



Critical thinking Assessment Test

# TRAINING MANUAL

Version 11

CENTER FOR ASSESSMENT & IMPROVEMENT OF LEARNING

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**TU** TENNESSEE TECH  
UNIVERSITY

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# An Overview of the CAT Instrument

The CAT instrument is a unique tool designed to assess and promote the improvement of critical thinking and real-world problem solving skills. The instrument is the product of extensive development, testing, and refinement with a broad range of institutions, faculty, and students across the country. The National Science Foundation has provided support for many of these activities.

The CAT instrument is designed to assess a broad range of skills that faculty across the country feel are important components of critical thinking and real-world problem solving. The test was designed to be interesting and engaging for students. All of the questions are derived from real-world situations. Most of the questions require short answer essay responses, and a detailed scoring guide helps ensure good scoring reliability.

The CAT instrument is scored by the institution's own faculty using the detailed scoring guide. Training is provided to prepare institutions for this activity. During the scoring process faculty are able to see their students' weaknesses and understand areas that need improvement. Faculty are encouraged to use the CAT instrument as a model for developing authentic assessments and learning activities in their own discipline that improve students' critical thinking and real-world problem solving skills. These features help close the loop in assessment and quality improvement.

# Contacts

## Center for Assessment and Improvement of Learning

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|---|---------------------|--|--------------|
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Partial support for this work was provided by the National Science Foundation's TUES Program (formerly CCLI Program) under grant 1022789. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

# Training and Services

The Center for Assessment and Improvement of Learning provides a variety of training and support options. Contact us for more information about the availability and associated costs of the services below.

## Regional Train-the-Trainer Workshops

Regional Train-the-Trainer workshops are now a combination of our original scoring workshops with our CAT App workshop. Day one will prepare participants to lead a faculty scoring workshop on their own campus. Attendees will participate in a real CAT scoring workshop and have an opportunity to experience the integrated components of faculty development during a scoring session. Day two will focus on the development of CAT Apps, discipline-specific assessments that integrate the skills measured by the CAT instrument. Participants will have the opportunity to create CAT Apps within their discipline with the assistance and feedback of the CAT trainers. Assessment planning support can be held via webinar after the completion of the training. This allows for additional personnel at each attendees' home institution to participate in those assessment planning discussions.

Institutions that want to use the CAT instrument on their campus should have 2-3 representatives attend a Train-the-Trainer workshop. These workshops are offered each semester in areas across the United States. To find out if we are planning a workshop near you, check the schedule on our website, <http://www.tntech.edu/cat/training/>.

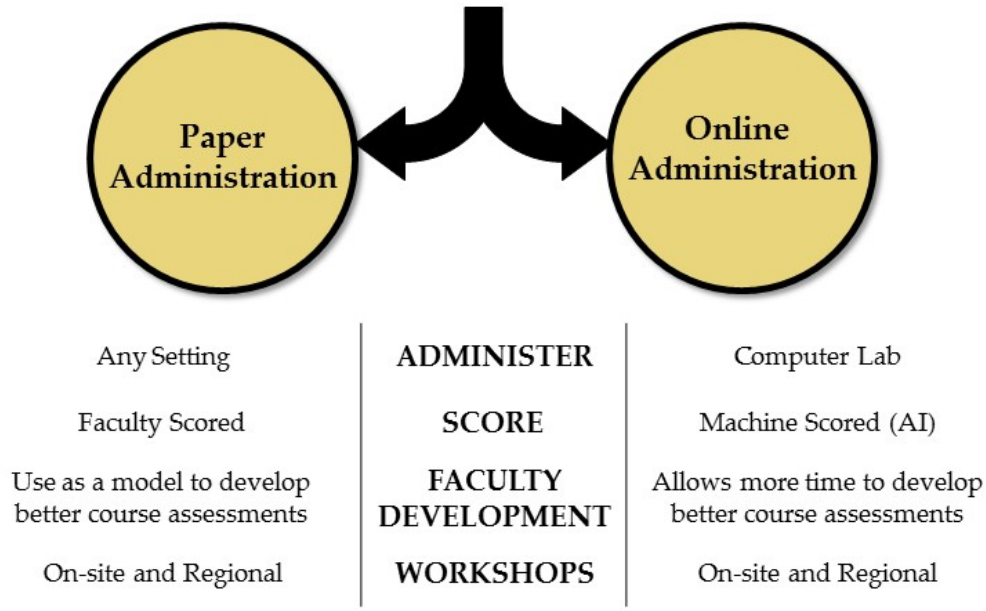
## Onsite Workshops

Onsite Workshops can be arranged to prepare larger groups of faculty to implement the CAT across the institution. This may be more economical than sending representatives from each program or department to our regional training workshops. This option allows you to choose your own dates and include a greater number of faculty participants promoting increased buy-in across your campus. These training workshops typically accommodate up to 15 participants and vary from 1-3 days depending on the content you would like to include. Onsite workshops can be tailored to your needs and include leading traditional scoring sessions, modified scoring sessions, facilitating CAT App development, guiding assessment discussion, and supporting other improvement initiatives.

## Supporting Improvement Initiatives

Let our team help you develop institutional plans for learning and assessment. Through our work with two and four year institutions, research groups, and professional organizations, we have significant experience and knowledge measuring student learning outcomes for programs, general education, accrediting bodies, and other institutional entities. As part of a SACS accredited institution, we have specific expertise in developing Quality Enhancement Plans (QEP). If you would like help deciding how to tackle an assessment problem you are facing, we may be able to help. Contact us for more information.

# Administration Options for the CAT



## Faculty Development with the CAT

Regardless of your preferred administration option, the CAT instrument can play a key role in faculty development. CAT scoring sessions provide a unique opportunity for faculty to discuss critical thinking while at the same time personally experiencing their students' weaknesses in the area of critical thinking. These scoring sessions also provide an opportunity to develop a teaching community where faculty come together to discuss effective practices for improving students' critical thinking and real-world problem solving skills.

Faculty who experience scoring the CAT are likely to make changes in teaching pedagogy. With knowledge of the test and rubric along with follow up training, faculty participants can be prepared to begin developing CAT Applications in the Disciplines (see On-Site Workshops). These course assessments allow students to practice the critical thinking skills associated with the CAT while also applying discipline content. Faculty are encouraged to use these CAT Apps as formative and summative assignments in their courses.

## Making the Most of Your CAT Online Administration

Tests administered in the online format are scored using machine learning algorithms specifically formulated for each question. We recommend a follow up training with faculty to allow them to see samples of student response and learn more about how to use CAT data to improve instruction and assessment. A sample of student responses from your online administration in presentation or booklet form are available for institutions to run a modified scoring session. This condensed scoring session allows faculty to be exposed to the CAT questions, student responses, and associated rubric. These materials also provide aggregate scores for each question; a feature not available when scoring the paper version. While traditional paper scoring sessions require a full day of scoring, these modified scoring sessions can be completed in 2-4 hours. Institutions are then able to devote more time to collaborate and develop courses activities and assessments that integrate critical thinking, such as CAT Apps. Our team can provide customized on-site training workshops to help your campus get the most out of your CAT online experience.

# PAPER ADMINISTRATION

## Ordering Paper Version

### Tests Booklets

Please let us know in advance when you will need the CAT tests. We generally need at least three weeks notice. Tests can be ordered at our standard price (see order form). All tests must be returned to the Center for Assessment & Improvement of Learning at TTU. Unused tests must be returned; an appropriate credit will be issued.

### Annual Fee

The annual fee covers costs associated with processing the tests, generating reports with national norm comparisons, and providing access to the latest scoring and training materials. The annual fee also covers the cost associated with rescoring a subsample of the tests to ensure scoring accuracy.

### Scoring Guides and Training Materials

Scoring guides will be provided with your test order if the scoring session is scheduled the same semester as the order. Otherwise, we will ship the scoring guides approximately two weeks before the campus scoring workshop is scheduled on the CAT order form. We will not ship scoring guides until we are informed about the date of the scoring workshop. You will receive the most recent version of the scoring guide, leader's guide, and training video. These materials must be returned to the Center for Assessment & Improvement of Learning at TTU after the scoring workshop has been completed.

**Please be certain to include the earliest possible date you might schedule a scoring workshop on the order form so that we can make sure that you have scoring guides and training modules.**

|  |
|--|
| <b>CAT Tests: \$9.95 each</b><br><b>Annual Fee: \$300.00</b> |
|--|

# CAT Materials Order Form (Paper Version)

January 1, 2019-December 31, 2019

PAPER VERSION

Please submit your order at least three weeks prior to your test administration date. Materials and shipping costs will be invoiced directly to the person indicated below. Test materials will be shipped by FedEx Ground service. Scoring guides may be shipped separately if CAT training has not been completed. All scoring guides and tests in this order must be returned to Tennessee Tech University within two weeks of completed onsite scoring session.

|  |  |             |       |
|--|--|-------------|-------|
| <b>TEST ADMINISTRATION</b>                     | Test administration dates: _____ to _____                              |             |       |
|  | # of Tests (Minimum 50)  | Price       | Total |
| <b>CAT Booklets</b>                            |  | \$9.95 each |       |
| <b>Annual Fee</b>                              | <input type="checkbox"/> Include <input type="checkbox"/> Already Paid | \$300.00    |       |
| <b>Subtotal</b> (shipping costs will be added) |  |             |       |

|                        |             |                               |             |
|------------------------|-------------|-------------------------------|-------------|
| <b>SCORING SESSION</b> |             | Scoring session date: _____   |             |
|                        | # Requested |                               | # Requested |
| <b>Scoring Guides</b>  |             | <b>Training Module Drives</b> |             |
| <b>Leader's Guides</b> |             |                               |             |

**Fed Ex Ground Shipping Address:**

\_\_\_\_\_

Name \_\_\_\_\_

Title \_\_\_\_\_

Institution \_\_\_\_\_

Department \_\_\_\_\_

Street Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

Email \_\_\_\_\_

**Bill to:** (if different from shipping address)

\_\_\_\_\_

Name \_\_\_\_\_

Title \_\_\_\_\_

Institution \_\_\_\_\_

Department \_\_\_\_\_

Street Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

Email \_\_\_\_\_

PRINT name and contact information of individual trained to lead CAT scoring workshop on your campus

**Non-Disclosure Agreement:**    Attached    On File

PRINT name and title of institutional representative ordering CAT materials

SIGN here \_\_\_\_\_ Date \_\_\_\_\_

**Return this order form to:**

|  |   |
|--|---|
| Center for Assessment & Improvement of Learning<br>Tennessee Tech University<br>244 Matthews Hall<br>80 West 8 <sup>th</sup> St.<br>Cookeville, TN 38505 | Phone: 931-372-3611<br><br>Fax: 931-372-3722<br><br>Email: CAT@tntech.edu |
|--|---|



# Returning CAT Materials

## What to Return

All materials that were shipped to you for the administration or scoring of the CAT must be returned to the Center for Assessment and Improvement of Learning. This includes all used tests, scored and unscored, as well as unused/unopened tests, and all additional reading packets that were packaged with the tests. A refund or credit will be applied for unopened tests and the additional reading packets are recycled. All scoring materials including scoring guides and training modules must be returned. The return shipment will not be processed until all materials are returned with a Material Return Form.

## Material Return Form

The Material Return Form will act as your shipping manifest. This form must be returned with the shipment or emailed to [kharris@tntech.edu](mailto:kharris@tntech.edu). The return shipment will not be processed until this form is returned. The Material Return Form provides us a count of all materials being returned. It also ensures that we have the correct contact information for issuing refunds and returning reports. The Material Return Form also provides us with information about your local codes and requested analyses. This form can be accessed on our website at <http://www.tntech.edu/cat>.

