

## **TFS QuickTool 9.6: Testing: Before You Test Your Students, Test Yourself on the Basics First**

by Brian R. Shmaefsky, Ph.D., TFS Partner Science Editor/Author

**T**ests are the bane of students and faculty alike. Students generally dislike tests because of the stress of wondering whether they are reviewing and retaining the correct information. Faculty feel the burden of wondering whether their tests adequately evaluate student knowledge and comprehension.

Educational researchers long ago have come up with strategies for effective test design. Unfortunately, the principles of test development have not made their way fully into the college classroom. This is not due to a lack of desire on the part of faculty. It results from insufficient training and poor-quality tests provided in college textbook test banks.



### **Fundamentals of test design**

The first principle of proper test designing is overcoming the notion that testing merely involves writing a bunch of questions. It starts with lectures organized to facilitate test taking; this does not mean teaching to the test.

An organized lecture stresses and expounds the major concepts being tested. Tests should not be a guessing game for students. They should know what material to emphasize in their studying by the importance placed in the lectures or presentations.

### **Clear terms crucial**

Terms and concepts appearing on tests need to be thoroughly explained with applications and examples. For example, defining the term “species” means nothing without instances of how biologists interpret and use the term.

So, different breeds of dogs, although they appear to vary greatly in size and appearance, belong to the same species because they can interbreed freely and successfully. However, African and Indian elephants, which look strikingly similar, do not belong to the same species because they cannot interbreed.

### **Designing questions**

Objective questioning is the preferred testing format for many faculty. The questions are difficult to design, however, they are simple to grade. There is only one correct answer and they can be graded using keys or electronic means.

Typical objective questions include definitions, fill-in-the-blank, matching, multiple choice, short answer and true-or-false questions. An important concern when designing objective questions is having one distinct correct answer. The distracters, or incorrect answers, should be easily identifiable and obviously erroneous. The use of choice E, "All of the above," or None of the Above" should be avoided according to most testing experts.

For example:

Charles Darwin is noted for:

- A) Cell theory.
- B) Theory of evolution.
- C) The development of vaccines.
- D) Sociobiology.



A student learning about Darwin from lecture or the textbook would know the answer is B. This then becomes an approximate measure of student knowledge. The following example is an improperly designed multiple choice question that can trip up students rather than test their comprehension under the stress of a test:

Charles Darwin most noted for:

- A) Theory of devolution.
- B) Theory of evolution.
- C) Theory of revolution.
- D) Law of evolution.

### Matching questions

Matching questions also should avoid ambiguity. Each term should have a distinct description in the answer column that does not overlap with other terms.

For example:

- |          |   |
|----------|---|
| 1. Horse | A. Toe nail forms a single hoof.                  |
| 2. Lion  | B. Capable of winter hibernation.                 |
| 3. Bear  | C. Talons used for catching predators.            |
| 4. Eagle | D. Male keeps a harem of females.                 |
| 5. Duck  | E. Eats diet of predominantly aquatic vegetation. |

However, avoid this situation:

- |          |                            |
|----------|----------------------------|
| 1. Horse | A. Has a mane.             |
| 2. Lion  | B. Claws used for hunting. |
| 3. Bear  | C. Eats diet high in fish. |
| 4. Eagle | D. Eats plant material.    |
| 5. Duck  | E. Lives in family units.  |

### Fill-in-the-blank questions

Lastly, fill-in-the-blank objective questions should have one blank for each concept being tested. Faculty too often use fill-in-the-blank questions that test the verbatim memorization of textbook and lecture note excerpts. An accurate fill-in-the-blank question is as follows:

“A mouse that learns to perform a task by being rewarded after doing the task is exhibiting \_\_\_\_\_conditioning.”

This example assesses the students’ knowledge of the term and forces them to discriminate it from other terms used in psychology. The following example is too confusing and does not accurately measure student learning:

“A mouse that \_\_\_\_\_to perform a task by being \_\_\_\_\_after doing the task is exhibiting \_\_\_\_\_conditioning.”

### The essay

Essay tests appear simpler to write because faculty do not have to conjure up specific questions with distracters that do not confound the students. Nonetheless, like objective questions, there must be measurable outcomes that are obvious to faculty and students. The question should have several possible answers rated from good to bad, rather than right or wrong. Essay questions should be reserved for higher order thinking that tests reasoning skills. This is best achieved by asking students to “agree or disagree,” “analyze,” “compare and contrast,” “rate the outcomes of,” or “what are the benefits and costs of .”

### Bloom’s Taxonomy

An exposition on test development is not complete without the mention of Bloom’s Taxonomy of learning domains. Student assessment at the college level requires six measures: knowledge, comprehension, application, analysis, synthesis and evaluation. Knowledge is a basic skill needed to perform higher-order reasoning skills. Comprehension, application, analysis, synthesis and evaluation measure higher-order thinking. A successful curriculum encourages students to apply and evaluate the information learned in class.

### Knowledge

Knowledge questions ask students to: cite, define, describe, draw, identify, label, list, match, name, outline, recite, recognize, select and tabulate.

### Comprehension

Important words for assessing comprehension include: articulate, associate, characterize, classify, compare, contrast, defend, detail, differentiate, discuss, distinguish, elaborate, example, explain, infer, interpret, predict, rewrite and summarize. Questions that focus on knowledge and comprehension are important for assessing how well students apply higher-order thinking.

### Application

College-level assessment should stress application, analysis, synthesis and evaluation questions. Application questions can be recognized because they ask students to: apply, ascertain, assign, calculate, complete, compute, construct, demonstrate, derive, employ, examine, graph, illustrate, investigate, manipulate, plot, prepare, relate, show, simulate, translate, use.

### Analyze

Questions asking students to analyze the subject matter use terms such as: analyze, break down, characterize, confirm, contrast, diagnose, discriminate, examine, explain, illustrate, summarize and transform.

## Synthesize

Synthesis terms include: abstract, arrange, construct, create, depict, explain, formulate, generalize, generate, improve, organize, prepare, prescribe, reconstruct, revise and summarize.

## Evaluate

The highest order of thinking involves the ability to evaluate the accuracy of logical of the subject matter. Essay questions are the best tool for measuring evaluation skills. Students can be assessed for the ability to evaluate with questions having the following directions: appraise, assess, compare, conclude, contrast, critique, estimate, evaluate, explain, interpret, judge, justify, predict, rank, recommend, score, support, validate and verify.



Faculty wishing to find excellent assessment examples should peruse ACT, Advanced Placement, GRE and SAT study guides. The questions in these examinations are developed to measure Bloom's categories of reasoning skills and have been validated as accurate and fair on numerous students. Also, educational psychology textbooks provide a wealth of information on valid testing.

## Action Steps:

Considering these tips, I will make the following improvements to my tests and quizzes: