Table 8 demonstrates improved critical thinking change in 13 of the 15 questions for all students that completed the Critical-thinking Assessment Test at CC and UCB.

**Figure 3.** Comparison of Mean Scores as Percentages of Maximum Possible Points per Question by Class Type for All Students.

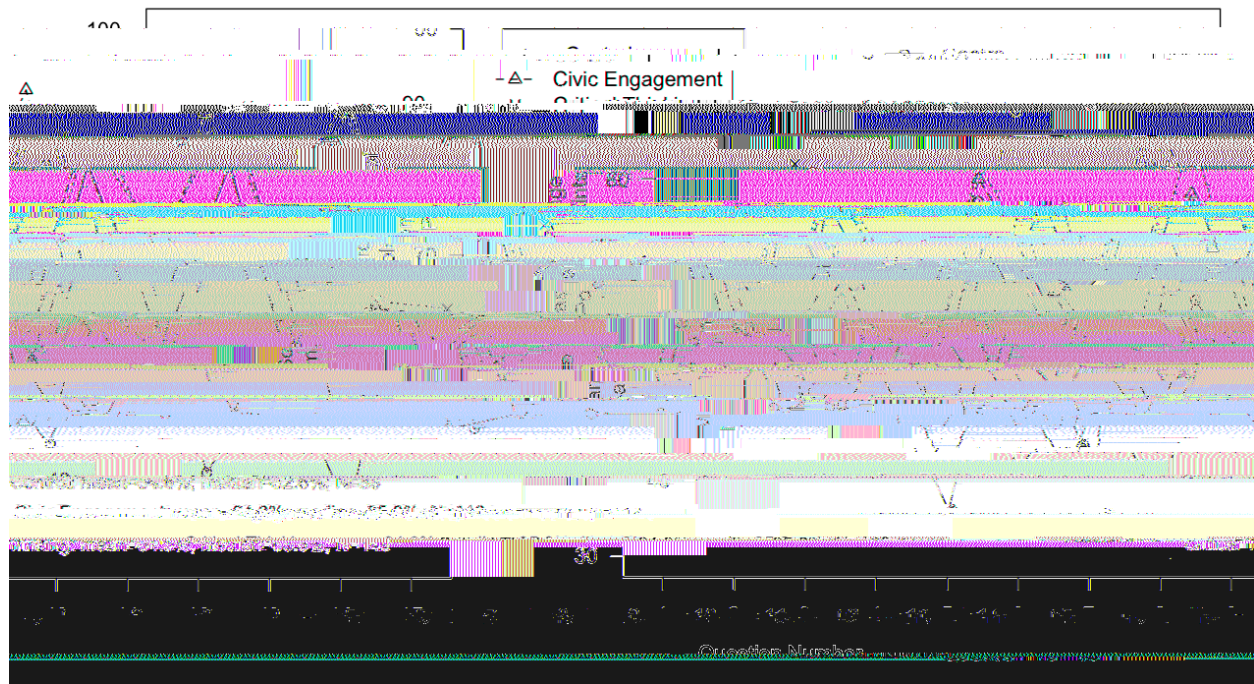


Figure 3 emphasizes the high degree of similarity in performance on each question across class types as well as the modestly but consistently lower scores for students in Control classes as compared to the Critical Thinking and Civic Engagement classes. The data used here were not separated by beginning and end of the term as the question of interest was comparison of the class types; these data demonstrate the overall pattern of similarity in performance across the three class types.







important results of this study of critical thinking skills in undergraduate students at these two institutions. This strategy, and the CAT instrument, can likely be applied effectively across a wide range of institutions of higher learning. We encourage use of the CAT instrument.

#### **ACKNOWLEDGEMENTS**

This work was funded by The Teagle Foundation, 570 Lexington Avenue, 38th Floor New York, NY 10022, US, 212-373-1972 and benefitted substantially from the generous advice and counsel of Barry Stein, Ada Haynes, M. Shane Grant, Alex Cruz, and Janis Antonovics.

#### **REFERENCES**

- Abrami, P., Bernard, R., Borokhovski, E., Wade, A., Surkes, M., Tamim, R., & Dai Zhang, D. (2008). instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research*, 78, 1102–34.
- Abrami, P., Bernard, R., Borokhovski, E., Waddington, D., Wade, C., & Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research*, 85, 274-314.
- Arum, R. & Roksa, J. (2011). *Academically adrift: Limited learning on college campuses*. Chicago, IL: The University of Chicago Press.
- Bailin, S. & Siegel, H. (2003). Critical thinking. In N. Blake, P. Smeyers, R. Smith, & P. Standish (Eds.), *The Blackwell Guide to the Philosophy of Education* (pp. 181-193). Oxford, UK: Blackwell.
- Bensley, D., & Murtagh, M. (2012). Guidelines for a scientific approach to critical thinking assessment. *Teaching of Psychology*, 39, 5-16.
- Bok, D. (2006). *Our underachieving colleges: A*

- Shavelson, R. (2010). *Measuring college learning responsibly: Accountability in a new era*. Stanford, CA: Stanford University Press.
- Stein, B., Haynes, A., & Redding, M. (2006). *Proceedings of the National STEM Assessment Conference: Project CAT: Assessing critical thinking skills*. <http://www.tntech.edu/files/cat/reports>
- Stein, B., Haynes, A., Redding, M., Ennis, T., & Cecil, M. (2007). Assessing critical thinking in STEM and beyond (pp. 79-82). In M. Iskander (Ed.), *Innovations in E-learning, Instruction Technology, Assessment, and Engineering Education*. Dordrecht, The Netherlands: Springer.
- Stein, B., Haynes, A., Redding, M., Harris, K., Tylka, M., & Lisic, E. (2010). *Proceedings of the 2009 International Joint Conferences on Computer, Information, and System Sciences, and Engineering: Faculty driven assessment of critical thinking: National dissemination of the CAT instrument*. <http://www2.tntech.edu/cat/presentations>
- Stein, B., & Haynes, A. (2011). Engaging faculty in the assessment and improvement of students' critical thinking using the critical thinking assessment test. *Change: The Magazine of Higher Learning*, 43, 44-49.
- Whang, L., Zhang, Z., McArdle, J., & Salthouse, T.A. (2009). Investigating ceiling effects in longitudinal analysis. *Multivariate Behavioral Research*, 43, 476-96.
- Whiley, D., Witt, B., Colvin R., Arrue, R., & Kotir, J. (2017). Enhancing critical thinking skills in first-year environmental management students: A tale of curriculum design, application, and reflection. *Journal of Geography in Higher Education*, 41, 166-81.