## Packaging

In order to make processing of the shipment easier, we ask that you organize and label the materials within your shipment. Ensure that all boxes have a packing list detailing the exact contents of each box. If different materials are stacked in the same box, make sure that each type of material is clearly labeled and separated. This can be done with brightly colored pieces of paper or plastic wrap. Please do not 'repackage' the test booklets into the packets of additional information. By keeping all materials separate, we can more easily identify each component and more quickly process the return.

## Shipping

**We ask that you use a preferred shipping provider such as FedEx or UPS, and that you ship with a tracking number.** Both of these providers make routine deliveries to our facility. It may be important and worthwhile to purchase insurance for your shipment; that is at your own discretion. Please ship all tests to the following address:

Center for Assessment & Improvement of Learning  
Tennessee Tech University  
244 Matthews Hall • 80 West 8<sup>th</sup> St. • Cookeville, TN 38505  
  
931-372-3611

# CAT Materials Return Form (Paper Version)

**Instructions for returning CAT materials:**

1. All materials including used and unused tests, additional readings, and scoring materials must be returned.
2. Keep all materials separate. Organize and label each type of material in each box.
3. Use a preferred shipping provider such as FedEx or UPS and ship with a tracking number.
4. Return this form with your shipment

**The return shipment will not be processed if this form is not received or if all materials are not returned.**

**Return Information:**

\_\_\_\_\_

Name of Institution

\_\_\_\_\_

Name of Primary Contact

\_\_\_\_\_

Test Administration Dates

\_\_\_\_\_

Scoring Session Date

**Have you included:**

|  | # |
|--|---|
| <input type="checkbox"/> Scored CAT Tests          |   |
| <input type="checkbox"/> Unscored CAT Tests        |   |
| <input type="checkbox"/> Unused CAT Tests          |   |
| <input type="checkbox"/> Scoring Guides            |   |
| <input type="checkbox"/> Leader's Guides           |   |
| <input type="checkbox"/> Training Module Drive     |   |
| <input type="checkbox"/> Additional Readings       |   |
| <input type="checkbox"/> Group Non-Disclosure Form |   |

**CAT Report Contact:**

\_\_\_\_\_

Name

\_\_\_\_\_

Title

\_\_\_\_\_

Institution

\_\_\_\_\_

Department

\_\_\_\_\_

Phone Fax

\_\_\_\_\_

Email

**Refund Address (if applicable):**

\_\_\_\_\_

Name

\_\_\_\_\_

Title

\_\_\_\_\_

Institution

\_\_\_\_\_

Department

\_\_\_\_\_

Street Address

\_\_\_\_\_

City State Zip Code

\_\_\_\_\_

Phone Fax

\_\_\_\_\_

Email

**Please Return all Materials to:**

|  |   |
|--|---|
| Center for Assessment & Improvement of Learning<br>Tennessee Tech University<br>244 Matthews Hall<br>80 West 8 <sup>th</sup> St.<br>Cookeville, TN 38505 | Phone: 931-372-3611<br><br>Fax: 931-372-3722<br><br>Email: CAT@tntech.edu |
|--|---|

# Administering the CAT – Paper Version

## Reserving a Testing Room

Make arrangements for a room to administer the CAT instrument. The test will take about one hour to complete, and you should allow for about 10–15 minutes to process the informed consent (if applicable), distribute the test, read the instructions aloud (instructions are printed on page 12), and let students complete the demographic information page. Try to arrange a location that is fairly quiet so that students can concentrate.

## Time to Complete the Test

Many students will complete the test in less than an hour. A few students may require a little longer. This is not a timed test, but it is designed to be completed by most students in one hour or less.

## Supplies

You should have extra pencils for people taking the test. Make copies of the informed consent form for students to sign before taking the test (if needed).

## Test Packet Contents

Test packets contain a test booklet and inner envelope. The test booklet contains the test questions, space for the student response, space for faculty scoring, and student demographic questions. The inner envelope contains readings that are required to answer questions in Part II of the test. Instructions on the inner envelope tell students to not open the envelope until the test booklet instructs to do so. It is important to watch and ensure that students are not opening the inner envelope at the beginning of the test administration, but that students are opening the inner envelope a little over halfway through the test.

## Student IDs and Local Codes

The student demographics page of the test booklet allows the student to enter a Student ID number. This 10 digit ID is numeric only and cannot be the student's social security number. The Student ID can be an important component to some assessment plans, especially in the case of a pre/post matched design or when combining CAT data with other data sets. You should have a list or access to a list of Student IDs at the test administration to ensure these IDs are entered correctly.

The student demographic page also contains a 4 digit field called the Local Code. The Local Code allows an institution to code different groups of students for later analysis and comparison. This code can also help to communicate your research design to our staff who process your results. Information about developing your Local Codes can be found on page 36 of this manual.

| <b>Student Information</b>                                |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| <b>Answer Selection:</b> Correct = ●    Incorrect = ✕ ✓ ⊕ |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |                      |
| Student ID Number   |                      |                      |                      |                      |                      |                      |                      |                      |                      | What is your Age?    |                      | Local Code           |                      |                      |                      |
| <input type="text"/>                                      | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 0   | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    | 0                    |
| 1   | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    | 1                    |
| 2   | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    | 2                    |
| 3   | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    | 3                    |
| 4   | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    | 4                    |

## Overview of Process

1. Students complete informed consent (if necessary).
2. Test packets are distributed.
3. Oral instructions are read aloud (oral instructions are provided on the following page).
4. Students open outer test envelope and complete the demographics section on the last page of test booklet (be sure to have students enter their student identification number and local code (if used) on the test).
5. Students read instructions at the beginning of test booklet.
6. Students complete Part I of test.
7. Students open inner envelope with additional readings when instructed by the test booklet.
8. Students complete remaining questions in Part II of the test.
9. All testing materials are collected.

## Motivating Students to Do Their Best

A motivational pep talk with students before taking the test, along with providing a snack/meal, has been found to increase students' positive attitudes toward taking the test. Motivation leads to more cognitive engagement, better performance, and a more valid measure of student potential. Take care in the selection of the test administrator. Select an individual with a positive attitude who is respected by students and who can communicate to students the importance of assessment. It is important that students understand that the institution values their time spent completing the CAT. The following information might be mentioned to students before taking the exam:

- Student performance on tests like the CAT affect external perceptions about the quality of the institution and the value of the degrees from this institution.
- The critical thinking and real-world problem solving skills assessed by the CAT instrument are very important to prospective employers.

## Suggestions for Administering a CAT Posttest

In a situation where students may be taking the CAT for the second time due to a pre/post design in a course or program or due to a longitudinal design, we find it beneficial to explain to students why they are taking the CAT again. Take a moment to discuss the nature of the experiences that the students have been afforded in the course or program and explain that the posttest is an opportunity for students to demonstrate what they have learned. Also, be cognizant of the scheduling of the posttest to ensure that students are not overwhelmed with studying for finals or completing final projects. This may require that the posttest is administered a couple of weeks before the end of the semester.

# Oral Instructions: Students Taking the CAT for the First Time (Paper Version)

**Each session should be monitored in its entirety to ensure that:**

- Students have nothing on their desks other than test materials.
- Students do not talk to each other once testing has begun.
- Students can ask questions if they are unclear about the instructions.
- All test materials are returned before students exit the session.
- Students should turn off cell phones and electronic devices during the testing session.

**Read aloud the instructions in the boxes below:**

The test you will be taking is designed to measure your ability to evaluate ideas and comprehend new information. This is a short answer/essay test. Please try to write or print as clearly as possible and to express your ideas as clearly as possible. There will be places in the test where you will see the instruction: "Do not go back to the preceding pages." Please adhere to this request. It is important that you answer the questions in the order they are presented. Think about each question carefully and then answer it as best you can. If you learn something from one question, you might have to apply it to questions that follow. The answer for each question will be evaluated on its own merit and should be complete – do not assume that your answer to an earlier question will be included as part of your response. We encourage you to do your best.

**Optional Motivating Statements:**

The skills assessed by this test are very important to both employers and graduate programs. Although your performance on this test does not affect your personal course grade, it does reflect on the quality of this institution and therefore it impacts the value of your degree. You have a significant investment in your education and the value of that investment is directly related to the perceived value of your degree. Please take the time to understand and complete each question to the best of your ability.

You will have 1 hour to take this test.\* Time will not start until you have been instructed to begin. When the allotted time has passed, you will be asked to return all test materials. If you complete the test before the allotted time has expired, you may turn in all test materials and leave the room quietly. While no breaks are scheduled for this session, if you find you must leave the room for any reason, leave all test materials with the administrator and exit quietly. Extra time will not be allowed for these absences.

You will be receiving an envelope that contains a test booklet and an inner envelope. Please open the clear plastic and remove the test booklet and envelope, but do not open the test booklet or the envelope. The test booklet provides both the test questions and space for your answers. **At this time you should enter your student identification number in the space provided on the back of the test booklet and answer all questions on the back of the test booklet.** (If your institution is using the local code fields to identify subgroups, explain how they should fill in the local code).

There will also be a packet of additional information inside of the envelope. You will need this to answer certain test questions on Part II of the test. **You should not open this packet until you encounter a written instruction inside the test booklet that directs you to do so.**

You will need to clear your desk of everything except a pen or pencil.

Does anyone have any questions?

You may begin.

\* This is not a timed test, and although most students complete the CAT in under 1 hour, you may allow additional time.

## Oral Instructions: Students Taking the CAT for the Second Time (Paper Version)

### Each session should be monitored in its entirety to ensure that:

- Students have nothing on their desks other than test materials.
- Students do not talk to each other once testing has begun.
- Students can ask questions if they are unclear about the instructions.
- All test materials are returned before students exit the session.
- Students should turn off cell phones and electronic devices during the testing session.

### Read aloud the instructions in the boxes below:

The test you will be taking is designed to measure your ability to evaluate ideas and comprehend new information. This is a short answer/essay test. Please try to write or print as clearly as possible and to express your ideas as clearly as possible. There will be places in the test where you will see the instruction: "Do not go back to the preceding pages." Please adhere to this request. It is important that you answer the questions in the order they are presented. Think about each question carefully and then answer it as best you can. If you learn something from one question, you might have to apply it to questions that follow. The answer for each question will be evaluated on its own merit and should be complete – do not assume that your answer to an earlier question will be included as part of your response. We encourage you to do your best.

### Optional Motivating Statements:

You may notice that you have answered the questions on this test before. We are asking you to complete this test again today in order to assess how this institution has improved your critical thinking and problem solving skills. This information will be used to help improve students' proficiency in these areas that are important to both employers and graduate programs.

Although this test does not affect your personal course grade, your performance does reflect on the quality of this institution and therefore it impacts the value of your degree. You have a significant investment in your education and the value of that investment is directly related to the perceived value of your degree. Please take the time to understand and complete each question to the best of your ability.

You will have 1 hour to take this test.\* Time will not start until you have been instructed to begin. When the allotted time has passed, you will be asked to return all test materials. If you complete the test before the allotted time has expired, you may turn in all test materials and leave the room quietly. While no breaks are scheduled for this session, if you find you must leave the room for any reason, leave all test materials with the administrator and exit quietly. Extra time will not be allowed for these absences.

You will be receiving an envelope that contains a test booklet and an inner envelope. Please open the clear plastic and remove the test booklet and envelope, but do not open the test booklet or the envelope. The test booklet provides both the test questions and space for your answers. **At this time you should enter your student identification number in the space provided on the back of the test booklet and answer all questions on the back of the test booklet.** (If your institution is using the local code fields to identify subgroups, explain how they should fill in the local code).

There will also be a packet of additional information inside of the envelope. You will need this to answer certain test questions on Part II of the test. **You should not open this packet until you encounter a written instruction inside the test booklet that directs you to do so.**

You will need to clear your desk of everything except a pen or pencil.

Does anyone have any questions?

You may begin.

