

Applying and Assessing the Impact of Cognitive Principles in College Courses and Across the Curriculum

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The Davis Educational Foundation

<http://www.davisfoundations.org/site/educational.asp>

Falmouth, Maine

Overview of Davis Educational Foundation Cognition Toolbox project

Major Goals

- Design
- Implement
- Assess the Impact of

instructional interventions based on proven principles of cognition.

Science of Learning: From the lab to the classroom and beyond

Diane F. Halpern, & Milton D. Hakel, M. D. (July/August, 2003).
Applying the science of learning to the university and beyond.
Change, 35, 4.

<http://www.earlycolleges.org/Downloads/HalpernHakel.pdf>

McDaniel, M.A., & Callender, A. A. (2008). Cognition, memory, and education. In J. Byrne et al. (Eds.). *Learning and Memory: A Comprehensive Reference*. Oxford, UK: Elsevier.

<http://psych.wustl.edu/learning/documents/mcdaniel.callender.pdf>

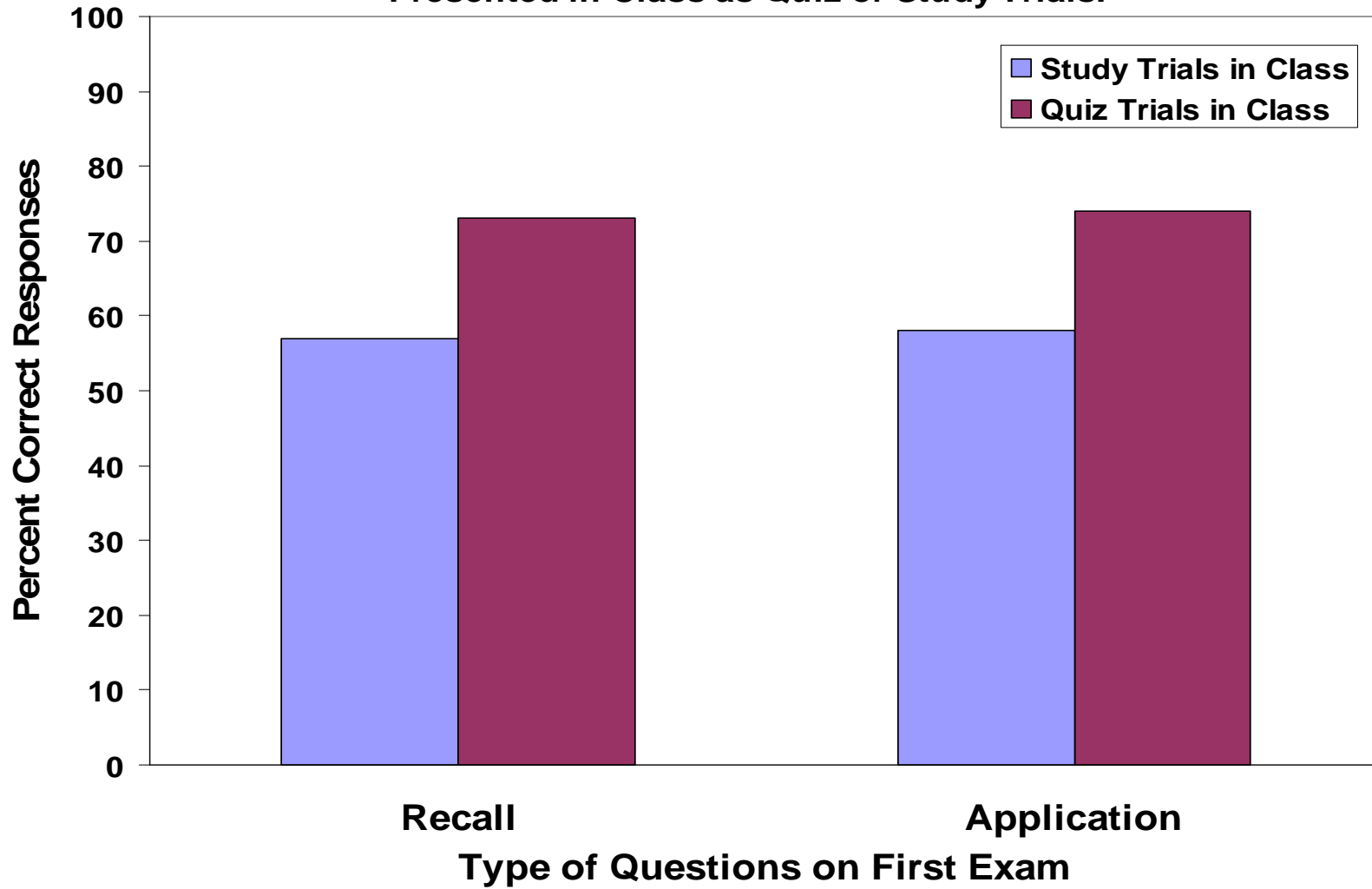
Three Basic Principles of Cognition Applicable in Academic Settings

