Engaging Faculty in Assessing Critical Thinking Using the CAT Instrument

Barry Stein, **Professor, Co-Director**   **Ada Haynes** **Professor, Co-Director**

Kevin Harris, Associate Director

Center for Assessment and Improvement of Learning

TTU Tennessee Tech University

Texas A&M Assessment Conference, 2013

Workshop Goals

- Give institutions hands-on experience with the CAT instrument.
- Explore how the CAT can be used to encourage more effective practices within disciplines.
- Discuss potential ways to use the CAT for assessment.

Workshop Materials

Yours to Keep

- Training Manual
- Technical Information
- Overview CD
- Sample Institutional Reports

Secure Items (not to be taken)

- CAT Test with Sample Responses
- Scoring Guide

National Advisory Board

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Importance of Critical Thinking

National polls indicate over 90% of the faculty in this country think critical thinking is <u>the</u> most important part of undergraduate education.

Derek Bok, 2005

President Emeritus of Harvard University

Importance of Critical Thinking

Explosion of Information

Internet

E=MC²

MySpace

Facebook

Email

Wikipedia

Blogs

Phone Apps

Augmented Reality

MOOCs

Magazines

Books

Television

Journals

Radio

The Changing Nature of Education

Remembering Information

Finding Relevant Information

Understanding & Evaluating Information

Using Information Effectively

Where Do We Get Information

75% of College Students use the Internet as Primary Method of Searching for Information

People are more likely to believe something on YouTube than from the CDC

59% of Adults Use the Internet for Healthcare Information

What is Critical Thinking?

Classic Emphasis

Evaluate Arguments and Conclusions

Reasoning

What is Critical Thinking?

Classical Emphasis

Expanded Contemporary Emphasis

Evaluate Arguments and Conclusions

Evaluate Ideas And Plans

Evaluate One's Own Understanding

Reasoning

Problem Solving

Life-Long Learning Skills

Communication

Creativity

Bloom's Classic Taxonomy

Evaluation
Synthesis
Analysis
Application
Comprehension

Information (rote retention)

Critical Thinking

Agreement on what is <u>not</u> Critical Thinking
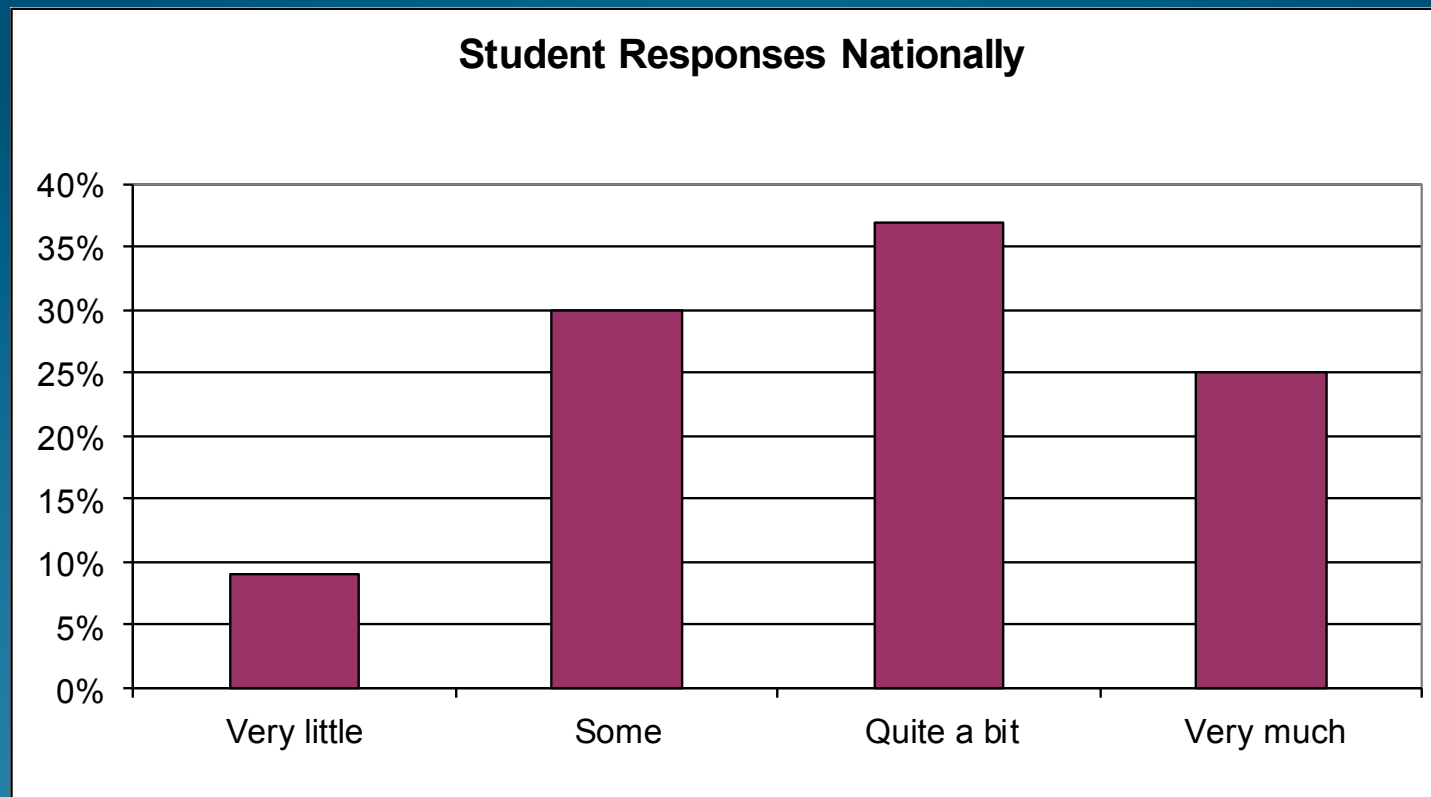
*NSSE Question
(2a) **Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form.**

Video

NSSE: Coursework emphasizes: Memorizing facts, ideas, or methods from your courses and readings

Student Responses Nationally

Why Assess Critical Thinking?