\* This is not a timed test, and although most students complete the CAT in under 1 hour, you may allow additional time.

# Recruiting Local Faculty for the Scoring Workshop

## Opportunity for Professional Development

The CAT scoring session should be treated as an opportunity for faculty development. The scoring will address three important goals related to faculty development.

- Help your faculty understand student weaknesses in critical thinking and real-world problem solving.
- Create an opportunity to discuss new pedagogical methods (effective practices) that might positively impact student learning.
- Help build a community of faculty interested in improving teaching and student learning.

## Desirable Faculty Characteristics

Identify individuals at your institution that are interested in encouraging students to think critically and develop life-long learning skills.

### Other important faculty characteristics:

- Ability to work with faculty across disciplines;
- Willingness to follow instructions and adhere to a scoring guide;
- Ability to deal with ambiguity and alternative points of view.

## Time Commitment

The scoring workshop normally takes a full day of approximately 7-8 hours, including lunch and breaks. You should let potential participants know that this will involve a full-day scoring workshop to score essay exams and that they will receive lunch and refreshments.

## Extra Compensation

Most institutions that have used the CAT instrument offer faculty extra compensation to participate in the full-day scoring workshop. When extra compensation is involved, the workshops are usually held on Saturday or during semester breaks when no classes are being taught. The rate of compensation varies from campus to campus. **If compensation is being offered, be sure to mention this when recruiting faculty.**

Some institutions have conducted the scoring workshops without extra pay during the normal work week and have released faculty from their normal activities that day. The latter model has been used successfully at some community colleges.

## Casual Dress

Encourage casual and comfortable dress, as this will be an extended workshop.

# Conducting the Scoring Workshop

## Arranging a Date for the Workshop

To ensure that you have the necessary scoring guides and training materials on hand, please be sure to contact us at least two months in advance.

## Selecting a Location

You will need to reserve a conference room with a large table or tables that can be arranged in a large rectangle to accommodate all the faculty scorers and trainers (about 12-15 people). The room should also have a large projection screen and a projection device that is connected to a computer with USB drive and external speakers. The training materials on USB drive include audio tracks, so make sure the speakers are sufficient for everyone to hear clearly. **We strongly recommend testing the USB drive on the equipment far enough in advance that we can help you troubleshoot any problems before your scoring workshop.**

The room should also have space for snacks and refreshments, as this will be a full-day scoring workshop. Try to select a pleasant, quiet room with good lighting and comfortable chairs.

## Refreshments

You will need to arrange to have an ample supply of snacks and drinks (including caffeinated beverages) for people during the workshop. Bottled water, soft drinks, fruit drinks, and coffee are appropriate, as are pretzels and M&Ms or other snack items.

## Lunch

You will also need to arrange to have a lunch delivered or served to the participants. What you serve is probably dependent on either your available food services department or local restaurants. The lunch can be served in the same conference room that will be used to score the tests or in some nearby location.

## Testing Materials

Remember to bring the completed test booklets and an adequate supply of sharpened pencils for the faculty graders. The test booklets should be separated from the packet of additional readings. You will only need the test booklets and perhaps a few copies of the additional readings for interested faculty to examine.

**We will provide scoring guides and training materials two weeks before your scoring workshop. If you have not received the materials at least two weeks before your workshop, please contact us immediately.**

## Other Materials and Forms to be Completed at the Workshop

Name tags would be helpful if the faculty at your workshop will not know each other. **Each scorer at the workshop should also sign a copy of the Non-Disclosure Agreement that is printed on page 16.**



# NON-DISCLOSURE AGREEMENT

## CAT Scoring Workshop Participants

As a participant in this scoring workshop for the CAT instrument, you will be working with a secure testing instrument and scoring guide that was developed by Tennessee Technological University with funding from the National Science Foundation. This instrument and associated material is protected under U.S. copyright law.

Your participation in this workshop is voluntary and you must agree not disclose the particular content of the test questions or the scoring guide as a condition of your participation. You are free to talk about the skills that the instrument is designed to assess and to discuss ways to improve student performance on these skills.

Your signature below indicates that you will protect the content of the CAT instrument and related scoring guide and not disclose, use, disseminate, or publish information about that content to any third party without the prior written consent of Tennessee Technological University.

---

Institution Name

### AGREED TO AND ACCEPTED BY:

| Printed Name | Signature | Date |
|--------------|-----------|------|
| 1            |           |      |
| 2            |           |      |
| 3            |           |      |
| 4            |           |      |
| 5            |           |      |
| 6            |           |      |
| 7            |           |      |
| 8            |           |      |
| 9            |           |      |
| 10           |           |      |
| 11           |           |      |
| 12           |           |      |
| 13           |           |      |
| 14           |           |      |
| 15           |           |      |

## Overview of the Scoring Process

The tests should be divided into approximately equal stacks and distributed to each faculty member at the scoring workshop. We recommend limiting the scoring to no more than 6-7 tests per faculty if they have no prior experience.

Training and scoring proceed question by question. You will train faculty to score question #1 and then faculty will score question #1 on all tests. As tests are scored, faculty will mark the appropriate score on the score sheet (next to the last page in the test booklet) and then leave the test booklet open to the response being scored. Once the question is scored, tests are passed clockwise to the next faculty scorer. After a second faculty member has graded question #1, the tests that need a third scorer (no agreement on scoring) are rotated clockwise to a third faculty member for scoring.

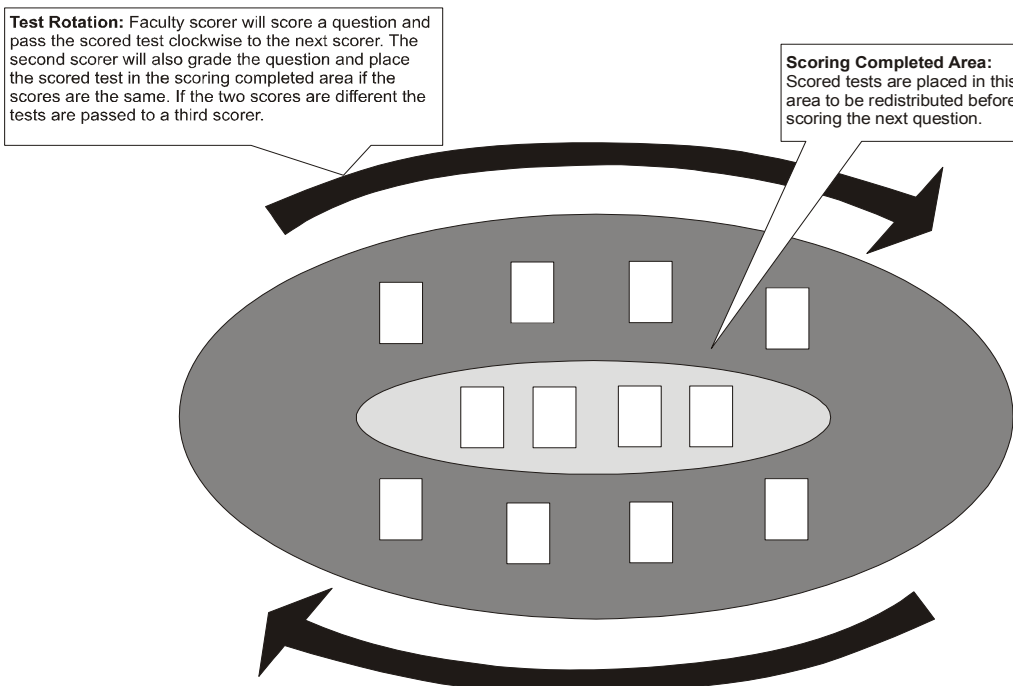
Faculty should not look at other assigned scores until they have arrived at their own judgment. Faculty can seek clarification about how to score a student response at any time during the scoring session.

The trainers should redistribute tests during the scoring process to unburden the slower scorers and keep everyone scoring. Redistributing tests will prevent bottlenecks and make the whole process more efficient.

After the training and scoring for one individual question is completed, the tests should be randomly sorted into equal stacks and distributed to each faculty member for training and scoring on the next question.

If two faculty members are finding that they are repeatedly in need of a third scorer, they should discuss among themselves how they are deriving their scores and, if necessary, consult with one of the workshop leaders. This discussion of any consistent pattern of disagreements is encouraged to improve scoring accuracy in the future and to clarify any potential misunderstanding of how the scoring guide should be applied.

It is very important that the workshop leader examine the faculty scoring page of each test to determine if all questions have been fully scored throughout the scoring session. Tests that are not completely scored will not be included in your reports.



# ONLINE ADMINISTRATION

## Ordering Online Version

### Tests

Please let us know in advance when you will administer the CAT. We generally need at least three weeks notice to setup an institutional account and administration ID in our online system. Proctors for your administration will need to be identified prior to your account setup.

### Proctors

Proctors are required to log in each individual student onto the online test system during the administration window. We recommend at least two proctors per course to reduce time spent on the login process. The name and email address of each proctor should be provided so that we can setup an account for each individual proctor. Login information and passwords will be emailed to proctors prior to the administration.

### Pricing and Annual Fee

Please contact Elizabeth Lisic to obtain a quote for your institution's online administration. Pricing is based on the volume of tests ordered and administered.

The annual fee covers costs associated with generating reports (including national norm comparisons) and providing training materials.

### Training Materials

A subset of student responses will be provided so that faculty have an opportunity to see a sample of their student responses and practice using the scoring guide to evaluate these responses. These sample responses can be provided in two formats: booklet style or presentation style. Scoring materials must be returned to the Center for Assessment & Improvement of Learning at TTU after the workshop has been completed. **Please be certain to discuss and confirm the possible date you might schedule a faculty workshop so that we can make sure that your student subset is prepared and scoring guides have been shipped.**

|  |
|--|
| <p><b>CAT Tests: Request Quote</b><br/><b>Annual Fee: \$300.00</b></p> |
|--|

# Administering the CAT – Online Version

## Reserving a Testing Room

Make arrangements for a room to administer the CAT instrument. Each student should have his/her own computer with internet access. The test will take about one hour to complete, and you should allow for about 10–15 minutes to process the informed consent (if applicable), log students into the online test, let students complete the demographic information page, and read the instructions aloud (instructions are printed on page 22). Try to arrange a location that is fairly quiet so that students can concentrate.

## Time to Complete the Test

Many students will complete the test in less than an hour. A few students may require a little longer. This is not a timed test, but it is designed to be completed by most students in one hour or less.

## Supplies

You should have pencils and scrap paper available for people taking the test. These can be useful for the student when completing a math problem in the test. Make sure that all scrap paper is collected at the end of the testing session. Make copies of the informed consent form for students to sign before taking the test (if needed).

## Test Process

There are a total of 15 test questions on the CAT. Questions on the test are presented in a sequence. Once a student completes and submits a response to a question, the response field is locked and the next question is presented. After a question response is submitted and the response field locked, there is no way for the student to go back and make changes even though the response can still be seen. Instructions in the test warn students that once the submit button is selected there is no going back to make changes to a response.

The last question set (Questions 10-15) provide additional readings for the student to use in solving a real world problem. The information provided in the readings is more than adequate to solve the problem, so students may not open additional browser windows or tabs to search for other information. Prompts on the screen instruct students on how to view each reading.

If a browser or computer suddenly shuts down or closes during testing, the student can still complete the test. Restarting the browser and following all login protocols should bring the student back to the last completed question. The student ID and local code will need to be entered exactly as those submitted with the first attempt.

## Proctor Login

In order for a student to access the test, a proctor must complete the proctor login screen. The login screen requires three pieces of information: email address, password, and administration ID number. This information will be emailed to the proctor by CAIL staff. Proctor access will only be available during the test administration window. Please ensure that all proctor login information is secure in order to protect the integrity of the test administration.