- Test Enhanced Learning (generation effect)
- Transfer-Appropriate Processing (organization effects)
- Desirable Difficulties

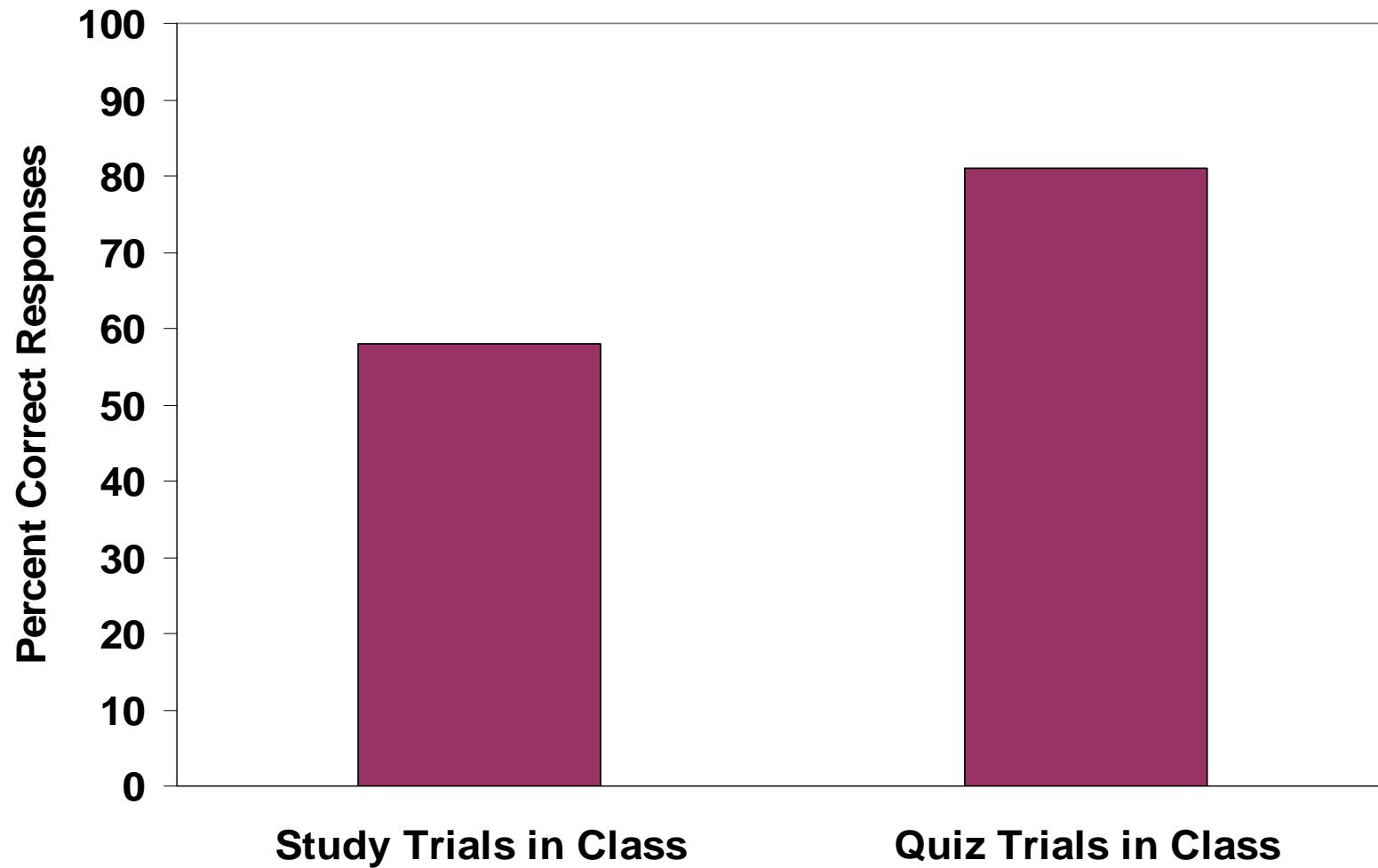
Test Enhanced Learning: Testing Effect in an Introductory Psychology Course

