UNIVERSITY OF TEXAS ARLINGTON

INSTITUTIONAL EFFECTIVENESS AND REPORTING

USING THE CAT TO ASSESS CRITICAL THINKING AT THE UNIVERSITY OF TEXAS AT ARLINGTON

SPRING **2016** REPORT

Using the CAT to Assess Critical Thinking at The University of Texas at Arlington

An increasing reliance on technology has created an unprecedented opportunity for our global society to collect massive amounts of informational data. As a result, the ability to think critically, especially about drawing conclusions and making data-driven decisions, is in high demand. In particular, hiring managers have reported on national surveys how important it is to find job candidates who can sift through data and apply problem solving strategies to evaluate this collection of information (National Association of Colleges and Employers, 2016). Indeed, critical thinking skills placed first in the 2015 and 2016 surveys in which employers rank career readiness competencies (Gray and Koncz, 2016).

Despite the need for critical thinkers, assessing these skills is challenging because the theoretical framework represented by critical thinking encompasses a complex constellation of skills. To address this assessment need, the Critical thinking Assessment Test (CAT; Stein, Haynes, & Ennis, 2003) was developed with support from the National Science Foundation. Reports confirm the face validity and criterion validity of this short-answer essay test in which the fifteen questions are based on real-world scenarios (Stein et al., 2003; Stein, Haynes, Redding, Ennis, & Cecil, 2007).

The University of Texas at Arlington piloted the use of the CAT in the Honors College in 2014 to assess the feasibility of using it to obtain direct evidence of Critical Thinking for reporting student attainment of the Texas Core Objectives to the Texas Higher Education Coordinating Board (THECB). In the pilot, recruitment consisted of an email invitation to all students in the Honors College that offered a twenty dollar cash payment and pizza dinner as an incentive for voluntary participation. The sample was small and the results were consistent with previous evidence. The current 2016 study expanded the use of the CAT with an intentional focus on methods that draw a larger student sample.

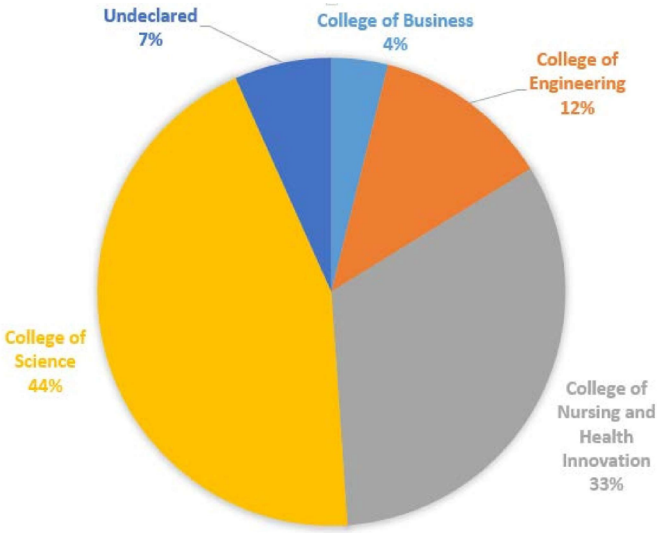
Method

The 2016 spring semester assessment plan called for administering the CAT test during normal course meeting times. In addition, the assessment plan was designed to draw a large sample of juniors and seniors and include as many Honors College students as possible. A list of upper-division (3000 and 4000 level) courses with high concentrations of Honors College students was identified. Then, the

professors of these courses were contacted and invited to participate. Administration dates were scheduled at the convenience of the instructor and course schedule. Many times the dates coincided with class times that the instructors were required to be absent (e.g., to attend conferences, serve on grant review panels). For the classes where the professor was in attendance, they were asked to step out of the classroom during the consent process to minimize the risk of students feeling compelled to participate. Student participation was voluntary and students were not paid for participate in the testing. That said, incentives such as extra credit toward course quizzes or tests were offered by some instructors.

After research staff gave the students information about the CAT test, informed consent procedures were followed, and the assessment booklet was distributed to the student volunteers. As such, CAT tests were group-administered within eight courses to 284 students. While the CAT is not a timed test; students typically completed it in about one hour. Participating students with declared majors represented four schools and colleges (see Figure 1).