The screenshot shows a web form titled "Proctor Login". It contains three text input fields stacked vertically, labeled "E-Mail Address", "Password", and "Administration ID". Below the "Administration ID" field is a blue button with the text "Login".

## Student IDs and Local Codes

The student login page of the test allows the student to enter a Student ID number. This 10 digit ID is numeric only and cannot be the student's social security number. The Student ID can be an important component to some assessment plans, especially in the case of a pre/post matched design or when combining CAT data with other data sets. You should have a list or access to a list of Student IDs at the test administration to ensure these IDs are entered correctly.

The student login page also contains a 4 digit field called the Local Code. The Local Code allows an institution to code different groups of students for later analysis and comparison. This code can also help to communicate your research design to our staff who process your results. Information about developing your Local Codes can be found on page 36 of this manual.

The screenshot shows a form with the heading "Please enter your Student ID and provided Local Code." Below the heading are two input fields. The first is labeled "Student ID:" and has a small numeric keypad icon to its right. Below it is the text "Numeric values only". The second field is labeled "Local Code:". Below this field is the text "If no local code necessary, please enter '0000'". At the bottom of the form is a green button with the text "Submit Information".

## Overview of Process

1. Students complete informed consent (if necessary).
2. Students log onto computer and open an internet browser. (Google Chrome or Mozilla Firefox; Internet Explorer will NOT work)
3. Students go to [www.criticalthinkingtest.com](http://www.criticalthinkingtest.com) and then full screen the browser (shortcut is generally F11).
4. Proctors select 'Login' in the top right corner of the page and enter credentials on the Proctor Login page.
5. Students do not proceed until everyone is logged in and instructions are provided.
6. Oral instructions are read aloud (oral instructions are provided on the following page).
7. Students enter student ID and local code on the Student Login page (be sure to provide student identification numbers and local codes).
8. Students complete the demographics page of the test.
9. Students proceed to the instructions page and begin the test.
10. Students complete the test.
11. All testing materials/scrap paper are collected.

## Administration Problems

If a student is accidentally logged out during the test or a browser error occurs, the student ID and local code can be used to restore the test administration. Close and reopen the browser; then follow Steps 3 and 4 above. On the Student Login page, enter the student ID and local code exactly as it was submitted with the first attempt. The test will reopen to the last question answered.

## Motivating Students to Do Their Best

A motivational pep talk with students before taking the test, along with providing a snack/meal, has been found to increase students' positive attitudes toward taking the test. Motivation leads to more cognitive engagement, better performance, and a more valid measure of student potential. Take care in the selection of the test administrator. Select an individual with a positive attitude who is respected by students and who can communicate to students the importance of assessment. It is important that students understand that the institution values their time spent completing the CAT. The following information might be mentioned to students before taking the exam:

Student performance on tests like the CAT affect external perceptions about the quality of the institution and the value of the degrees from this institution. The critical thinking and real-world problem solving skills assessed by the CAT instrument are very important to prospective employers.

## Suggestions for Administering a CAT Posttest

In a situation where students may be taking the CAT for the second time due to a pre/post design in a course or program or due to a longitudinal design, we find it beneficial to explain to students why they are taking the CAT again. Take a moment to discuss the nature of the experiences that the students have been afforded in the course or program and explain that the posttest is an opportunity for students to demonstrate what they have learned. Also, be cognizant of the scheduling of the posttest to ensure that students are not overwhelmed with studying for finals or completing final projects. This may require that the posttest is administered a couple of weeks before the end of the semester.

# Oral Instructions: Students Taking the CAT for the First Time (Online Version)

**Each session should be monitored in its entirety to ensure that:**

- Students have nothing on their desks other than test materials.
- Students do not talk to each other once testing has begun.
- Students can ask questions if they are unclear about the instructions.
- Students do not open additional browser windows or tabs.
- Students should turn off cell phones and electronic devices during the testing session.

**Read aloud the instructions in the boxes below:**

The test you will be taking is designed to measure your ability to evaluate ideas and comprehend new information. This is a 15 question mostly short answer/essay test. Please try to express your ideas as clearly as possible. It is important that you think about each question carefully and then answer it as best you can. If you learn something from one question, you might have to apply it to questions that follow. The answer for each question will be evaluated on its own merit and should be complete – do not assume that your answer to an earlier question will be included as part of your current response. We encourage you to do your best.

**Optional Motivating Statements:**

The skills assessed by this test are very important to both employers and graduate programs. Although your performance on this test does not affect your personal course grade, it does reflect on the quality of this institution and therefore it impacts the value of your degree. You have a significant investment in your education and the value of that investment is directly related to the perceived value of your degree. Please take the time to understand and complete each question to the best of your ability.

You will have 1 hour to take this test.\* If you complete the test before the allotted time has expired, you may leave the room quietly. While no breaks are scheduled for this session, if you find you must leave the room for any reason, leave all test materials with the administrator and exit quietly. Extra time will not be allowed for these absences.

Questions on the test are presented in a specific order and only after you submit a response to a question will the next question appear. Be sure that you are satisfied with a response before submitting as there is no way to go back and change submitted responses. There will also be additional information provided for questions in Part 2 of the test. Please read all instructions and prompts carefully to access and use this additional information. At no time, are you allowed to close or minimize the test window to open additional browser windows/tabs or other programs.

At this time you should enter your student ID number and local code.

Does anyone have any questions?

When you click 'Submit Information,' you will be asked to complete a series of demographics questions and then the test will begin. Again, be sure to read all instructions in the test.

You may begin.

\* This is not a timed test, and although most students complete the CAT in under 1 hour, you may allow additional time.

## Oral Instructions: Students Taking the CAT for the Second Time (Online Version)

### Each session should be monitored in its entirety to ensure that:

- Students have nothing on their desks other than test materials.
- Students do not talk to each other once testing has begun.
- Students can ask questions if they are unclear about the instructions.
- Students do not open additional browser windows or tabs.
- Students should turn off cell phones and electronic devices during the testing session.

### Read aloud the instructions in the boxes below:

The test you will be taking is designed to measure your ability to evaluate ideas and comprehend new information. This is a 15 question mostly short answer/essay test. Please try to express your ideas as clearly as possible. It is important that you think about each question carefully and then answer it as best you can. If you learn something from one question, you might have to apply it to questions that follow. The answer for each question will be evaluated on its own merit and should be complete – do not assume that your answer to an earlier question will be included as part of your current response. We encourage you to do your best.

### Optional Motivating Statements:

You may notice that you have answered the questions on this test before. We are asking you to complete this test again today in order to assess how this institution has improved your critical thinking and problem solving skills. This information will be used to help improve students' proficiency in these areas that are important to both employers and graduate programs.

Although this test does not affect your personal course grade, your performance does reflect on the quality of this institution and therefore it impacts the value of your degree. You have a significant investment in your education and the value of that investment is directly related to the perceived value of your degree. Please take the time to understand and complete each question to the best of your ability.

You will have 1 hour to take this test.\* If you complete the test before the allotted time has expired, you may leave the room quietly. While no breaks are scheduled for this session, if you find you must leave the room for any reason, leave all test materials with the administrator and exit quietly. Extra time will not be allowed for these absences.

Questions on the test are presented in a specific order and only after you submit a response to a question will the next question appear. Be sure that you are satisfied with a response before submitting as there is no way to go back and change submitted responses. There will also be additional information provided for questions in Part 2 of the test. Please read all instructions and prompts carefully to access and use this additional information. At no time, are you allowed to close or minimize the test window to open additional browser windows/tabs or other programs.

At this time you should enter your student ID number and local code.

Does anyone have any questions?

When you click 'Submit Information,' you will be asked to complete a series of demographics questions and then the test will begin. Again, be sure to read all instructions in the test.

You may begin.

\* This is not a timed test, and although most students complete the CAT in under 1 hour, you may allow additional time.



# Frequently Asked Questions

## **What are the advantages of using the CAT Instrument?**

The CAT instrument has two major advantages relative to existing tests of critical thinking. First, the CAT scoring workshops on your campus are effective development experiences that help instructors understand student weaknesses, increase motivation for pedagogical improvement, and provide a forum for discussing new ideas for implementing effective practices in education. Second, the CAT instrument was designed with considerable faculty input to assess skills that faculty think are important components of critical thinking.

## **Should the CAT test be used to evaluate individual students?**

We do not advise using the CAT instrument to evaluate individual students. Although great effort has gone into refining the test and the scoring guide, we believe that it is best used to make judgments about groups of students (10 or more) that have taken a course or gone through a program.

## **Can we give students more time to take the CAT test if they have a disability?**

The CAT test is not a timed test. Most students will complete the test in less than an hour. You are free to give students extra time to complete the test if you deem it necessary.

## **Are there different versions of the CAT test for testing students over time?**

Although we are currently developing alternate versions of the test, we have evaluated changes in student performance over a semester or less with a single version of the CAT instrument administered twice. Neither our institution nor other institutions have found significant improvements in performance for control groups where nothing is done to improve critical thinking skills.

## **Is the CAT test suitable for freshmen, seniors, and community college students?**

The CAT instrument has been successfully administered to all levels of undergraduate students at four year institutions and to students at community colleges without floor effects or ceiling effects. We believe the test could also be used in high schools and graduate schools, but we have not evaluated it in those populations.

## **Can students be provided their scores on the CAT instrument?**

Yes, students can be shown their scores on the CAT instrument. However, it is important to provide context for the scores. This may be done by providing a comparison to other peers at the institution or a comparison to national norms. Also, the scoring of the CAT instrument and the analysis of the data may take significant time. Students may no longer be available to receive their scores. CAT Apps can be an alternative for providing immediate formative feedback to students on critical thinking skill. Refer to page 31 to find out more about CAT Apps.

## **Is IRB approval required?**

In many cases institutions will be using the CAT instrument for institutional research, and such research does not typically require IRB approval. *However, if your institution will be receiving external funds to administer the CAT, you may need to obtain IRB approval.* You should check with your IRB board or research office to determine if such approval is required. If IRB approval is required you must obtain approval before administering the CAT test. The test does not include personally identifying information other than a student ID (which should not be a social security number). The Center for Assessment and Improvement of Learning will protect the confidentiality of all test data.

### **Is the CAT instrument sensitive to the effects of a single class?**

We have found that a single course that includes instruction relevant to the skills assessed by the CAT instrument can lead to a statistically significant improvement on the CAT instrument.

### **How many tests can be scored by a group of faculty in one day?**

The number of tests that can be scored will vary depending on the familiarity of the faculty with the scoring process and the amount of discussion that is encouraged about effective practices. Generally, we recommend that only 6–7 tests be scored per faculty member during a full-day scoring workshop if they have no prior experience. Experienced graders can score around 10 - 14 tests during a scoring workshop, and very experienced scorers can score about 20 tests during a scoring workshop.

### **How do we know we have scored the test correctly?**

The detailed scoring guide, the scoring procedure, the training workshops, and the training materials are designed to maintain reliable scoring. We also rescore a subsample of tests from each institution in order to further check scoring accuracy. If problems are found, institutions are informed about them, and specific suggestions are made to improve scoring accuracy.

### **Are tests scored at one institution equivalent to tests scored at another institution?**

Yes, see previous question.

### **How do we know that we have scored an ambiguous student response correctly?**

Some student responses are inherently ambiguous and require a judgment call. Such responses tend to require a third scorer. If two scorers agree, we use that score; if all three scorers disagree, we use the average of the three scores. These strategies have proven surprisingly reliable.

### **Can faculty scorers look at other scores assigned to a question before finalizing their own evaluation?**

We discourage faculty from looking at other ratings until they have finalized their own evaluation to avoid any bias. We do encourage discussion of any consistent pattern of disagreements to improve scoring accuracy in the future and to clarify any potential misunderstanding of how the scoring guide should be applied.