- Enrollment = 30+
- Daily in-class quizzes
- Quizzes included fill-in-blank recall questions and fill-in-blank statements with the answer included in bold and underlined
- Two Regular Exams
- Comprehensive Final Exam

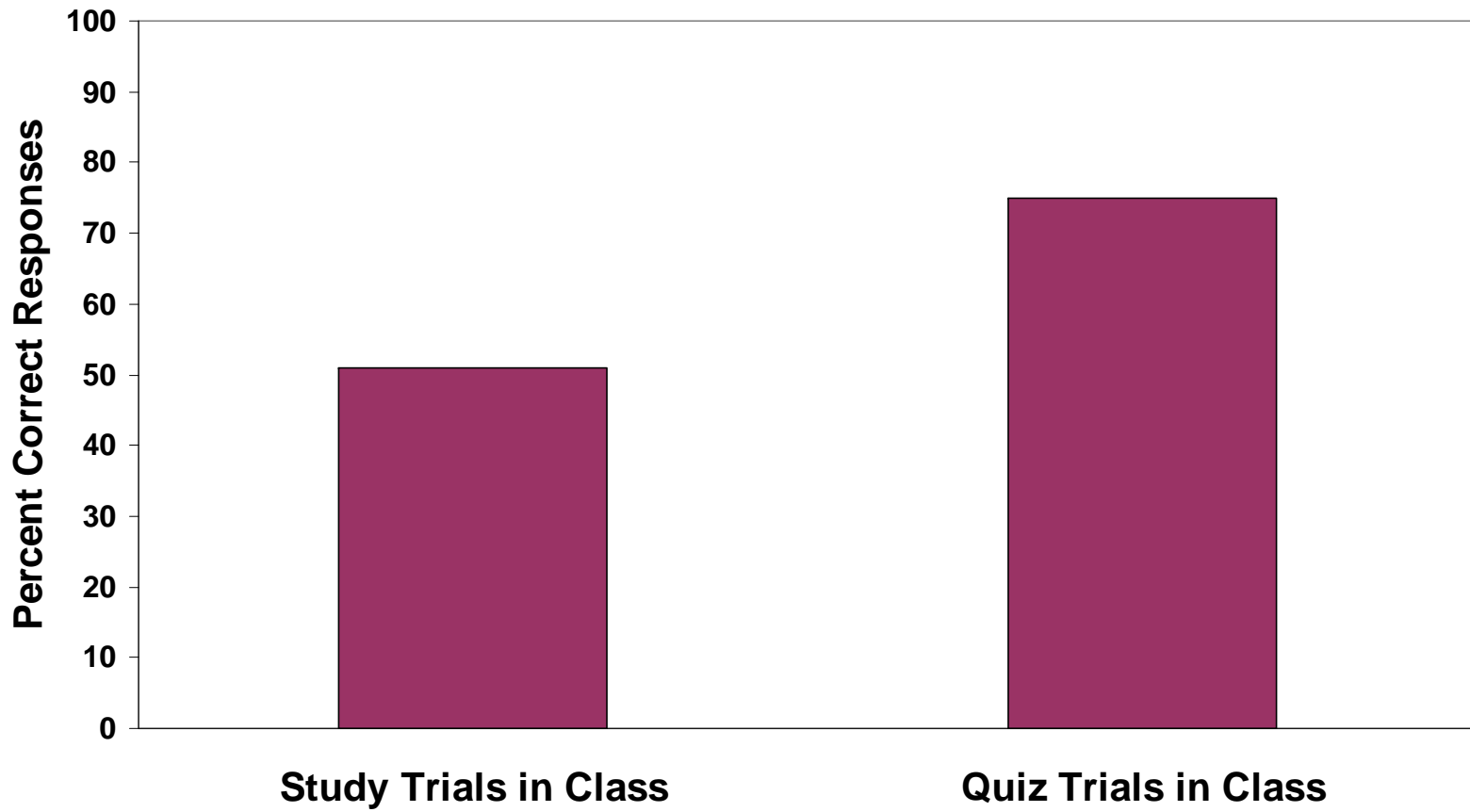
Percent Correct Responses on Midterm Recall and Multiple-Choice Application Questions as a Function of Whether the Items Were Presented in Class as Quiz or Study Trials.



