Designing Multiple Choice Questions

This resource page was compiled for the Faculty of Engineering, Architecture and Science. For more teaching and learning resources, visit the LTO’s website: http://www.ryerson.ca/lt/resources/

When determining the best option for test design, consider the pros and cons of using multiple choice questions.

Strengths of Multiple-Choice Items
1. Versatility in measuring all levels of cognitive skills.
2. Permit a wide sampling of content and objectives.
3. Provide highly reliable test scores.
4. Can be machine-scored quickly and accurately.
5. Reduced guessing factor compared with true-false items.

Limitations of Multiple-Choice Items
1. Difficult and time-consuming to construct.
2. Depend on student's reading skills and instructor's writing ability.
3. Ease of writing low-level knowledge items leads instructors to neglect writing items to test higher-level thinking.
4. May encourage guessing.

Excerpted from “How to Write Better Tests,” University of Indiana http://www.indiana.edu/~best/write_better_tests.shtml

Getting Started

1. Write questions throughout the term. Multiple-choice question exams are challenging and time-consuming to create. You will find it easier if you write a few questions each week, perhaps after a lecture when the course material is still fresh in your mind.
2. Instruct students to select the “best answer” rather than the “correct answer”. By doing this, you acknowledge the fact that the distracters may have an element of truth to them and discourage arguments from students who may argue that their answer is correct as well.
3. Use familiar language. The question should use the same terminology that was used in the course. Avoid using unfamiliar expressions or foreign language terms, unless measuring knowledge of such language is one of the goals of the question. Students are likely to dismiss distracters with unfamiliar terms as incorrect.
4. Avoid giving verbal association clues from the stem in the key. If the key uses words that are very similar to words found in the stem, students are more likely to pick it as the correct answer.
5. Avoid trick questions. Questions should be designed so that students who know the material can find the correct answer. Questions designed to lead students to an incorrect answer, through misleading phrasing or by emphasizing an otherwise unimportant detail of the solution, violate this principle.

6. **Avoid negative wording.** Students often fail to observe negative wording and it can confuse them. As a result, students who are familiar with the material often make mistakes on negatively worded questions. In general, avoid having any negatives in the stem or the options. In the rare cases where you use negatives be sure to emphasize the key words by putting them in **UPPER CASE**, and **bolding or underlining them**.


**Parts of a Multiple Choice Question**
A traditional multiple choice question (or item) is one in which a student chooses one answer from a number of choices supplied. A multiple choice question consists of
1. **A stem** - the text of the question 
2. **Options** - the choices provided after the stem 
3. **The key** - the correct answer in the list of options 
4. **Distracters**: the incorrect answers in the list of options


**Writing Stems**
1. **Express the full problem in the stem.** When creating the item, ask yourself if the students would be able to answer the question without looking at the options. This makes the purpose of the question clear.
2. **Put all relevant material in the stem.** Do not repeat in each of the alternatives information that can be included in the stem. This makes options easier to read and understand, and makes it easier for students to answer the question quickly.
3. **Eliminate excessive wording and irrelevant information from the stem.** Irrelevant information in the stem confuses students and leads them to waste time


**Writing Answers**
1. **Avoid lifting phrases directly from text or lecture.** This becomes a simple recall activity for the student. Use new language as frequently as possible.
2. **Write the correct answer before writing the distracters.** This makes sure you pay enough attention to formulating the one clearly correct answer.
3. **Answer options should be about the same length and parallel in grammatical structure.** Too much detail or different grammatical structure can give the answer away.
4. **Limit the number of answer options.** Research shows that three-choice items are about as effective as four-choice items. Four choice items are the most popular, and never give more than five alternatives.

5. **Distracters must be incorrect, but plausible.** If you can, include among the distracters options that contain common errors. Students will then be motivated to listen to your explanations of why those options are incorrect.

6. **To make distracters more plausible, use words that should be familiar to students.** If a recognizable key word appears in the correct answer, it should appear in some or all of the distracters as well. Don't let a verbal clue decrease the accuracy of your exam.