### **Can we copy the CAT test, Scoring Guide, and training materials?**

The CAT instrument and associated materials are copyrighted. We maintain strict control over the test and scoring aids to protect the integrity of the instrument. Only institutions that have signed non-disclosure agreements with Tennessee Tech University can access these materials. The CAT materials should not be photocopied, scanned, or reproduced. Each test is uniquely numbered, as are the scoring guides. We update the scoring guides and training materials regularly to improve the accuracy of scoring. The scoring guides are provided as part of the annual participation fee.

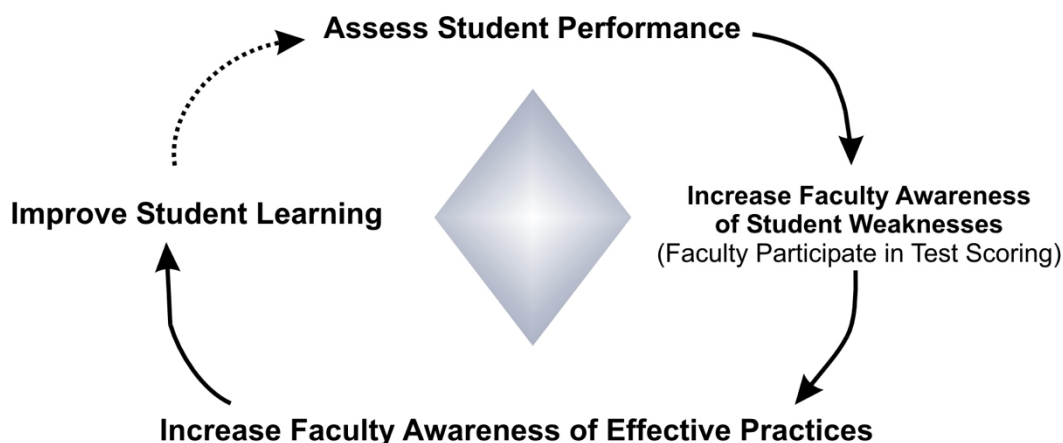
### **Do we have to return the CAT instrument and associated materials to TTU when we are finished?**

For reasons noted above, we require all CAT tests and scoring guides/videos be returned to us once the scoring workshops have been completed. We also update these materials on a regular basis to improve scoring accuracy. We distribute the latest scoring guides for each scheduled scoring session.

# Effective Practices for Improving Students' Critical Thinking and Real-world Problem Solving

One important feature of the CAT instrument is the role it can play in faculty development. The CAT scoring sessions provide a unique opportunity for faculty to discuss critical thinking while at the same time personally experiencing their students' weaknesses in the area of critical thinking. Indeed, there is probably no better time to create a dialogue about effective practices than when faculty are being made aware of students' weaknesses. The CAT scoring sessions provide an opportunity to develop a teaching community where faculty come together to identify student weaknesses and discuss effective practices for improving students' critical thinking and real-world problem solving skills.

## Closing the Loop in Assessment and Quality Improvement



The information in this section provides a brief overview of effective practices for improving student's critical thinking and real-world problem solving skills that will impact performance on the CAT instrument.

### Skill areas assessed by the CAT instrument

The skill areas on the CAT assessment were developed by an interdisciplinary team of faculty and validated by other faculty across the country. While the list is not exhaustive of all possible skills related to critical thinking/real-world problem solving, it may be the best consensus of skills that faculty across disciplines agree are important components of critical thinking. These skills should be the targets of efforts designed to improve students' critical thinking and their performance on the CAT instrument. We believe that it is beneficial to consider how effective practices should be implemented to maximize the impact of skill development in these areas.

#### Evaluating Information and Other Points of View

- Separating factual information from inferences.
- Interpreting numerical relationships in graphs.
- Understanding the limitations of correlation data.
- Evaluating evidence and identifying inappropriate conclusions.

#### Creative Thinking

- Identifying alternative interpretations for data or observations.
- Identifying new information that might support or contradict a hypothesis.
- Explaining how new information can change a problem.

### Learning & Problem Solving

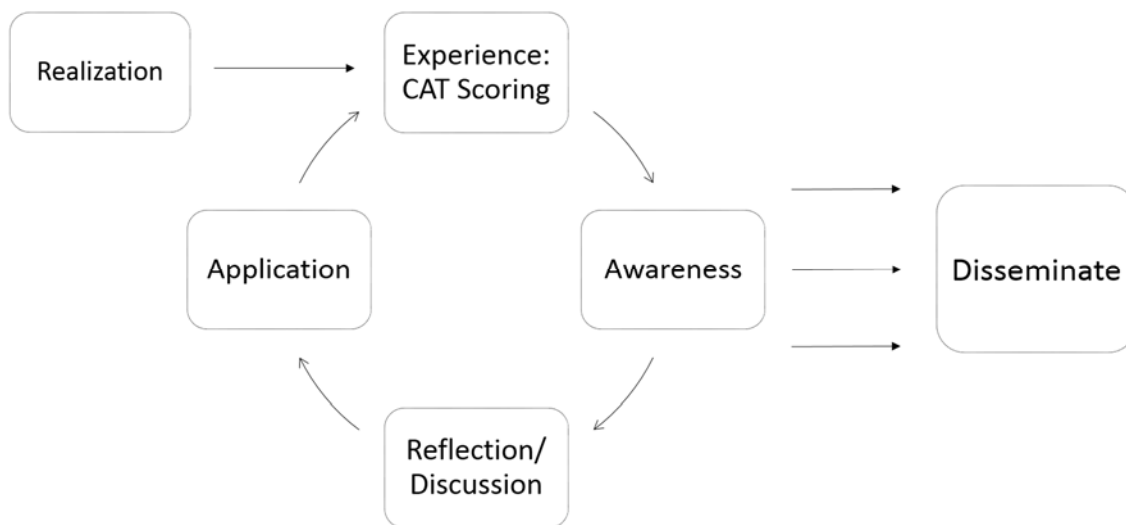
- Separating relevant from irrelevant information.
- Integrating information to solve problems.
- Learning and applying new information.
- Using mathematical skills to solve real-world problems.

### Communication

- Communicating ideas effectively.

## Using CAT Scoring as Faculty Development

The CAT scoring process can be used as an experiential learning strategy to raise faculty participants' awareness of students' critical thinking ability while motivating participants to implement change to courses activities and assessments. Participants' reflections on their observations of student learning lead to the application of critical thinking assessment within the disciplines. The faculty development process begins with realization at the individual, departmental, or institutional level that change in instructional or assessment practices are needed for further improvement in student learning. Faculty members sharing this realization enter into the cycle through the initial experience - participation in a CAT scoring workshop. Through the process of observing and scoring student work, faculty gain a greater awareness of student strengths and weaknesses. The integrated elements of professional community lead to discussion regarding goals and objectives for student learning, adoption of high-impact educational practices, and personal reflection on what participants can take away from this experience. The next stage of the cycle allows participants to apply their new awareness and observations by infusing critical thinking assessment within their discipline-specific courses. By modifying course assessments to better align with skills faculty want students to learn, participants are closing the loop between assessment and the improvement of learning. Participants are then invited to revisit the experience by participating in another CAT scoring workshop. They will bring newly learned and applied material into the scoring session, providing greater enrichment for novice participants. Throughout all stages of the model, participants are encouraged to disseminate their observations and findings with colleagues in diverse disciplines to enhance the community of learners participating in this professional development experience.



## Creating Active Learning and Real-World Problem Solving Experiences

There are numerous examples of effective practices in each discipline to encourage active learning and involve students in real-world problem solving. A variety of these methods are discussed below. These types of experiences provide opportunities to develop students' critical thinking by presenting issues and problems that stimulate original thought while utilizing previously acquired knowledge or finding and applying new information. Consider how to structure these activities so that they maximally impact critical thinking and real-world problem solving.

### Some General Principles for Construction of Activities

Although effective practices vary with disciplines, course objectives, student interests, and other factors, there are some general principles that you should consider when constructing activities to improve students' critical thinking/real-world problem solving. First, you should use some type of active learning to engage students in the learning process. Having students solely memorize information has a negative relationship with critical thinking and CAT scores in particular. Select activities and topics within those activities that are interesting to your students. Students who are interested will be more motivated and thus put more time, energy, and effort into the learning process. Information and activities should be presented in a way that is seen as appropriate, meaningful, and organized by students. Assessment of students should be related to the outcome goals including the development of critical thinking and real-world problem solving. It is often helpful for students to have the opportunity to learn collaboratively. For general guidance on maximizing student learning, we recommend *How People Learn* which can be found online from National Academies Press at [http://www.nap.edu/openbook.php?record\\_id=9457](http://www.nap.edu/openbook.php?record_id=9457).

### Service Learning

Service learning can be used to aid in critical thinking performance by providing meaningful learning experiences in local communities, such as allowing engineering students to design playgrounds for underfunded neighborhoods. Students would be presented with the problem of creating a playground with available materials, which is fun, safe, affordable, and accessible to individuals with physical impairments. Students would gather information from various sources and evaluate the best possible solutions. They would then present their findings to the local community. Excellent sources of information on conducting service learning projects can be found at the National Service-Learning Clearinghouse and Campus Compact at <http://www.compact.org>.

### Debates

A debate on global warming may be utilized to stimulate creative thinking among biology students. One group would be told to gather research to defend the theory that global warming is a natural cycle the earth goes through. Another group would gather research that supported the claim that global warming is caused by pollution. Each group would be given research on global warming and required to find the relevant research and differentiate it from irrelevant information, analyze claims, and synthesize information from multiple sources by effectively communicating their argument. However, students should not just research their position on global warming; they should also have to research the opposing view. This helps them understand opposing perspectives, as well as anticipate the arguments of the opposition. When using strategies such as debates, you will be most successful if your evaluation of your students corresponds to your teaching goals. Therefore, your debates will be more successful when the students are provided at the outset with your evaluation rubric which should correspond to such critical thinking components as separating factual information from inferences, identifying inappropriate conclusions, and separating relevant from irrelevant information.

## **Simulations**

Simulations could be utilized in which sociology students are assigned characters that represent an individual of another social, economic, or cultural group. The students are given constraints for each character. The students then randomly select life events throughout the semester, such as “you’re involved in a car accident and receive \$4000 in related bills.” This would affect each individual character differently and require students to figure out how changes in the nature of a problem may affect the best solution, identify additional information that is relevant, and differentiate relevant from irrelevant information, and synthesize information from multiple sources.

## **Case Studies**

Case studies have been used extensively for many years across many disciplines. Case studies provide a rich description and context for a current or past problem in a discipline. Students put themselves into the role of the investigator to analyze the information provided and make decisions in complex and ambiguous situations. A large collection of case studies in science can be found at the NSF funded National Center for Case Study Teaching in Science, <http://sciencecases.lib.buffalo.edu/cs/collection/>.

## **Real-World Problem Solving Tasks**

Having students solve real-world problems can be an effective tool in any field. For example, students in education could be asked to write a grant proposal for selecting a computer system for their classroom. In addition to being able to communicate effectively, students are required to develop skills in research, separate relevant from irrelevant information, separate factual information from inferences, among other skills. If you would like to have students also learn how new information might change the problem, you could add additional constraints such as a budget limit, a particular type of classroom, or different characteristics of the students.

## **Involving Students in Original Research**

We have found a positive relationship between student involvement in original research projects and their performance on the CAT instrument. These research experiences can be beneficial because they provide students with opportunities to develop skills in many of the areas that are evaluated by the CAT instrument.

An example of involving students in original research would be to have students conduct a research project in their given discipline. A biology student may have to form a hypothesis about water quality issues at a local park. The student would then design an experiment to test their hypothesis, conduct the experiment by collecting data, and analyze the data to evaluate their hypothesis. There should be opportunities to evaluate alternative explanations for the findings and for identifying what additional information might be needed to support their hypothesis. These experiences provide opportunities to develop many of the skills assessed by the CAT instrument. In fact, having students present their findings to the class or in written form would also help develop communication skills that are assessed by the CAT instrument.

Students in nursing or other health care fields could make a documentary on an issue such as Hospital Acquired Infections (HAI). As part of the documentary, students could explore the factors related to Hospital Acquired Infections and develop solutions to reduce the number of Hospital Acquired Infections while providing an effective educational tool for others in health care fields. In this documentary, students can also address how changes to the nature of the problem can impact the potential solution by exploring how recent changes in the types of bacterial infections have provided new challenges for health care professionals.

## Skill Checklist for the CAT Instrument

|  |  |
|--|--|
|  | CAT Questions  |
|  | Q1: Summarize a pattern of information without making inappropriate inferences.                                  |
|  | Q2: Evaluate how strongly information supports a hypothesis or interpretation.                                   |
|  | Q3: Provide alternative explanations for observations.   |
|  | Q4: Identify additional information needed to evaluate a hypothesis or particular explanation of an observation. |
|  | Q5: Evaluate whether spurious relationships strongly support a claim.  |
|  | Q6: Provide alternative explanations for spurious relationships.   |
|  | Q7: Identify additional information needed to evaluate a hypothesis/interpretation.                              |
|  | Q8: Determine whether an invited inference in an advertisement is supported by information.                      |
|  | Q9: Provide relevant alternative interpretations of information.   |
|  | Q10: Separate relevant from irrelevant information when searching for information to solve a real-world problem. |
|  | Q11: Analyze and integrate information from separate sources to solve a real-world problem.                      |
|  | Q12: Use basic mathematical skills to help solve a real-world problem.   |
|  | Q13: Identify suitable solutions for a real-world problem using relevant information.                            |
|  | Q14: Identify and explain the best solution for a real-world problem using relevant information.                 |
|  | Q15: Explain how changes in a real-world problem situation might affect the solution.                            |

# Developing CAT Applications in the Disciplines

The questions used on the CAT instrument are specifically designed to simulate real-world experiences that require critical thinking. These problems can serve as models for constructing discipline specific analogs, or CAT Apps, that can be used as instructional tools for involving students in active learning that encourages critical thinking. Although it is extremely important to protect the integrity of the CAT test and not release its contents, we encourage faculty to think about developing their own discipline-specific activities that provide opportunities to practice skills assessed by the CAT questions and using those activities to involve students in active learning experiences that help them improve their critical thinking skills. These activities should be part of how students' performance is assessed in the course.

After faculty have had the opportunity to score the test, it would be beneficial to have them work in groups to identify parallel learning activities for the CAT questions that could be used in their courses as opportunities to develop students' critical thinking. Interdisciplinary collaboration provides a sense of community and opportunities to reflect on student skills and strategies to influence student learning.

## Skill Sets Associated with the CAT Instrument

| Skill Set 1  |
|--|
| 1. Evaluate how strongly information supports an idea or interpretation  |
| 2. Provide alternative interpretations for information or observations that have several possible interpretations. |
| 3. Identify additional information or evidence needed to evaluate alternative interpretations.                     |

*Skill Set 1 focuses on ambiguous information in your discipline that could have many possible causes/interpretations. This could be a literary interpretation, a historical event, a set of patient symptoms, a pattern of data, part of a case study, etc. It could also involve information in a graph.*

| Skill Set 2  |
|--|
| 1. Separate relevant from irrelevant information when searching for information to solve a real-world problem. |
| 2. Identify and explain the best solution for a real-world problem using relevant information.                 |
| 3. Explain how changes to a real-world problem situation might alter the recommended solution.                 |

*Skill Set 2 focuses on a highly constrained real-world problem in your discipline that will require searching for relevant information and analyzing/applying it to solve the problem. This could involve the selection of new lab equipment, the design of a set for a play, the selection of food for a diabetic patient, the best medical treatment for an illness, etc. The real-world problem should include a variety of constraints that are articulated in the scenario you develop. The constraints should be specific enough to severely limit the range of optimal solutions.*



## **Rubric Development for CAT Apps**

Developing a rubric for your CAT App provides added benefits for your students, as well as additional evidence of teaching and learning. This process begins by anticipating potential student responses to the questions on your CAT App. These potential responses should range from poor responses to good responses to excellent responses. The anticipated responses can then be matched to the appropriate category in the rubric templates in order better define when points should be awarded. The development of a rubric not only improves the reliability of scoring your CAT App but can also provide formative feedback to students.

## **CAT Apps as a Grade**

Fully developed CAT Apps with a corresponding rubric can and should be used to determine a portion of a student's grade in a course. The inclusion of CAT Apps seeks to prioritize not only increased content knowledge but also the development of critical thinking skills in the assignment of grades. As we know, students are invested in how the final grade for a course will be determined. By prioritizing critical thinking skills as a portion of the final grade, students are more likely to work toward the development of those skills, especially when provided feedback from performance on CAT Apps.

## **Validating CAT Apps and Establishing Transfer**

Using CAT Apps in conjunction with a pre and post administration of the CAT can provide valuable information about not only potential gains in critical thinking skills but also the validity of your CAT Apps. In order to validate CAT Apps, the Apps should be scored using the developed rubric. Performance on the CAT Apps can be compared to performance on the CAT. A strong relationship between the two measures help to establish concurrent validity. Determining the validity of a CAT App can be an important component of professional presentation, publications, and grant proposals.

When implementing multiple CAT Apps, it is possible to see gains in student content knowledge and application of critical thinking skills across a semester. Again, this assessment design can be strengthened with a pre and post administration of the CAT. The combination of the measures helps to support a couple of arguments. First, gains seen on the CAT Apps support a conclusion that students have made gains in content knowledge and their ability to think critically about the content. Second, gains seen on the CAT support the conclusion that not only was there an improvement in critical thinking skills related to the content of the course, but these skills also transferred to a more general context. This evidence supporting transfer is an excellent opportunity for a professional presentation or publication.

# Effectively Using the CAT Instrument to Assess Student Learning

## Assessment Models/Designs

The CAT instrument is adaptable to a variety of assessment goals and designs. We discuss these assessment goals and some of the more frequently used models below.

The CAT instrument can be used for a variety of assessment goals:

- To evaluate effects of college education
- To evaluate effects of a program of study
- To evaluate effects of a course
- To evaluate effects of informal learning experiences

There are a variety of assessment designs that can be employed with the CAT instrument. The CAT instrument is very adaptable to various research/assessment designs because the test is very sensitive to treatment effects and because the test can be used with all levels of college students without floor effects (students obtaining the minimum score possible) or ceiling effects (students obtaining the maximum score possible). These include:

- Pre-test/Post-test designs
  - Test students at the beginning and end of course or experience (with or without a control group).
  - Test students when they are freshmen and then again when they are seniors (true value added).
- Cross-sectional studies
  - Compare freshmen to seniors (typical value-added analysis).
- Evaluate changes in program outcomes over time
  - Compare scores on the CAT after program improvements to established baseline scores that precede program changes.
  - Compare scores on the CAT to national norms over time and look for improvements.
- Evaluate changes in programs or courses by comparison to a control group.
  - Compare scores on the CAT for students who have had special courses/experiences to those for a control group who have not had the special courses/experiences.

## Reducing Costs with Appropriate Sampling

We advocate a variety of practices to reduce the cost of testing without compromising the accuracy of the assessment. For example, various sampling strategies can be used to reduce the need to test all students. If that is not possible, then only a sample of the tests given might be scored. We discuss two accepted methods of sampling to ensure valid and representative results. However, we realize that the sampling techniques are not feasible at all institutions. Center staff will be happy to discuss these and other alternatives in more detail.

1. Random sampling: A subset of the student population of interest is randomly selected for testing/scoring. The larger the sample, the more confidence there is that the sample is representative of the population of interest. In a random sample, all students have an equal chance of being selected. This is not to be confused with a convenience sample that includes only those students who volunteer to take the test.
2. Stratified random sampling: The population is divided into subgroups (e.g., Arts & Sciences, Engineering, Education, etc.). A random sample of students within each subgroup is then selected. The number of students in each randomly sampled subgroup should be proportional to that group's proportion of the population. Stratification can help ensure a more representative sample with smaller sample sizes.

### **Sampling after Test Administration (for paper version only)**

In many institutions it is not possible to administer the test to a random sample of students within a class. In these situations, we recommend administering the test to the larger group and then randomly sampling tests from that group to score during the faculty scoring session. This procedure will allow institutions to achieve a more representative sample without greatly increasing the faculty time needed to score tests. We recommend having a minimum of 10 – 15 tests or pairs of tests per group (e.g., class, program of study, etc.).

### **Scoring Accuracy Checks (for paper version only)**

At various times during the year, we conduct analyses of scoring accuracy and provide feedback about the accuracy of scoring and, if necessary, specific recommendations for improving the accuracy of scoring on a question-by-question basis. These reports are sent separately from the institutional summary report.

## Example Assessment Designs to Use with the CAT Instrument

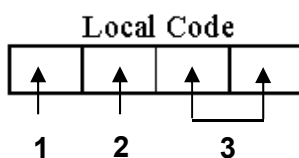
(These designs can easily be coded in the Local Code Field on the CAT Instrument)

| Objective  | Model/Design   | Sampling Procedure   | Sampling Before Scoring   | Advantages/ Disadvantages   |
|--|--|--|---|---|
| <i>Find courses or programs of study that Improve students' critical thinking</i>                  | <b>Pre-test vs. Post-test</b><br>In selected courses or programs of study<br><br>(matched students)                    | Administer to all students at the beginning and end of certain targeted courses or experiences             | Randomly sample pairs of tests to score from each course or experience (minimum of 10 matched pairs of tests per class) | A powerful and efficient design to evaluate specific courses and experiences (student IDs must match) |
|  | (students not matched)   |  | (min. of 15 pretests and 15 post-tests per class)   | Less efficient & less powerful than above   |
|  | <b>Pre-test vs. Post-test with Control Group</b><br>In selected courses or programs of study<br><br>(matched students) | Administer to all students at the beginning and end of certain targeted courses or experiences             | Randomly sample pairs of tests to score from each course or experience (minimum of 10 matched pairs of tests per class) | A powerful design to evaluate treatment effects relative to a control                                 |
|  | (students not matched)   |  | (min. of 15 pretests and 15 post-tests per class)   | Less efficient & less powerful than above   |
|  | <b>Treatment vs. Control</b>   | Administer to all students at the end of certain targeted courses or experiences                           | Randomly sample tests that will be scored after administering to a larger sample  | Might be difficult to establish equivalence of treatment & control conditions                         |
|  | <i>How much is the institution or program of study improving students' critical thinking</i>                           | <b>Freshmen vs. Upperclassmen</b><br>(value added)<br><b>Cross-sectional Study</b><br>(must equate groups) | Administer to a random sample of freshmen and seniors every year  | Randomly sample tests that will be scored after administering to a larger sample                      |
| <b>Cross Sectional Study</b><br>of seniors over time<br>(with or without national norm comparison) |  | Administer to a random sample of seniors (or all seniors) every year                                       | Randomly sample tests that will be scored after administering to a larger sample  | Would be necessary to establish the equivalence of samples over time                                  |

## Using the Local Code Fields to Identify Assessment Design

A Local Code Field with 4 digits appears on the back of each test booklet. You should use this area to code subgroups in your population so that the data can be easily analyzed.