Figure 1. Student representation for completed CATs by School or College



CAT scoring consisted of an all-day faculty session on campus to apply a scoring guide developed by the authors of the test. Faculty were given instructions about how to score the first question and then each student's response to that question was rated twice (by the first scorer working individually

and then passed to a second scorer). The group of faculty scorers (N = 10) represented a multi-disciplinary cross-section of UT Arlington Schools and Colleges (see Table 1).

Table 1
Faculty by School and College Affiliation

UT Arlington Schools and Colleges	Number of Faculty	Percent
College of Science	1	10%
College of Education	1	10%
College of Nursing and Health Innovation	4	40%
College of Liberal Arts	4	40%

In tenns of the analytical plan, the test authors conducted analyses of the completed CAT tests and produced the institutional report found in Appendix A. The report summarizes the results from the entire sample of UT Arlington students (N = 284). Comparisons were made using the means from a national sample of students from four-year institutions. As such, the report contains evidence of student attainment of critical thinking at UT Arlington with comparisons to similar institutions nationally.

Results

UT Arlington student scores on average exceeded 50% of the total possible points for the CAT. The average CAT score for the sample as a whole was 19.15 of 38 (n = 284, $\bar{X}$ = 19.15, *SD*= 5.51). See Appendix A for student scores by question and student demographic information.

Further, it is important to note that differences between UT Arlington students and the national comparison group for each of the individual questions was tabulated. The effect size was reported, based on differences between means (e.g., Cohen's *d,* $d = \frac{\bar{x}_1 - \bar{x}_2}{s}$; Cohen, 1992). This method illuminated the fact that UT Arlington students performed significantly better than their national counterparts three areas: evaluating how strongly correlational-type data supports a hypothesis *(p* < .001, *d* = +0.23), determining whether an invited inference is supported by specific information *(p* < .01, *d*= +0.15) and identifying and explaining the best solution for a real-world problem using relevant information *(p* < .05, *d* = +0.13). Student scores were not as strong as the national counterparts in two

areas represented by three questions: identifying additional information needed to evaluate a hypothesis and explaining how changes in a real-world problem situation might affect the solution, however the effect sizes for these differences were small to moderate (d = -0.14 , -0.38 and -0.15, respectively).

Summary

Evidence of student attainment of satisfactory critical thinking skills was set by the CAT developers as correctly responding to the short-answer questions and receiving at least fifty percent of the total points possible. UT Arlington student scores for the sample exceeded 50% on the CAT. This direct evidence suggests that the university met the requirements for the Critical Thinking Objective as set forth by the Texas Higher Education Coordinating Board for courses approved to deliver the Texas Core Curriculum.

References

Cohen, J. (1992). A power primer. *Psychological Bulletin 112* (1), 155-159. doi:10.1037/0033-2909.112.l.155, PMID 19565683.

Gray, K. and Koncz, A. (2016). *Employers identify four "must have" career readiness competencies for college graduates.* National Association of Colleges and Employers Job Outlook 2016 Spring Update. Retrieved on 7/18/2016 from http://www.naceweb.org /about-us/press/2016/four-must-have-career-readiness-competencies.aspx.

Stein, B., Haynes, A., & Ennis, T. (December, 2003). *Assessing Critical Thinking.* Paper Presented at Commission on Colleges of the Southern Association of Colleges and Schools Annual Meeting in Atlanta, Georgia.

Stein, B., Haynes, A., Redding, M., Ennis, T., & Cecil, M. (2007). Assessing Critical Thinking in STEM and Beyond. In M. lskander (ed.), *Innovations in E-learning, Instruction Technology, Assessment, and Engineering Education,* 79-82. New York: Springer.

Appendix A

INSTITUTIONAL REPORT

CENTER FOR ASSESSMENT & IMPROVEMENT OF LEARNING

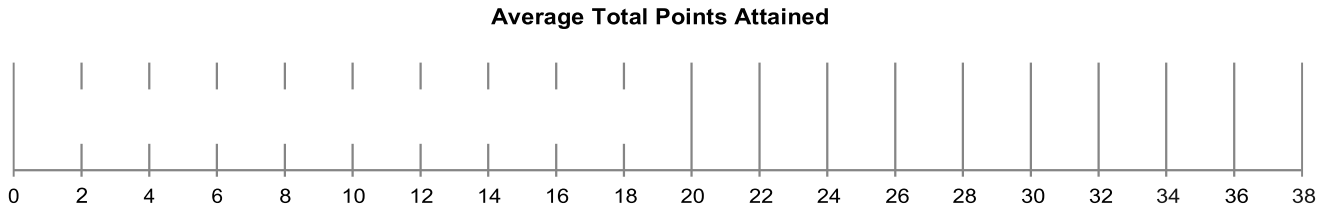
University of Texas - Arlington

CAT Institutional Report

June 2016 - All Students

CAT Overview: Descriptive Statistics for CAT Total Score
University of Texas -Arlington: June 2016 -All Students