Need to Measure Success for Accountability

Assessment Drives Improvement Efforts

How We Assess - Determines What Students Learn

History of CAT Development

Preliminary Work At TTU 2000 - 2004

NSF

Collaborate With Other Institutions To Refine CAT 2004 - 2007

NSF

Develop Training Methods for National Dissemination & Collect Norms 2007 - 2010
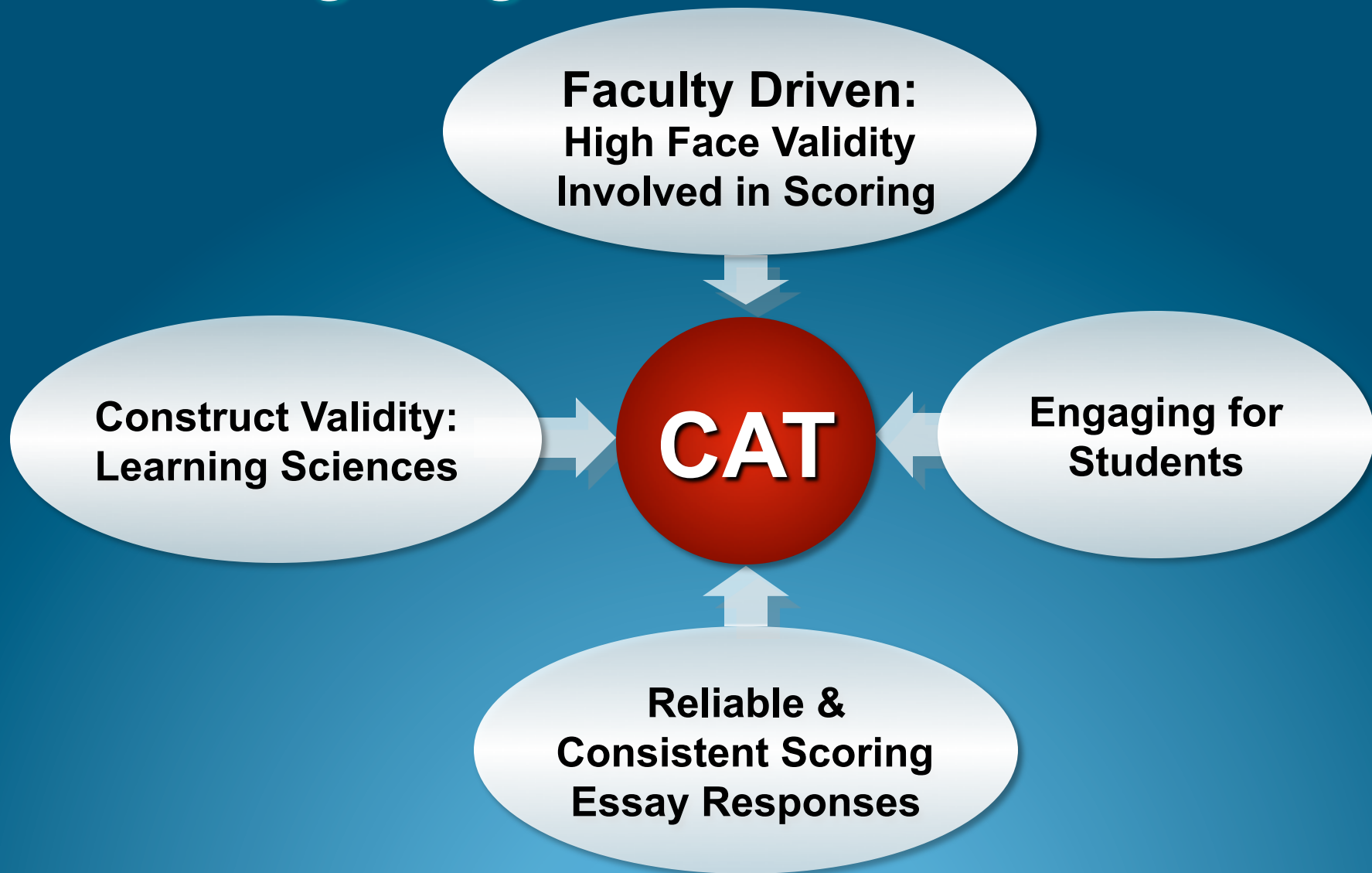
NSF

Expand National Dissemination & Support Assessment in NSF Projects 2010 - 2014

Over 150 Institutions Collaborating

Designing the CAT Instrument

Skills Evaluated by CAT Instrument

Evaluating Information

Separate factual information from inferences.

Interpret numerical relationships in graphs.

Understand the limitations of correlational data.

Evaluate evidence and identify inappropriate conclusions

Creative Thinking

Identify alternative interpretations for data or observations.

Identify new information that might support or contradict a hypothesis.

Explain how new information can change a problem.

Learning & Problem Solving

Separate relevant from irrelevant information.