### Recommended Use of Local Code



**Column 1:** Use to indicate the **Type of Design** for data included in the report.

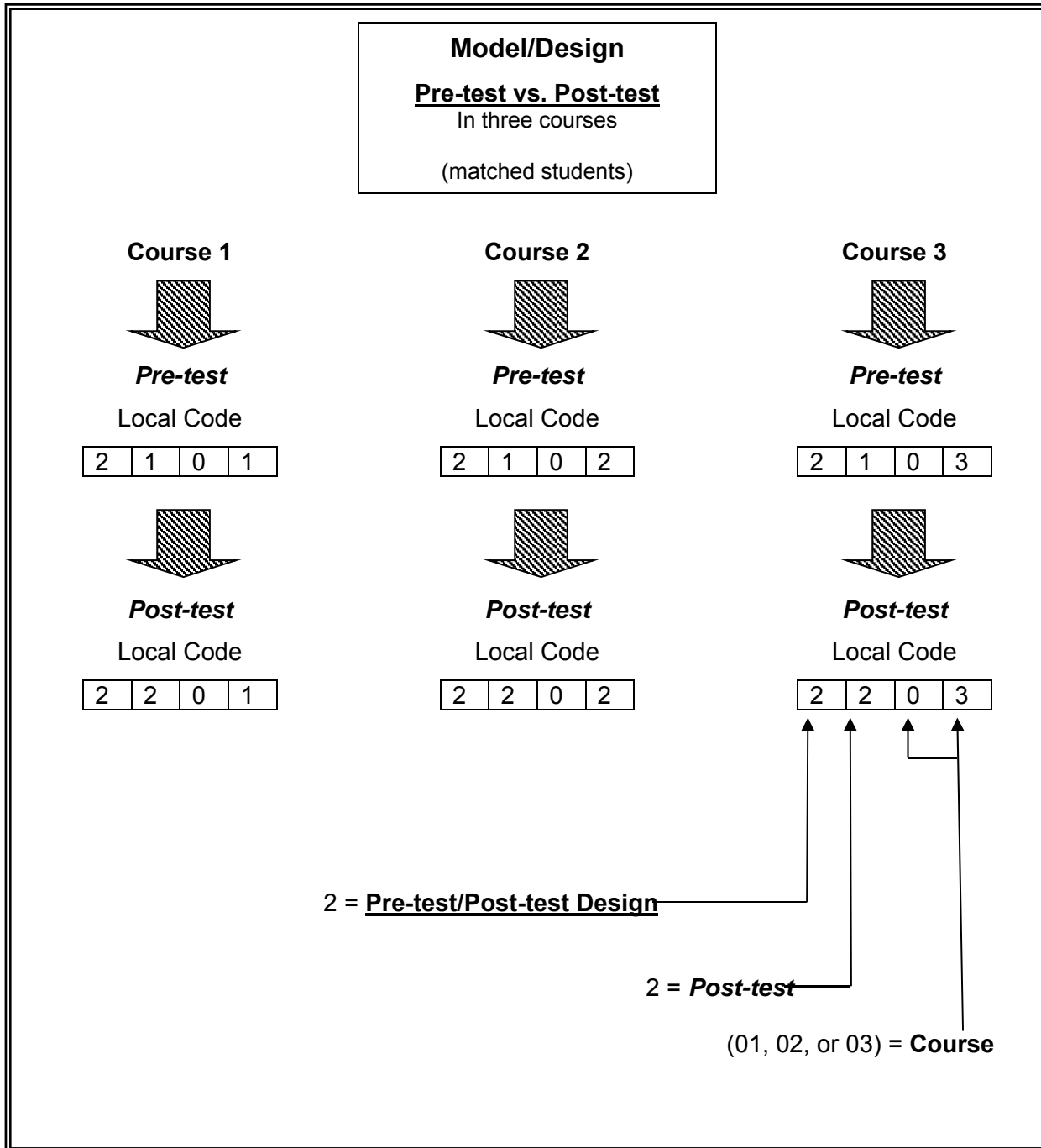
**Column 2:** Use to indicate the student's specific **Treatment Condition** in the design.

**Column 3:** Use to indicate the particular class that was being tested **if a breakdown by class is desired**.

| Column 1   | Column 2  | Column 3 & 4   |
|--|---|--|
| 0 (or blank) = No Breakdown  | 0 (or blank) = No Breakdown   | 0 (or blank) = No Breakdown<br><br>1 – 99 = Code for each course or section tested if scores are to be compared by class |
| 1 = Breakdown only by course   | 1 = Breakdown only by course  |  |
| 2 = <b>Pretest/Post-test Design Matched Students</b><br>(identical ID #'s are used)                    | 1 = Pretest<br>2 = Post-test  |  |
| 3 = <b>Pretest/Post-test Design Not Matched Students</b>   | 1 = Pretest<br>2 = Post-test  |  |
| 4 = Treatment vs. Control<br>(single post-test used)   | 0 = Control<br>1 = Treatment  |  |
| 5 = Lower Division vs. Upper Division Students   | 1 = Lower Division<br>2 = Upper Division  |  |
| 6 = <b>Pretest/Post-test Design with Control Group Matched Students</b><br>(identical ID #'s are used) | 0 = Control Pretest<br>1 = Control Post-test<br>2 = Treatment Pretest<br>3 = Treatment Post-test  |  |
| 7 = <b>Pretest/Post-test Design with Control Group Not Matched Students</b>                            | 0 = Control Pretest<br>1 = Control Post-test<br>2 = Treatment Pretest<br>3 = Treatment Post-test  |  |
| 8 = <b>Regression Design (use # of courses taken to predict CAT Score)</b>                             | These fields are left blank (contact us for more information). Institution must supply a data file with student ID#s and number of courses completed. |  |

We can easily generate reports with breakdowns of data if you use the coding scheme above. We encourage you to contact us and discuss your plans for developing your local code before administering the test.

# Example of How to Code Tests with Local Codes



## Correlations with Entering ACT and SAT Scores

Student scores on the CAT instrument correlate with their scores on college entrance exams like the ACT and SAT. These entrance scores can explain about 25% of the variability in student performance on the CAT instrument.

|     | ACT    | SAT    |
|-----|--------|--------|
| CAT | 0.501* | 0.516* |

\* correlations significant,  $p < .01$  (updated on 8/10/10)

We provide the following table to show how the average entering ACT/SAT score at an institution might impact upper division student performance on the CAT instrument at 4 year institutions.

### CAT National User Norms (Upper division undergraduate, 4 year institutions)

| Average College Entrance Score* |                                | Upper Division           |
|---------------------------------|--------------------------------|--------------------------|
| ACT<br>(Composite)              | SAT<br>(Verbal & Quantitative) | CAT Score<br>(Estimated) |
| 13                              | 620                            | 10.79                    |
| 14                              | 680                            | 11.93                    |
| 15                              | 740                            | 13.07                    |
| 16                              | 780                            | 13.83                    |
| 17                              | 830                            | 14.78                    |
| 18                              | 870                            | 15.54                    |
| 19                              | 910                            | 16.30                    |
| 20                              | 950                            | 17.06                    |
| 21                              | 990                            | 17.82                    |
| 22                              | 1030                           | 18.58                    |
| 23                              | 1070                           | 19.34                    |
| 24                              | 1110                           | 20.10                    |
| 25                              | 1140                           | 20.67                    |
| 26                              | 1180                           | 21.43                    |
| 27                              | 1220                           | 22.19                    |
| 28                              | 1260                           | 22.95                    |
| 29                              | 1300                           | 23.71                    |
| 30                              | 1340                           | 24.47                    |
| 31                              | 1380                           | 25.23                    |
| 32                              | 1420                           | 25.99                    |
| 33                              | 1470                           | 26.94                    |
| 34                              | 1520                           | 27.89                    |

\*Updated 8/10/10

Sample Institution

**CAT Institutional Report**

Date



## Your Institutional Report and Data File

CAT institutional reports provide information about your students' scores on the CAT instrument with descriptive information about sample demographics, mean score, minimum and maximum score, and standard deviation. In addition, the report provides a detailed frequencies breakdown of the distribution of answers (point values) for each question together with a general description of what the question is measuring. The mean score for each question and the percent of total points attained is also included. Current information about national norms is also provided. Additional comparisons are included as specified by the use of local codes.

A data file in Excel format is provided. This file contains the following information:

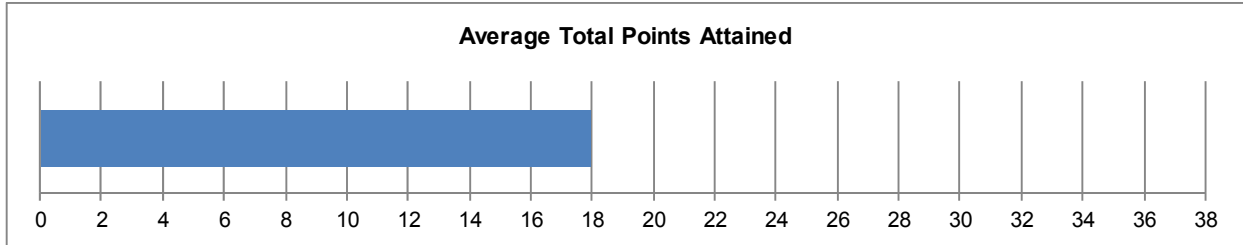
- Individual student responses for all questions on the demographics page and final scores for each test question
- The file includes two spreadsheets. One sheet includes all student data, the other sheet includes only students that did not have excessive missing data. The report is based on student data that is complete.
- The file also includes additional sheets with breakdowns of CAT scores that are included in the printed report.

The institutional report and data file are uploaded to our secure FTP server to be accessed by the designated data owner at your institution. Contact Kevin Harris for more information (kharris@tntech.edu, 931-372-3886).

| <b>Variable Name</b> | <b>Type</b> | <b>Description</b>   |
|----------------------|-------------|--|
| std_s1               | Scale       | Entrance Exam Score as entered by the institution                                    |
| qpa                  | Scale       | QPA as entered by the institution  |
| testnum              | Nominal     | Test Booklet Number  |
| stude1               | Nominal     | Student ID Number  |
| loc-code             | Nominal     | Local Code as entered by institution   |
| age                  | Nominal     | Age  |
| gender               | Nominal     | Gender (0=Male; 1=Female)  |
| spanish              | Nominal     | Spanish/Hispanic/Latino (0=No; 1=Yes)  |
| primary              | Nominal     | English is primary language (0=No; 1=Yes)  |
| profi1               | Nominal     | Proficiency with English Language (1=Excellent; 2=Very Good; 3=Good; 4=Fair; 5=Poor) |
| standing             | Nominal     | Class Standing (1=Freshman; 2=Sophomore; 3= Junior; 4=Senior)                        |
| class                | Nominal     | University Standing (1=Undergraduate; 2=Graduate)                                    |
| white                | Nominal     | Race: White (0=No; 1=Yes)  |
| black                | Nominal     | Race: Black or African American (0=No; 1=Yes)  |
| amer1                | Nominal     | Race: American Indian or Alaska Native (0=No; 1=Yes)                                 |
| asian                | Nominal     | Race: Asian (0=No; 1=Yes)  |
| nativ1               | Nominal     | Race: Native Hawaiian or Other Pacific Islander (0=No; 1=Yes)                        |
| other1               | Nominal     | Race: Other (0=No; 1=Yes)  |
| q1f – q15f           | Scale       | Computed Score for each question   |
| total                | Scale       | CAT total score  |
| q1 – q15             | Scale       | Computed Score for each question (Rounded)   |
| report               | Nominal     | Case included in report (Y=Yes; N=No)  |

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

|                        | <b>N</b> | <b>Min.</b> | <b>Max.</b> | <b>Mean</b> | <b>Std. Dev</b> |
|------------------------|----------|-------------|-------------|-------------|-----------------|
| <b>CAT Total Score</b> | 100      | 8.00        | 29.00       | 17.97       | 4.68            |