	N	Min.	Max.	Mean	Std. Dev
CAT Total Score	284	7.00	33.00	19.15	5.51



CAT Demographics: Descriptive Statistics for Sample

		Freq.	Freq.%
Gender	Male	127	45.0%
	Female	155	55.0%
Class Standing	Freshman	4	1.4%
	Sophomore	74	26.7%
	Junior	107	38.6%
	Senior	92	33.2%
Class	Undergraduate	279	98.2%
	Graduate	5	1.8%
Age	≤ 20years	113	41.7%
	21-25 years	125	46.1%
	26 years	33	12.2%

		Freq.	Freq.%
Proficiency with the English Language*	Excellent	175	61.6%
	Very Good	87	30.6%
	Good	21	7.4%
	Fair	1	0.4%
	Poor	0	0.0%

* Self-rated

		Freq.	Freq. %
Race**	White	132	46.5%
	Black or African American	32	11.3%
	American Indian or Alaska Native	4	1.4%
	Asian	102	35.9%
	Native Hawaiian or Other Pacific Islander	0	0.0%
	Other Race	29	10.2%

**The cumulative percent may exceed 100% as students are allowed to select more than one category.

	Freq.	Freq.%
Spanish/Hispanic/Latino Ethnicity	62	21.8%
Considered English primary language?	238	83.8%

CAT Breakdown: Frequency of Points Awarded for Each Question

University of Texas -Arlington: June 2016 -All Students

	Skill Assessed by CAT Question	Points Awarded	Freq.	Freq.%
Q1	Summarize the pattern of results in a graph without making inappropriate inferences.	**0**	91	32.3%
		1	191	67.7%
Q2	Evaluate how strongly correlational-type data supports a hypothesis.	**0**	51	18.1%
		1	117	41.5%
		2	46	16.3%
		3	68	24.1 %
Q3	Provide alternative explanations for a pattern of results that has many possible causes.	**0**	83	29.3 %
		1	69	24.4 %
		2	92	32.5%
		3	39	13.8%
Q4	Identify additional information needed to evaluate a hypothesis .	**0**	94	33.2%
		1	84	29.7 %
		2	61	21.6 %
		3	32	11.3%
		4	12	4.2%
Q5	Evaluate whether spurious information strongly supports a hypothesis.	**0**	69	24.4 %
		1	214	75.6%
Q6	Provide alternative explanations for spurious associations.	**0**	29	10.2%
		1	97	34.2%
		2	108	38.0%
		3	50	17.6%
Q7	Identify additional information needed to evaluate a hypothesis.	**0**	147	51.8%
		1	112	39.4%
		2	25	8.8%
QB	Determine whether an invited inference is supported by specific information.	**0**	73	25.7 %
		1	211	74 .3%
Q9	Provide relevant alternative interpretations for a specific set of results.	**0**	77	27.1%
		1	147	51.8%
		2	60	21.1 %
Q10	Separate relevant from irrelevant information when solving a real-world problem.	**0**	1	0.4%
		1	6	2.1%
		2	46	16.3%
		3	111	39 .2%
		4	119	42.0%
Q11	Use and apply relevant information to evaluate a problem.	**0**	36	12.7%
		1	163	57.6%
		2	84	29.7 %
Q12	Use basic mathematical skills to help solve a real-world problem.	**0**	41	14.5%
		1	241	85.5%
Q13	Identify suitable solutions for a real-world problem using relevant information.	**0**	82	29.1 %
		1	110	39. 0%
		2	56	19.9%
		3	34	12.1%
Q14	Identify and explain the best solution for a real-world problem using relevant information.	**0**	76	27.0 %
		1	35	12.5%
		2	7	2.5%
		3	25	8.9%
		4	101	35 .9%
		5	37	13.2%
Q15	Explain how changes in a real-world problem situation might affect the solution.	**0**	113	40.2%
		1	77	27.4 %
		2	70	24.9%
		3	21	7.5%

Institutional/Departmental Profile

University of Texas - Arlington: June 2016 - All Students

Evaluate and Interpret Info	Problem Solving	Creative Thinking	Effective Comm.		Skill Assessed by CAT Question	Institution/Department	
						Mean	Avg. % of Attainable Points
X				Q1	Summarize the pattern of results in a graph without making inappropriate inferences.	0.68	68%
X			X	Q2	Evaluate how strongly correlational-type data supports a hypothesis.	1.47	49%
		X	X	Q3	Provide alternative explanations for a pattern of results that has many possible causes.	1.31	44%
	X	X	X	Q4	Identify additional information needed to evaluate a hypothesis .	1.24	31%
X				Q5	Evaluate whether spurious information strongly supports a hypothesis.	0.76	76%
		X	X	Q6	Provide alternative explanations for spurious associations.	1.63	54%
	X	X	X	Q7	Identify additional information needed to evaluate a hypothesis .	0.57	29%
X				QB	Determine whether an invited inference is supported by specific information.	0.74	74%
		X	X	Q9	Provide relevant alternative interpretations for a specific set of results.	0.94	47%
X	X			Q10	Separate relevant from irrelevant information when solving a real-world problem.	3.20	80%
X	X		X	Q11	Use and apply relevant information to evaluate a problem.	1.17	58%
	X			Q12	Use basic mathematical skills to help solve a real-world problem.	0.85	85%
X	X			Q13	Identify suitable solutions for a real-world problem using relevant information.	1.15	38%
X	X		X	Q14	Identify and explain the best solution for a real-world problem using relevant information.	2.54	51%
	X	X	X	Q15	Explain how changes in a real-world problem situation might affect the solution.	1.00	33%
					CAT Total Score	19.15	50%

The map of skills covered by each question above is a suggested theoretical guide for interpreting results.

Upper Division CAT Means Comparison Report

University of Texas - Arlington: June 2016 - All Students

Evaluate and Interpret Info	Problem Solving	Creative Thinking	Effective Comm.		Skill Assessed by CAT Question	Institution	National		
						Mean	Mean	Probability of difference[a]	Effect Size[b]
x				Q1	Summarize the pattern of results in a graph without making inappropriate inferences.	0.68	0.67		
x			x	Q2	Evaluate how strongly correlational-type data supports a hypothesis.	1.47	1.21	***	+.23
		x	x	Q3	Provide alternative explanations for a pattern of results that has many possible causes.	1.31	1.35		
	x	x	x	Q4	Identify additional information needed to evaluate a hypothesis .	1.24	1.41	*	-.14
x				Q5	Evaluate whether spurious information strongly supports a hypothesis.	0.76	0.73		
		x	x	Q6	Provide alternative explanations for spurious associations.	1.63	1.56		
	x	x	x	Q7	Identify additional information needed to evaluate a hypothesis.	0.57	0.82	***	-.38
x				QB	Determine whether an invited inference is supported by specific information.	0.74	0.68	**	+.15
		x	x	Q9	Provide relevant alternative interpretations for a specific set of results.	0.94	0.93		
x	x			Q10	Separate relevant from irrelevant information when solving a real-world problem.	3.20	3.14		
x	x		x	Q11	Use and apply relevant information to evaluate a problem.	1.17	1.11		
	x			Q12	Use basic mathematical skills to help solve a real-world problem.	0.85	0.82		
x	x			Q13	Identify suitable solutions for a real-world problem using relevant information.	1.15	1.18		
x	x		x	**Q14**	Identify and explain the best solution for a real-world problem using relevant information.	2.54	2.29	*	+.13
	x	x	x	Q15	Explain how changes in a real-world problem situation might affect the solution.	1.00	1.15	*	-.15
					CAT Total Score	19.15	19.04		

• . * p<.05 **p<.01 ***p<.001 (2-tailed) Does not Account for entering ACT/SAT.

[b] Mean difference divided by pooled group standard deviation.
(0.1 - 0.3 = small effect; 0.3 - 0.5 = moderate effect; >0.5 = large effect)

The map of skills covered by each question above is a suggested theoretical guide for interpreting results.