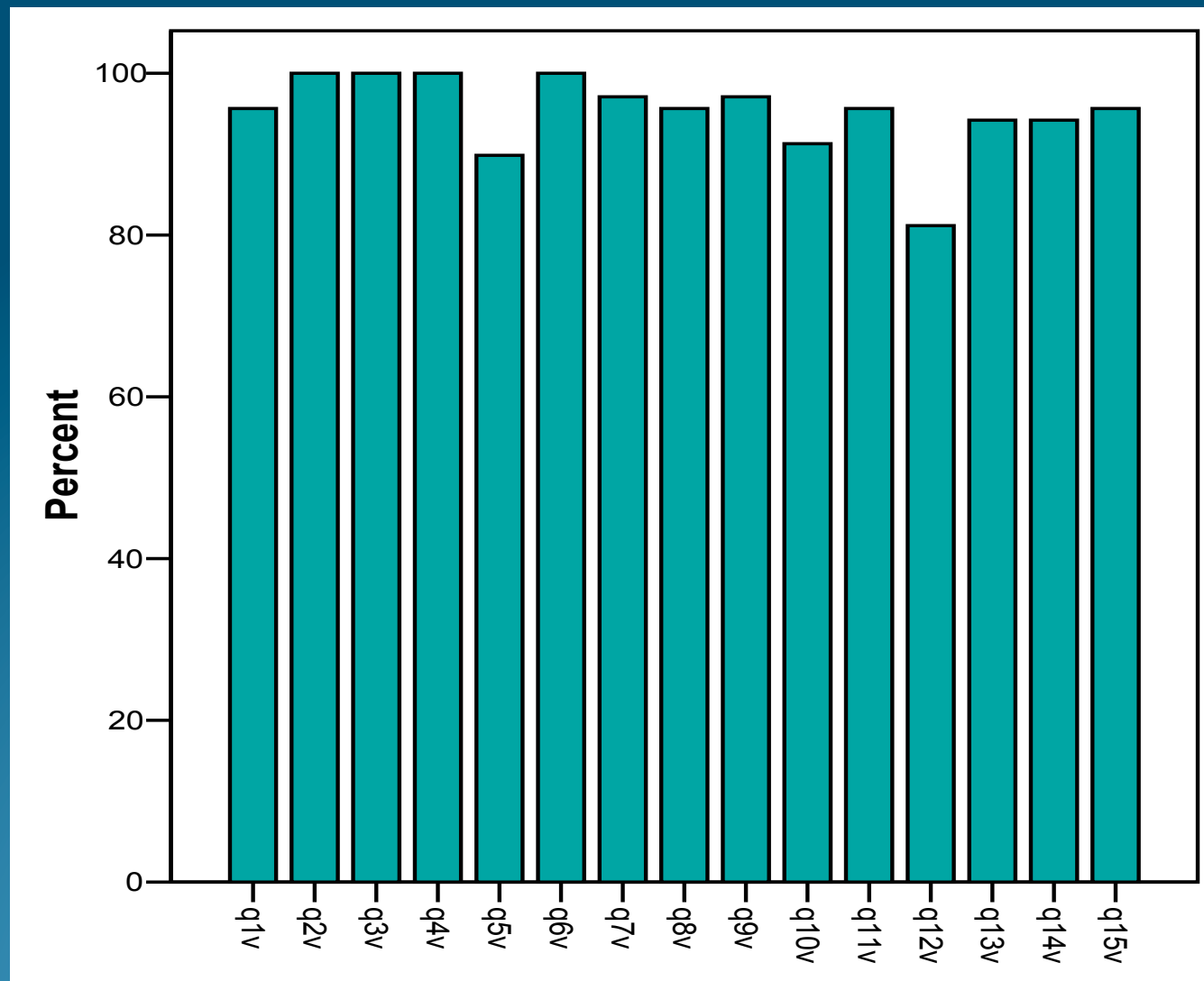Integrate information to solve problems.

Learn & apply new information.

Use mathematical skills to solve real-world problems.

Communication

Communicate ideas effectively.

Faculty Evaluations of Question Validity

CAT Statistics

	ACT	SAT	Academic Profile	Grade Point Average
CAT	0.501*	0.516*	0.562*	0.295*

	CCTST (California Critical Thinking Skills Tests)	CAAP Critical Thinking Module
CAT	0.645*	0.691*

CAT Results with 2005 NSSE
(National Survey of Student Engagement)
Multiple R = .490
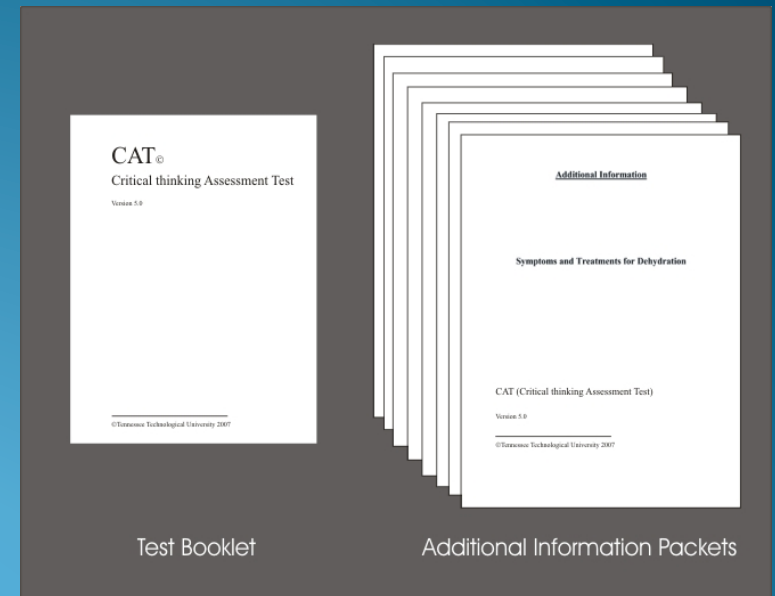### (explains 24% of variability in CAT)

NSSE Question	Beta Coefficient
(2a) Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form. *(negative relationship)*	-.341 **
(3b) Number of books read on your own (not assigned) for personal enjoyment or academic enrichment.	.277 **
(11e) Thinking critically and analytically & (11m) Solving complex real-world problems	.244 **
(7h) Culminating Senior Experience (thesis, capstone course, project, comprehensive exam, etc.)	.231 *