**CAT Demographics: Descriptive Statistics for Sample**

|                |               | <b>Freq.</b> | <b>Freq. %</b> |
|----------------|---------------|--------------|----------------|
| Gender         | Male          | 32           | 32.3%          |
|                | Female        | 67           | 67.7%          |
| Class Standing | Freshman      | 0            | 0.0%           |
|                | Sophomore     | 0            | 0.0%           |
|                | Junior        | 1            | 1.0%           |
|                | Senior        | 97           | 99.0%          |
| Class          | Undergraduate | 80           | 100.0%         |
|                | Graduate      | 0            | 0.0%           |
| Age            | ≤ 20 years    | 2            | 2.0%           |
|                | 21-25 years   | 87           | 88.8%          |
|                | ≥ 26 years    | 9            | 9.2%           |

|        |   | <b>Freq.</b> | <b>Freq. %</b> |
|--------|---|--------------|----------------|
| Race** | White                                     | 94           | 94.0%          |
|        | Black or African American                 | 2            | 2.0%           |
|        | American Indian or Alaska Native          | 0            | 0.0%           |
|        | Asian                                     | 4            | 4.0%           |
|        | Native Hawaiian or Other Pacific Islander | 1            | 1.0%           |
|        | Other Race                                | 0            | 0.0%           |

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

|  |           | <b>Freq.</b> | <b>Freq. %</b> |
|--|-----------|--------------|----------------|
| Proficiency with the English Language* | Excellent | 61           | 61.6%          |
|  | Very Good | 28           | 28.3%          |
|  | Good      | 9            | 9.1%           |
|  | Fair      | 1            | 1.0%           |
|  | Poor      | 0            | 0.0%           |

\* Self-rated

|                                      |    | <b>Freq.</b> | <b>Freq. %</b> |
|--------------------------------------|----|--------------|----------------|
| Spanish/Hispanic/Latino Ethnicity    | 4  | 4.0%         |                |
| Considered English primary language? | 97 | 97.0%        |                |

### CAT Breakdown: Frequency of Points Awarded for Each Question

|     | Skill Assessed by CAT Question  | Points Awarded | Freq. | Freq. % |
|-----|---|----------------|-------|---------|
| Q1  | Summarize the pattern of results in a graph without making inappropriate inferences.        | 0              | 29    | 29.0%   |
|     |   | 1              | 71    | 71.0%   |
| Q2  | Evaluate how strongly correlational-type data supports a hypothesis.                        | 0              | 39    | 39.4%   |
|     |   | 1              | 36    | 36.4%   |
|     |   | 2              | 18    | 18.2%   |
|     |   | 3              | 6     | 6.1%    |
| Q3  | Provide alternative explanations for a pattern of results that has many possible causes.    | 0              | 27    | 27.0%   |
|     |   | 1              | 41    | 41.0%   |
|     |   | 2              | 22    | 22.0%   |
|     |   | 3              | 10    | 10.0%   |
| Q4  | Identify additional information needed to evaluate a hypothesis.                            | 0              | 36    | 36.0%   |
|     |   | 1              | 32    | 32.0%   |
|     |   | 2              | 18    | 18.0%   |
|     |   | 3              | 10    | 10.0%   |
|     |   | 4              | 4     | 4.0%    |
| Q5  | Evaluate whether spurious information strongly supports a hypothesis.                       | 0              | 35    | 35.0%   |
|     |   | 1              | 65    | 65.0%   |
| Q6  | Provide alternative explanations for spurious associations.                                 | 0              | 7     | 7.0%    |
|     |   | 1              | 46    | 46.0%   |
|     |   | 2              | 37    | 37.0%   |
|     |   | 3              | 10    | 10.0%   |
| Q7  | Identify additional information needed to evaluate a hypothesis.                            | 0              | 45    | 45.0%   |
|     |   | 1              | 47    | 47.0%   |
|     |   | 2              | 8     | 8.0%    |
| Q8  | Determine whether an invited inference is supported by specific information.                | 0              | 28    | 28.0%   |
|     |   | 1              | 72    | 72.0%   |
| Q9  | Provide relevant alternative interpretations for a specific set of results.                 | 0              | 40    | 40.0%   |
|     |   | 1              | 40    | 40.0%   |
|     |   | 2              | 20    | 20.0%   |
| Q10 | Separate relevant from irrelevant information when solving a real-world problem.            | 0              | 0     | 0.0%    |
|     |   | 1              | 8     | 8.1%    |
|     |   | 2              | 12    | 12.1%   |
|     |   | 3              | 43    | 43.4%   |
|     |   | 4              | 36    | 36.4%   |
| Q11 | Use and apply relevant information to evaluate a problem.                                   | 0              | 22    | 22.0%   |
|     |   | 1              | 59    | 59.0%   |
|     |   | 2              | 19    | 19.0%   |
| Q12 | Use basic mathematical skills to help solve a real-world problem.                           | 0              | 10    | 10.0%   |
|     |   | 1              | 90    | 90.0%   |
| Q13 | Identify suitable solutions for a real-world problem using relevant information.            | 0              | 28    | 28.0%   |
|     |   | 1              | 44    | 44.0%   |
|     |   | 2              | 22    | 22.0%   |
|     |   | 3              | 6     | 6.0%    |
| Q14 | Identify and explain the best solution for a real-world problem using relevant information. | 0              | 29    | 29.0%   |
|     |   | 1              | 11    | 11.0%   |
|     |   | 2              | 0     | 0.0%    |
|     |   | 3              | 10    | 10.0%   |
|     |   | 4              | 44    | 44.0%   |
|     |   | 5              | 6     | 6.0%    |
| Q15 | Explain how changes in a real-world problem situation might affect the solution.            | 0              | 25    | 25.5%   |
|     |   | 1              | 25    | 25.5%   |
|     |   | 2              | 39    | 39.8%   |
|     |   | 3              | 9     | 9.2%    |

## Upper Division CAT Means Comparison Report

Sample Institution: Date

| Evaluate and Interpret Info | Problem Solving | Creative Thinking | Effective Comm. |     | Skill Assessed by CAT Question  | Institution | National |  |                          |
|-----------------------------|-----------------|-------------------|-----------------|-----|---|-------------|----------|--|--------------------------|
|                             |                 |                   |                 |     |   | Mean        | Mean     | Probability of difference <sup>a</sup> | Effect Size <sup>b</sup> |
| X                           |                 |                   |                 | Q1  | Summarize the pattern of results in a graph without making inappropriate inferences.        | 0.71        | 0.67     |  |                          |
| X                           |                 |                   | X               | Q2  | Evaluate how strongly correlational-type data supports a hypothesis.                        | 0.91        | 1.21     | *                                      | -.29                     |
|                             |                 | X                 | X               | Q3  | Provide alternative explanations for a pattern of results that has many possible causes.    | 1.15        | 1.35     |  |                          |
|                             | X               | X                 | X               | Q4  | Identify additional information needed to evaluate a hypothesis.                            | 1.14        | 1.41     | *                                      | -.23                     |
| X                           |                 |                   |                 | Q5  | Evaluate whether spurious information strongly supports a hypothesis.                       | 0.65        | 0.73     |  |                          |
|                             |                 | X                 | X               | Q6  | Provide alternative explanations for spurious associations.                                 | 1.50        | 1.56     |  |                          |
|                             | X               | X                 | X               | Q7  | Identify additional information needed to evaluate a hypothesis.                            | 0.63        | 0.82     | **                                     | -.29                     |
| X                           |                 |                   |                 | Q8  | Determine whether an invited inference is supported by specific information.                | 0.72        | 0.68     |  |                          |
|                             |                 | X                 | X               | Q9  | Provide relevant alternative interpretations for a specific set of results.                 | 0.80        | 0.93     |  |                          |
| X                           | X               |                   |                 | Q10 | Separate relevant from irrelevant information when solving a real-world problem.            | 3.08        | 3.14     |  |                          |
| X                           | X               |                   | X               | Q11 | Use and apply relevant information to evaluate a problem.                                   | 0.97        | 1.11     | *                                      | -.22                     |
|                             | X               |                   |                 | Q12 | Use basic mathematical skills to help solve a real-world problem.                           | 0.90        | 0.82     |  |                          |
| X                           | X               |                   |                 | Q13 | Identify suitable solutions for a real-world problem using relevant information.            | 1.06        | 1.18     |  |                          |
| X                           | X               |                   | X               | Q14 | Identify and explain the best solution for a real-world problem using relevant information. | 2.47        | 2.29     |  |                          |
|                             | X               | X                 | X               | Q15 | Explain how changes in a real-world problem situation might affect the solution.            | 1.33        | 1.15     |  |                          |
| CAT Total Score             |                 |                   |                 |     |   | 17.97       | 19.04    |  |                          |

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

b. Mean difference divided by pooled group standard deviation.

## Pre-Post Test Profile

Sample Institution:    Date

| Evaluate and Interpret Info | Problem Solving | Creative Thinking | Effective Comm. |     | Skill Assessed by CAT Question  | Institution/Department |              |  |                          |
|-----------------------------|-----------------|-------------------|-----------------|-----|---|------------------------|--------------|--|--------------------------|
|                             |                 |                   |                 |     |   | Pre Mean               | Post Mean    | Probability of difference <sup>a</sup> | Effect Size <sup>b</sup> |
| X                           |                 |                   |                 | Q1  | Summarize the pattern of results in a graph without making inappropriate inferences.        | 0.45                   | 0.73         | *                                      | +.56                     |
| X                           |                 |                   | X               | Q2  | Evaluate how strongly correlational-type data supports a hypothesis.                        | 0.55                   | 1.27         | *                                      | +.67                     |
|                             |                 | X                 | X               | Q3  | Provide alternative explanations for a pattern of results that has many possible causes.    | 1.09                   | 1.27         |  |                          |
|                             | X               | X                 | X               | Q4  | Identify additional information needed to evaluate a hypothesis.                            | 0.64                   | 0.73         |  |                          |
| X                           |                 |                   |                 | Q5  | Evaluate whether spurious information strongly supports a hypothesis.                       | 0.64                   | 0.82         |  |                          |
|                             |                 | X                 | X               | Q6  | Provide alternative explanations for spurious associations.                                 | 1.64                   | 2.00         |  |                          |
|                             | X               | X                 | X               | Q7  | Identify additional information needed to evaluate a hypothesis.                            | 0.18                   | 0.45         | *                                      | +.50                     |
| X                           |                 |                   |                 | Q8  | Determine whether an invited inference is supported by specific information.                | 0.82                   | 0.64         |  |                          |
|                             |                 | X                 | X               | Q9  | Provide relevant alternative interpretations for a specific set of results.                 | 0.91                   | 0.91         |  |                          |
| X                           | X               |                   |                 | Q10 | Separate relevant from irrelevant information when solving a real-world problem.            | 3.18                   | 3.27         |  |                          |
| X                           | X               |                   | X               | Q11 | Use and apply relevant information to evaluate a problem.                                   | 0.73                   | 1.09         | *                                      | +.55                     |
|                             | X               |                   |                 | Q12 | Use basic mathematical skills to help solve a real-world problem.                           | 1.00                   | 1.00         |  |                          |
| X                           | X               |                   |                 | Q13 | Identify suitable solutions for a real-world problem using relevant information.            | 0.73                   | 0.91         |  |                          |
| X                           | X               |                   | X               | Q14 | Identify and explain the best solution for a real-world problem using relevant information. | 1.64                   | 2.27         |  |                          |
|                             | X               | X                 | X               | Q15 | Explain how changes in a real-world problem situation might affect the solution.            | 0.64                   | 0.73         |  |                          |
| <b>CAT Total Score</b>      |                 |                   |                 |     |   | <b>14.82</b>           | <b>18.09</b> | <b>**</b>                              | <b>+ .66</b>             |

a. \* p<.05    \*\*p<.01    \*\*\*p<.001 (2 –tailed)

b. Mean difference divided by pooled group standard deviation.

# Notes

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