**Percent Correct Responses on Multiple-Choice Application Questions
as a Function of Whether the Items Were Presented in Class as Quiz or
Study Trials (Second Exam).**



**Percent Correct Responses on Multiple-Choice Application Questions
as a Function of Whether the Items Were Presented in Class as Quiz or
Study Trials (Comprehensive Final Exam).**



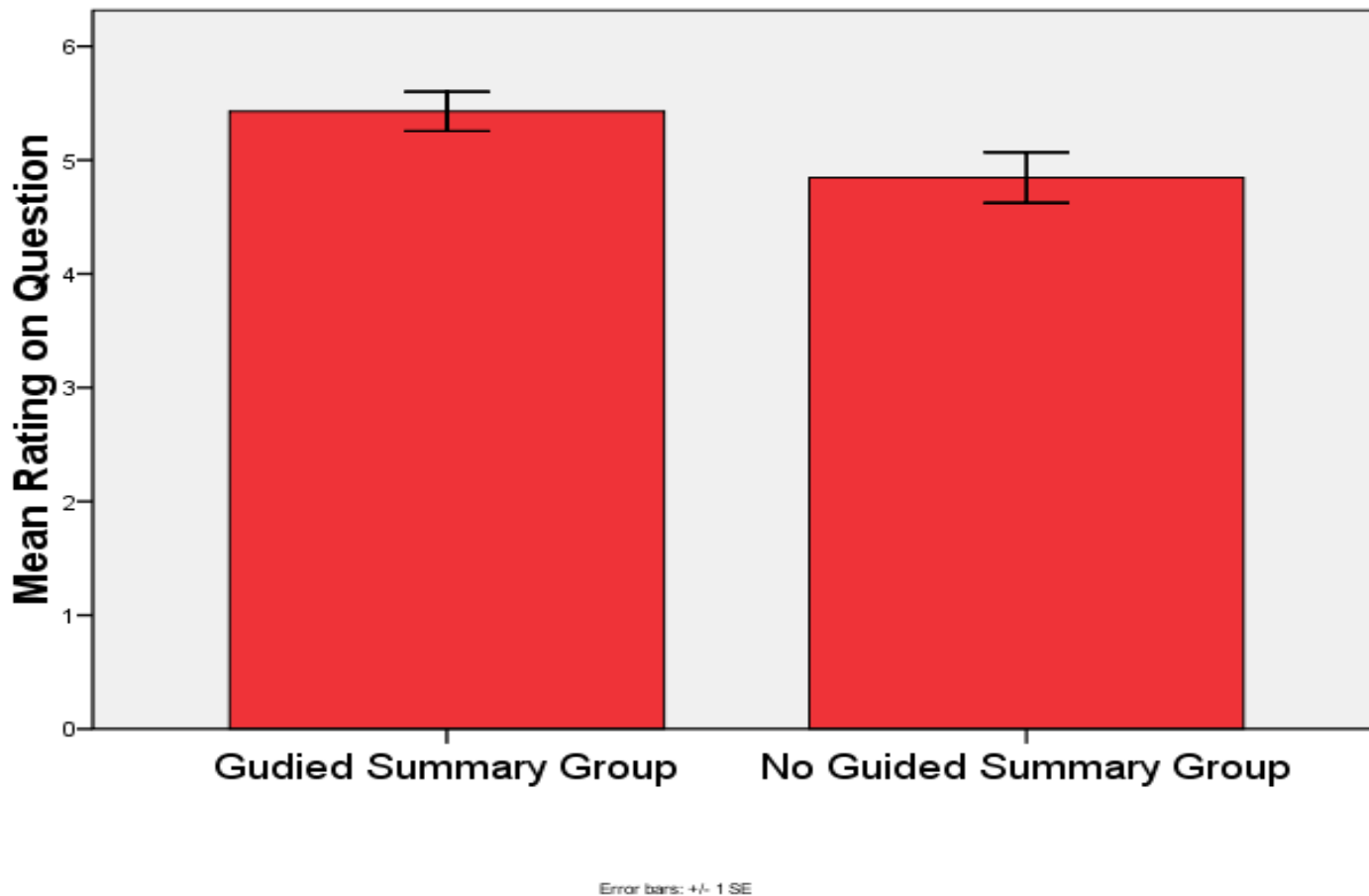
Transfer-Appropriate Processing in an Upper-Level Occupational Therapy Course

- **700-level writing intensive course.**
- **N = 35+**
- **Prior to writing a formal paper that asked students to describe the key issues raised in a set of research articles as well as the relation among the articles,**
half of class (random) responded to a set of “guiding” questions for each of the assigned articles.

Results

- **Instructor gave a higher mean grade to the response papers written by the students who had prepared responses to the guided summary questions than to the students who had not.**
- **However, possibility that some unintentional bias crept in because the instructor was intimately involved in the project and might have received cues from students about having answered guided summary questions.**
- **For this reason, we had a trained rater read and rate the response papers without any prior knowledge of the project or that some students had written responses to guided summary questions before preparing their response papers.**

How well did the student integrate information that was provided in the two assigned articles?



Current and Planned Projects

We are currently working with faculty teaching courses in Neuroscience, Social Work, English, Psychology, Statistics, Health Management and Policy, and Occupational Therapy.

Next semester, we will add courses in Animal Science, Natural Resources, Nursing, Chemistry, Economics, Kinesiology, Political Science, Genetics, Horticultural Technology, Recreation Management and Policy, etc.

Reading = 94 (120)
Writing = 42 (70)

Reading = 74.6
Writing = 34.7

“This course is premised upon the belief that all new learning is dependent upon previous knowledge, and that learning occurs best when the student becomes aware of how he or she learns. This ‘metacognitive’ approach means that you will continually examine your behavior as you learn, assess the quality of your learning, and develop strategies to achieve the learning you need to.”

“When I was in high school my only focus was chasing girls and avoiding teachers so I could sneak off the school grounds and smoke cigarettes.”

“I am not prepared for college, I don't know how to write a college essay, I don't know how to study for a college test, and I don't know how to take a test.”

SQ3R

- Before reading, survey the title, headings, subheadings, references, and reading questions. Look for bolded or italicized words. Think about what the reading will focus on, and what you know about it
- Skim the beginnings of paragraphs to determine whether the author uses a topic sentence approach that forecasts the main ideas
- What questions do you think this reading will answer?

SQ3R

- Read through once, quickly, annotating and highlighting, making note of any context clues that will be important to spend time on
- Determine whether your first predictions about the content of the reading were accurate
- Conduct a series of “close readings,” reflecting upon new information, making connections with your prior knowledge, asking questions, taking notes
- Summarize small sections of your notes in your own sentence patterns

“I’ll be honest. The first thing I did was read it beginning to end, and then proceeded to realize there was no chance at all of me comprehending the assignment successfully that way.”

“First, I took a moment to look at the titles, subheadings, and any bold or italicized words that were in the reading. Next, I quickly read through the reading in an attempt to further familiarize myself with the reading. After that, I read at a very slow pace, taking my time to understand what was being said in each sentence, and stopping to highlight words and phrases that I knew were key points. When writing my first draft, I looked at each paragraph to take note of what I highlighted, using the highlighted parts to jump start my memory of what I had read. I would write a sentence or two on the subject, being careful to stick to the main point.”

“It was quite challenging. We had just finished talking about plagiarism, but I could not figure out how to paraphrase a reading without using similar (if not exactly the same) wording. I tried so hard to avoid plagiarizing, but upon review of my first draft, it was very obvious that I had failed miserably.”

“When I was doing the assignment, it was pure torture. I had no idea what I was writing.”

“The reading itself was at an extremely high level, even for college students, so the handouts gave us a much more simplistic way of looking at the topic.”

“The class activity helped give me more prior knowledge in many ways. For example, when we were broken up into separate groups, my group decided to assign each person a type of intelligenceThis immediately forced me to look deep into the intelligence I was going to have to speak about, and made me realize there was more to what the writing was about than just a few definitions.”

“I learned that when you have reading you don’t understand, then maybe you need to take a step back, do some research on the subject.”

“This entire procedure made it very clear to me that when it comes to difficult texts, I must build a schema in order to fully understand the material.”

“I need to give myself more time to actively read. It would help if also I read aloud to myself more. Finally, I need to start taking notes and using diagrams as a tool to help me read and retain information.”

“Not only did I benefit from the handouts, but I also used my entire conference with Anna to go over the exercise. Taking notes, surveying, and being given the handouts were all important steps toward success, but for me that conference made all the difference. It really helped to be able to talk to somebody with so much experience in writing. Through the conference, I learned that the whole time I knew exactly what I wanted to say, I just couldn’t figure out how to put it on paper until Anna got me to explain it. . . . Bottom line is, if you really want to understand something, it takes a lot of work, and occasionally even some help from others.”

A strategy for helping students master statistics

Students take a pre-test that is in the same format as the exam.

Pretest

- You are interested in determining if a new technique will help students be able to get up on time for class. With this technique, you play try to wake them by making noise first. Then, you give each student some caffeine every night for a week and measure the ability to wake up then. You obtain the following results concerning how long it takes each student to get out of bed:
 - PRETEST (before they get caffeine): 9 8 9 8 7 8 7 9 7 6
 - POSTTEST (after they have had caffeine): 5 4 5 4 6 4 4 6 6 8
- Is there a difference? Do the analysis.
- Please identify if the result is significant or not and write the equation out in the standard format
 - $t = 1.75, N = 90$
 - $t = -0.66, N = 7$
 - $t = -2.48, N=15$
 - $t = 4.56, N = 27$
- Assume you have two groups of students who are working on trying to determine the best strategy for studying. The first group of students study with music on while the second group studies in silence. The students are then measured on a scale of 1-10 on ability to remember what they were trying to study. You obtain the following results:
 - Group 1: 7, 4, 5, 6, 4, 3, 5, 2, 2, 6, 2
 - Group 2: 8, 5, 6, 7, 7, 7, 6, 5, 6, 5
- Is there a difference between the two groups? Do the analysis.
- Assume you have a population mean of 30. You take a sample of 50 and find a sample mean of 35 and a sample standard deviation of 5. Is this sample significantly different from the population? Write the answer in standard form.

Actual test

- Please identify if the result is significant or not and write the equation out in the standard format
 - $t = 4.75, N = 10$
 - $t = -2.56, N = 27$
 - $t = -2.02, N = 150$
 - $t = 1.56, N = 7$
- Assume you have two groups of students who are working on trying to determine which drug will help rats run a maze more quickly. The first group of rats receive caffeine while the second group gets a placebo. The rats then run the maze and the students measure the time it takes to complete it, in seconds. You obtain the following results:
 - Group 1: 17, 14, 25, 16, 14, 32, 15, 12, 22, 16, 12
 - Group 2: 18, 25, 26, 17, 27, 37, 26, 25, 26, 15
- Is there a difference between the two groups? Do the analysis.
- Assume you have a population mean of 25. You take a sample of 150 and find a sample mean of 28 and a sample standard deviation of 6. Is this sample significantly different from the population? Write the answer in standard form.

Post test checks (PTC's)

After the exams, students are then given short quizzes to determine that the transfer is not just one of memorizing the material, but learning the material for the exam.

Results

- Exams increased from an average of 38/50 to 44/50 from year one to year two.
- Students' PTC's have increased from 5/10 to 8/10 from year one to year two.
- Students report that the pre-tests helped them to focus on and learn the material.
- Discussion points: cognitive toolbox: testing effect.

Putting it Together in an Assessment Framework

Linking pedagogy and student learning outcomes assessment:

Course outcomes

Major curriculum outcomes

General education outcomes

Design Course → Implement Cognitive Principles → Assess Impact on Student Learning → Make Changes as Necessary

Discussion