* Significant at .01 level
** Significant at .001 level

CAT features

- One hour exam

- Mostly short answer essay

- Faculty scored in workshops

- Detailed scoring guide

- Sensitive to course effects

- Reliable

- Valid

CAT©
Critical thinking Assessment Test
Version 5.0

©Tennessee Technological University 2007

Additional Information

Symptoms and Treatments for Dehydration

CAT (Critical thinking Assessment Test)
Version 5.0

©Tennessee Technological University 2007

Test Booklet

Additional Information Packets

Sample Disclosed Question

A scientist working at a government agency believes that an ingredient commonly used in bread causes criminal behavior.   To support his theory the scientist notes the following evidence.
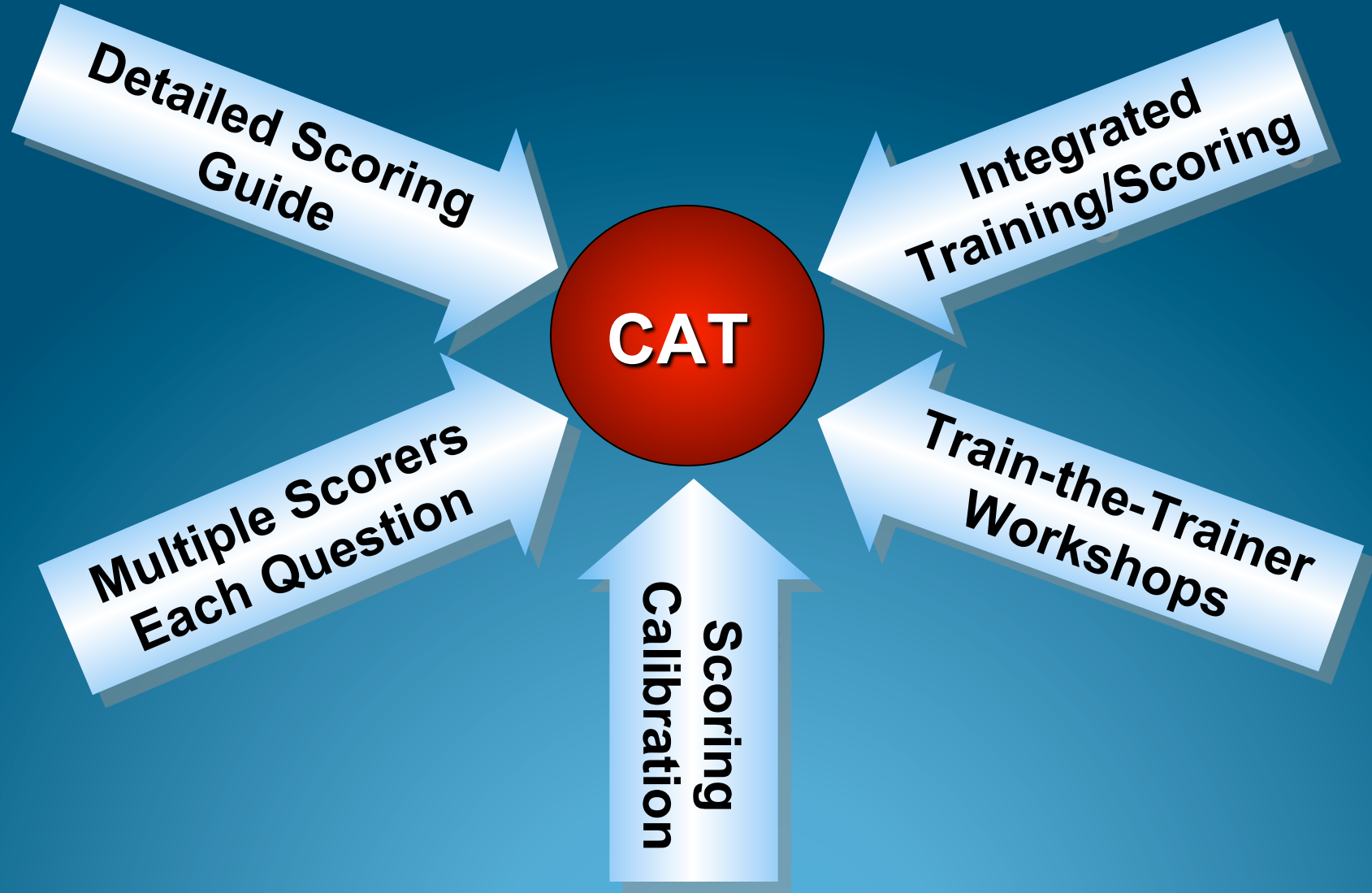
- 99.9% of the people who committed crimes consumed bread prior to committing crimes.
- Crime rates are extremely low in areas where bread is not consumed.

Do the data presented by the scientist strongly support their theory? Yes ___   No____

Are there other explanations for the data besides the scientist's theory? If so, describe.

_____

What kind of additional information or evidence would support the scientist's theory?

_____

Ensuring Reliability of Scoring

CAT

Detailed Scoring Guide

Integrated Training/Scoring

Multiple Scorers Each Question

Train-the-Trainer Workshops

Scoring Calibration

Mini-workshop vs. Standard Training

Mini-workshop   **Standard Train-the-Trainer Workshop**

Examine Sample Student Responses

Use Scoring Guide

Score Real Student Tests

Use Scoring Guide

Use Multiple Scorers

Deal with Ambiguous Responses
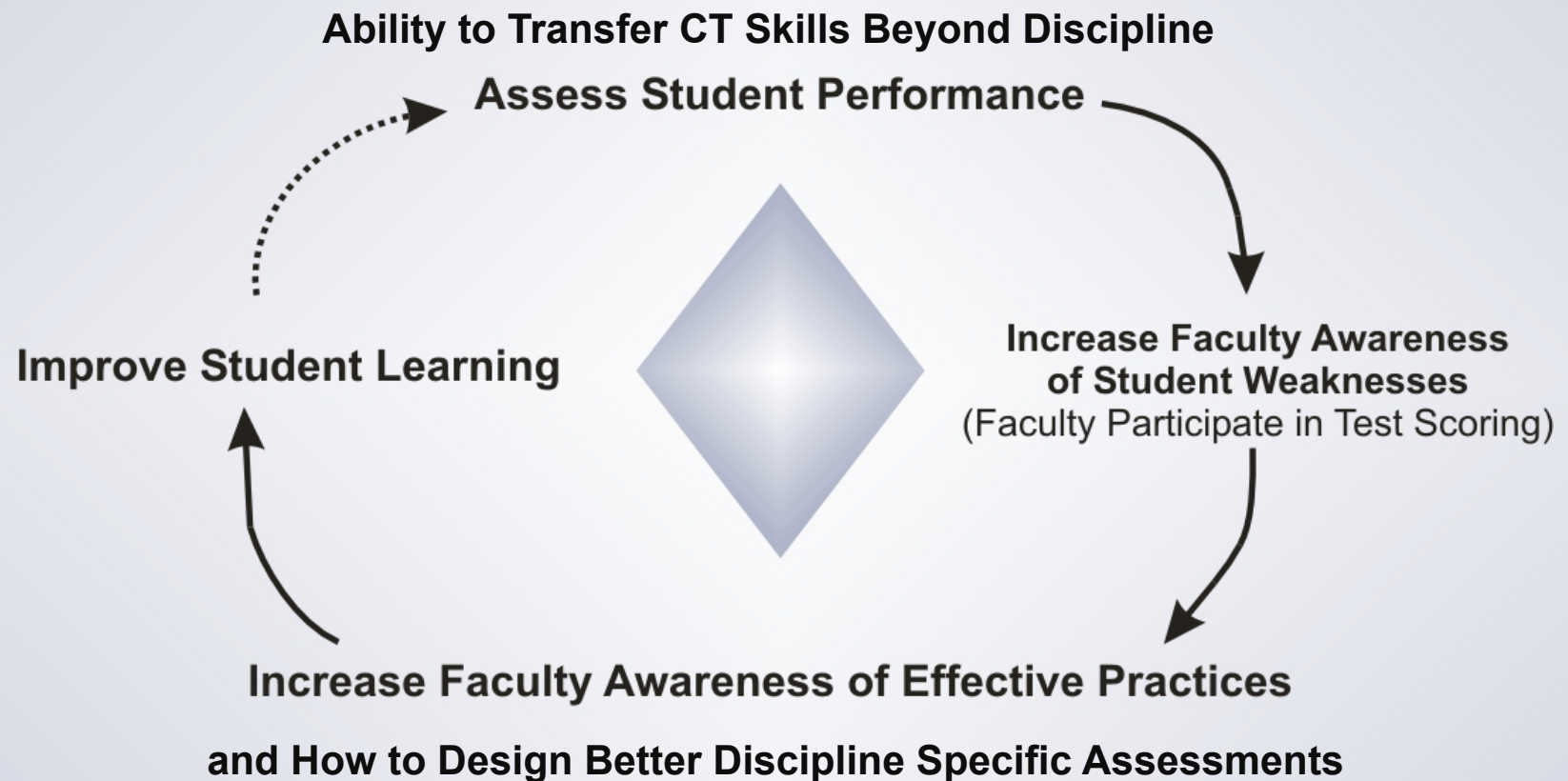
CAT Test with Sample Student Responses

Effective Practices Are A Moving Target

Video

Closing the Loop in Assessment and Quality Improvement

Closing the Loop in Assessment and Quality Improvement

Ability to Transfer CT Skills Beyond Discipline

Assess Student Performance

Increase Faculty Awareness of Student Weaknesses
(Faculty Participate in Test Scoring)

Increase Faculty Awareness of Effective Practices

and How to Design Better Discipline Specific Assessments

Improve Student Learning

Professional Development:
Faculty Involvement in CAT Scoring

Identify
Student Weaknesses

Recognize Faculty
Strengths & Weaknesses

Develop a
Teaching Community

Use Effective
Practices

Design a task that resembles what we want students to do.

Engage Students In Active Learning

Learning Activity = Real-World Goal

Create Numerous Opportunities to Practice In Diverse Contexts

Use as Primary Course Assessment
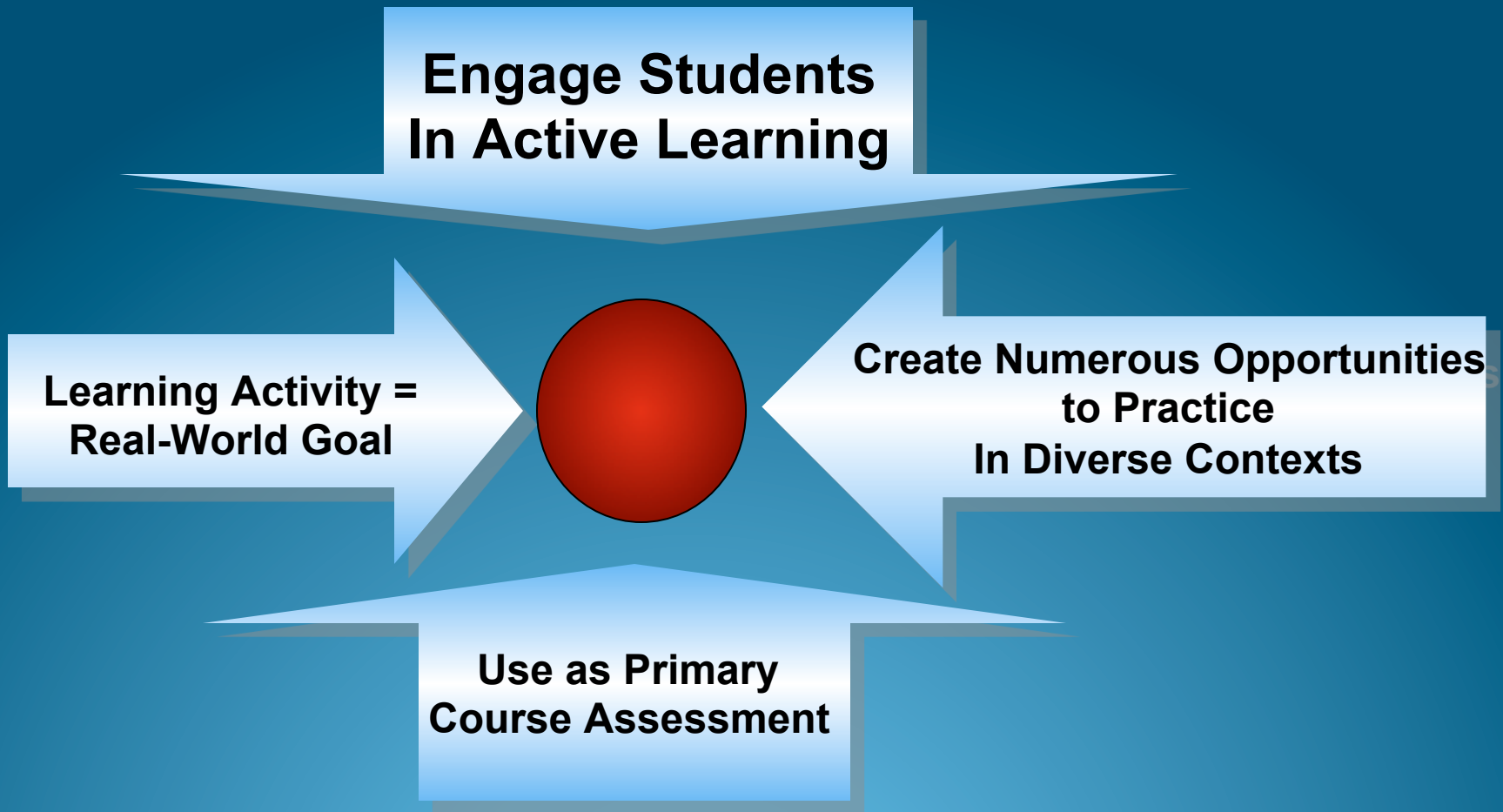
Handout
Activity

Skill Set 1: Encouraging Effective Course Assessments

Provide alternative interpretations for information or observations that have several possible interpretations.

Identify additional information or evidence needed to evaluate the alternative interpretations.

Patterns of Data   **Historical Events**   **Literature**

Skill Set 2: Encouraging Effective Course Assessments

Separate relevant from irrelevant information when searching for information to solve a real-world problem.
Identify and explain the best solution for a real-world problem using relevant information.
Explain how changes to a real-world problem situation might alter the recommended solution.

Selecting New Lab Equipment

Solving a Community Problem – Feral Cats

Designing a Set For a Play

What Are We Learning From National Use of the CAT

Faculty Involvement is Beneficial

Faculty Can Improve Course Assessments

Strategies for Improving Critical Thinking

Examples of Effective Practices for Teaching Critical Thinking

CRITICAL THINKING ASSESSMENT TEST

in depth

Home
CAT Info
Contacts
Reports
Grants
Using CAT
Training
* Video Resources
Improving CAT Performance
Contact Us

SUCCESSFUL PROJECTS

Some Examples of Projects that have Improved CAT Scores

Under Construction

Clemson University

NSF TUES (CCLI) Project #0837540. Development of an Inquiry-Based Cell Biology Laboratory with Emphasis on Scientific Communication Skills. PI: Dr. Lesly Temesvari (**LTEMESV@clemson.edu**) or Dr. Terri Bruce (**terri@clemsnon.edu**).

This project involved the development of a new cell biology laboratory course that emphasized critical thinking, effective writing and communication, and ethical reasoning. The new course used an inquiry-based pedagogic strategy allowing students to design and perform experiments in the context of mini research projects. Students also gained experience in communicating their findings through poster/oral presentations and through the writing of manuscripts in standard journal format. As a part of the scientific inquiry and communication processes, students also engaged in the discussion of the ethics of scientific communication.

Duquesne University

NSF TUES (CCLI) Project #717685. A Model for Incorporating Application-Based Service Learning in the Undergraduate Science Curriculum. Dr. Nancy Trun (PI) **trun@duq.edu** , Dr. Lisa Ludvico & Dr. Becky Morrow (Co-PIs).
http://www.scienceresearch.duq.edu/bio/biofac/ntrun/ABSL/index.html

Application Based Service Learning (ABSL) is a pedagogy that we are developing to address the need for novel approaches to Science, Technology, Engineering and Math (STEM) education at the undergraduate level. ABSL combines traditional service learning with novel undergraduate research

Various CT Assessments

CAT
Portfolios, Rubrics, & other Tests
(CLA, CCTST, CAAP CT module)
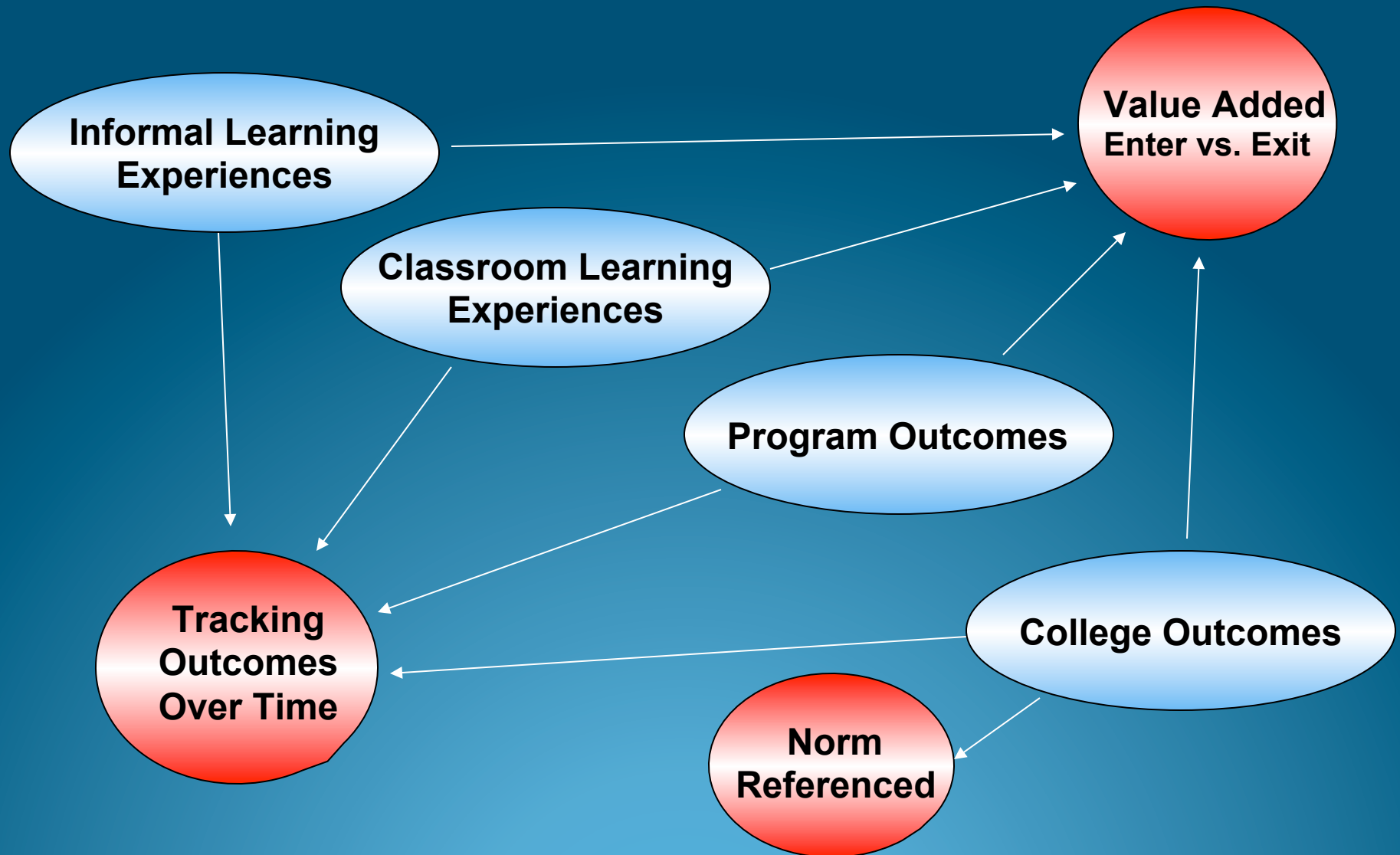→ **Student Performance**

IDEA Teaching Evaluations
NSSE/CSSE & other surveys
→ **Student Perceptions**

Alumni & Employer surveys
→ **Alumni/Employer Perceptions**

Assessment Uses of CAT

CAT Institutional Reports

Sample Report
Page # 31 of Manual

Name of Institution

Student Information

Answer Selection: Correct = ●   Incorrect = ⊠ ✓ ⊖

Student ID Number   What is your Age?   Local Code

1. What is your gender? *Select One.*   (M)   (F)

   Note: Please answer BOTH Questions 2 and 3.

2. Are you Spanish/Hispanic/Latino? *Select One.*   (Y)   (N)

3. What is your race? *Select one or more categories to indicate your race* (from U.S. Census Categories).

   O White   O Asian

   O Black or African American   O Native Hawaiian or Other Pacific Islander

   O American Indian or Alaska Native   O Other race

4. Do you consider English your primary language? *Select One.*   (Y)   (N)

5. Rate your proficiency with the English Language. *Select level of proficiency.*

Excellent	Very Good	Good	Fair	Poor
(E)	(V)	(G)	(F)	(P)

6. What is your class standing?   7. Undergraduate or Graduate?

(F)	(S)	(J)	(S)	(U)	(G)
Freshman	Sophomore	Junior	Senior	Undergraduate	Graduate

11

CAT Overview: Descriptive Statistics for CAT Total Score
Sample Institution: Date 2010

	N	Min.	Max.	Mean	Std. Dev
CAT Total Score	99	11.00	36.00	24.32	5.92

Average Total Points Attained

| 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 |
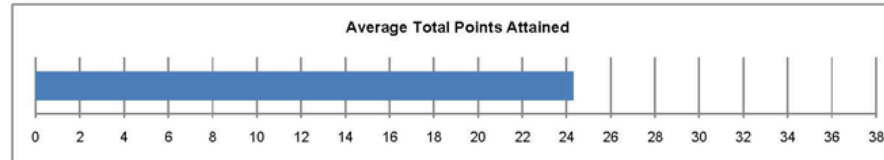
CAT Demographics: Descriptive Statistics for Sample

		Freq.	Freq. %
Gender	Male	48	48.5%
	Female	51	51.5%
Class Standing	Freshman	36	36.7%
	Sophomore	31	31.6%
	Junior	16	16.3%
	Senior	15	15.3%
Class	Undergraduate	-	-
	Graduate	-	-
Age	≤ 20 years	72	72.7%
	21-25 years	26	26.3%
	≥ 26 years	1	1.0%

		Freq.	Freq. %
Race**	White	61	61.6%
	Black or African American	9	9.1%
	American Indian or Alaska Native	0	0.0%
	Asian	29	29.3%
	Native Hawaiian or Other Pacific Islander	1	1.0%
	Other Race	1	1.0%

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

		Freq.	Freq. %
Proficiency with the English Language*	Excellent	71	73.2%
	Very Good	17	17.5%
	Good	9	9.3%
	Fair	0	0.0%
	Poor	0	0.0%

* Self-rated

	Freq.	Freq. %
Spanish/Hispanic/Latino Ethnicity	5	5.1%
Considered English primary language?	86	86.9%

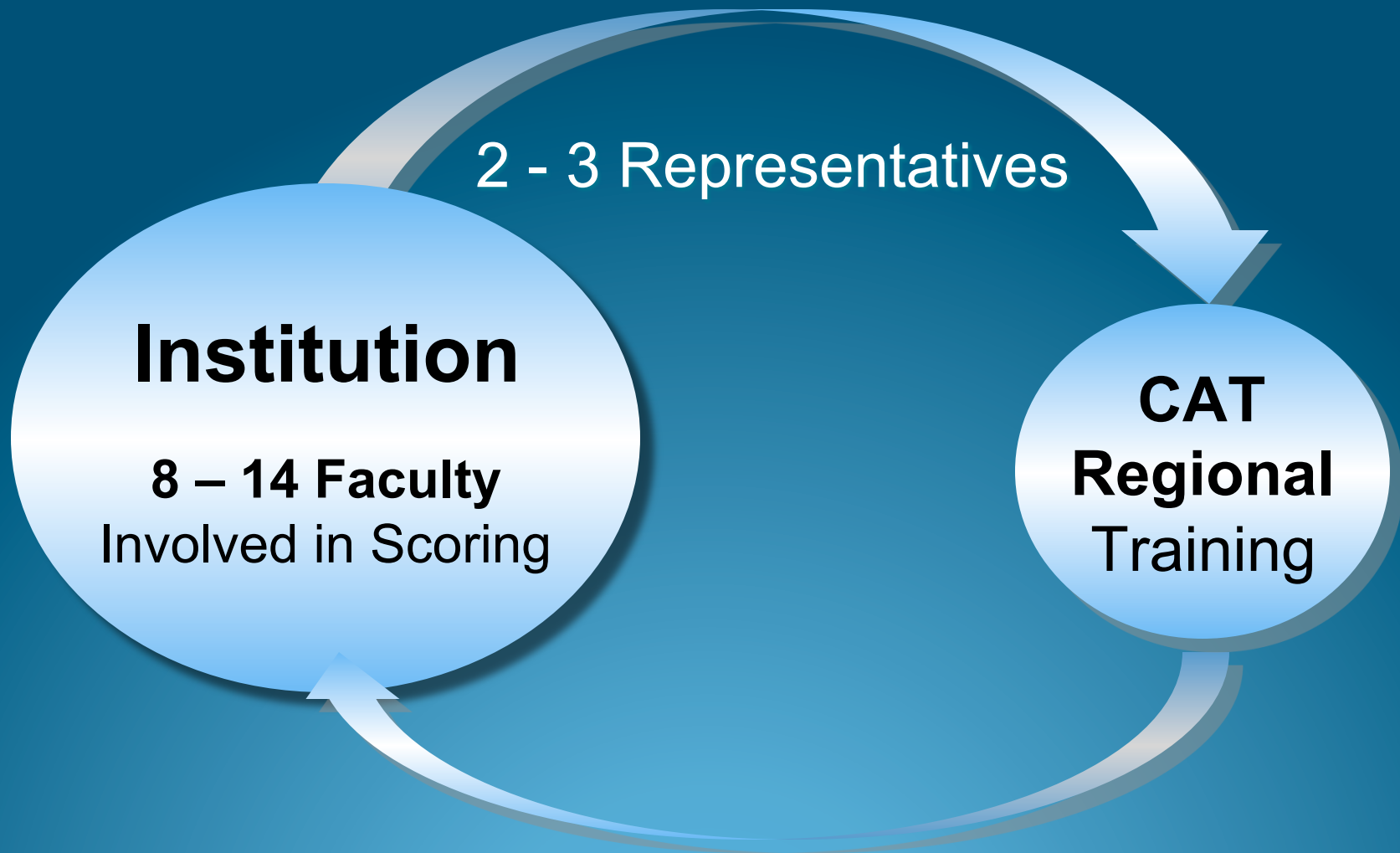|					CAT Means Comparison Report Sample Institution: Date 2010 (N=25)				
Evaluate and Interpret Info	Problem Solving	Creative Thinking	Effective Comm.		Skill Assessed by CAT Question	Institution			
						Pre Mean	Post Mean	Probability of difference[a]	Effect Size[b]
X				Q1	Summarize the pattern of results in a graph without making inappropriate inferences.	.48	.52		
X			X	Q2	Evaluate how strongly correlational-type data supports a hypothesis.	.39	.45		
		X	X	Q3	**Provide alternative explanations for a pattern of results that has many possible causes.**	.79	1.37	*	+.58
	X	X	X	Q4	**Identify additional information needed to evaluate a hypothesis.**	.81	1.46	**	+.78
X				Q5	Evaluate whether spurious information strongly supports a hypothesis.	.58	.55		
		X	X	Q6	**Provide alternative explanations for spurious associations.**	.91	1.30	*	+.46
	X	X	X	Q7	**Identify additional information needed to evaluate a hypothesis.**	.58	1.00	**	+.68
X				Q8	Determine whether an invited inference is supported by specific information.	.45	.55		
		X	X	Q9	**Provide relevant alternative interpretations for a specific set of results.**	.70	1.12	*	+.55
X	X			Q10	Separate relevant from irrelevant information when solving a real-world problem.	3.39	3.15		
X	X		X	Q11	Use and apply relevant information to evaluate a problem.	1.15	1.21		
	X			Q12	Use basic mathematical skills to help solve a real-world problem.	.79	.82		
X	X			Q13	Identify suitable solutions for a real-world problem using relevant information.	.88	.67		
X	X		X	Q14	Identify and explain the best solution for a real-world problem using relevant information.	1.30	1.34		
	X	X	X	Q15	**Explain how changes in a real-world problem situation might affect the solution.**	.30	.82	**	+.68
					CAT Total Score	13.51	16.33	***	+.55

[a]. * p<.05 **p<.01 ***p<.001 (2 –tailed)
[b]. Mean difference divided by pooled group standard deviation.
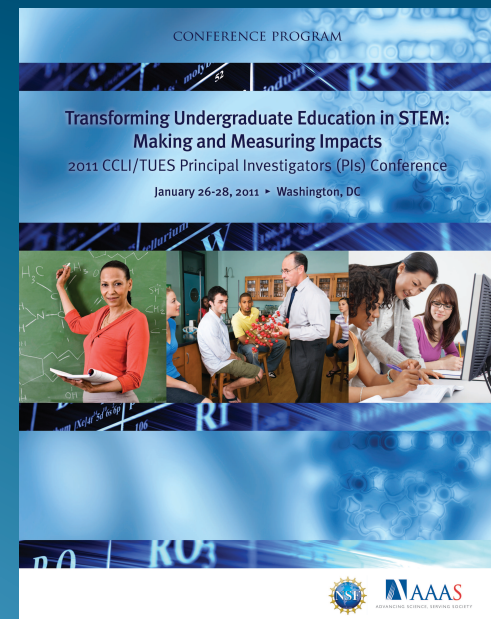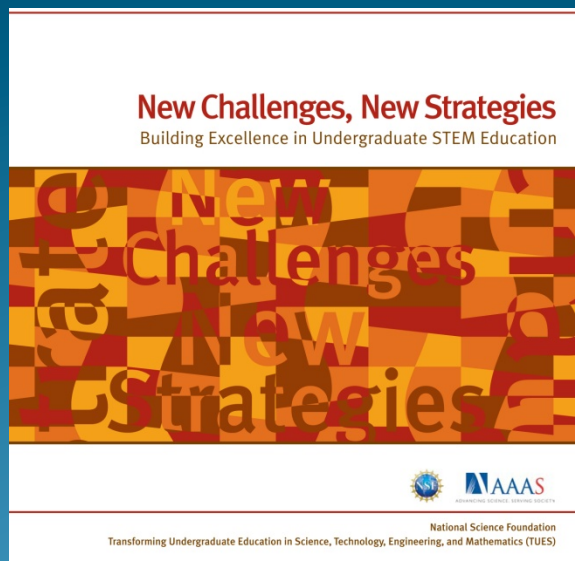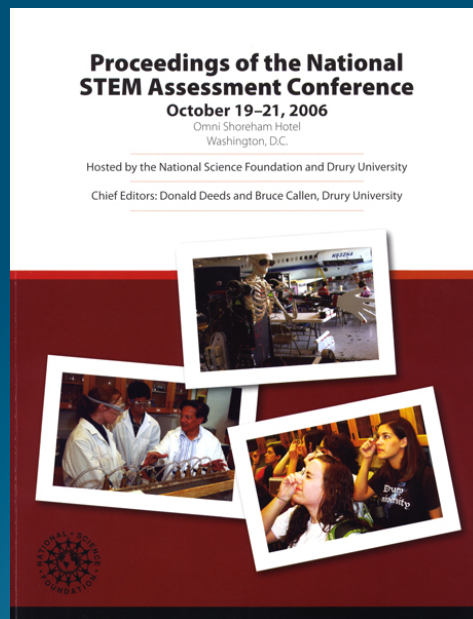   (0.1 - 0.3 = small effect; 0.3 - 0.5 = moderate effect; >0.5 = large effect)
The map of skills covered by each question above is a suggested theoretical guide for interpreting results.
   Center for Assessment & Improvement of Learning © 2007, 2010

National Dissemination Model

2 - 3 Representatives

Institution

8 – 14 Faculty
Involved in Scoring

CAT
Regional
Training

www.CriticalThinkingTest.org

Proceedings of the National STEM Assessment Conference
October 19–21, 2006
Omni Shoreham Hotel
Washington, D.C.

Hosted by the National Science Foundation and Drury University

Chief Editors: Donald Deeds and Bruce Callen, Drury University

New Challenges, New Strategies
Building Excellence in Undergraduate STEM Education

National Science Foundation
Transforming Undergraduate Education in Science, Technology, Engineering, and Mathematics (TUES)

CONFERENCE PROGRAM

Transforming Undergraduate Education in STEM:
Making and Measuring Impacts
2011 CCLI/TUES Principal Investigators (PIs) Conference

January 26-28, 2011 ▶ Washington, DC