7. **Help students see crucial words in the question.** For example: "Which of the following is NOT an explicit norm?" Likewise, when you ask a similarly-worded question about two different things, always highlight the difference between the questions.

8. If it is too easy to eliminate one or two options, then the question loses much of its measurement value. If you must come up with one more distracter, **consider either offering a true statement that does not answer the question and/or a jargon-ridden option that is meaningless to someone who understands the concept.**

9. **Use Rarely:**
   - **Extreme words** like "all," "always" and "never" (generally a wrong answer).
   - **Vague words** or phrases like "usually," "typically" and "may be" (generally a correct answer).
   - "All of the above" - eliminating one distracter immediately eliminates this, too.
   - "None of the above" - use only when the correct answer can be absolutely correct, such as in math, grammar, historical dates, geography, etc. Do not use with negatively-stated stems, as the resulting double-negative is confusing. Studies do show that using "None of the above" does make a question more difficult, and is a better choice when the alternative is a weak distracter.

Excerpted from “Writing Multiple-Choice Questions that Demand Critical Thinking,” University of Oregon
http://tep.uoregon.edu/resources/assessment/multiplechoicequestions/mc4criithink.html

**Suggestions for Writing MCQs Which Measure Higher Objectives**

1. Present practical or real-world situations to the students. These problems may use short paragraphs describing a problem in a practical situation. Items can be written which call for the application of principles to the solution of these practical problems, or the evaluation of several alternative procedures.

2. Present the student with a diagram of equipment and ask for application, analysis, or evaluations, e.g., "What happens at point A if .?" "How is A related to B?"

3. Present actual quotations taken from newspapers or other published sources or contrived quotations that could have come from such sources. Ask for the interpretation or evaluation of these quotations.

4. Use pictorial materials that require students to apply principles and concepts.

5. Use charts, tables or figures that require interpretation.

Excerpted from “How to Write Better Tests,” University of Indiana
http://www.indiana.edu/~best/write_better_tests.shtml
Designing Multiple Choice Questions: Recent Literature

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Abstract: This note discusses some of the shortcomings of multiple choice tests in Mathematics given to undergraduate engineering students. Examples are presented, where the disadvantages of a multiple choice test are pointed out and suggestions how to overcome the difficulties are given.


Abstract: A participatory learning approach, combined with both a traditional and a competitive assessment, was used to motivate students and promote a deep approach to learning biochemistry. Students were challenged to research, author, and explain their own multiple-choice questions (MCQs). They were also required to answer, evaluate, and discuss MCQs written by their peers. The technology used to support this activity was PeerWise—a freely available, innovative web-based system that supports students in the creation of an annotated question repository. In this case study, we describe students' contributions to, and perceptions of, the PeerWise system for a cohort of 107 second-year biomedical science students from three degree streams studying a core biochemistry subject. Our study suggests that the students are eager participants and produce a large repository of relevant, good quality MCQs. In addition, they rate the PeerWise system highly and use higher order thinking skills while taking an active role in their learning. We also discuss potential issues and future work using PeerWise for biomedical students.


Abstract: Too many multiple-choice tests are administered without an evaluative component. Teachers often return student assessments or Scantron cards—computerized bubble forms—without review, assuming that the printing of the correct answer will suffice. However, a more
constructivist approach to follow up multiple-choice tests can make for more meaningful learning experiences for students. One way is to have students explain, classify, and analyze the nature of their errors. Here you will discover some strategies that will help make the evaluation of multiple-choice assessments more meaningful.


Abstract: A Chemistry Concept Reasoning Test was created and validated providing an easy-to-use tool for measuring conceptual understanding and critical scientific thinking of general chemistry models and theories. The test is designed to measure concept understanding comparable to that found in free-response questions requiring explanations over calculations. The development of the test focused on the design of new multiple-choice questions to challenge and determine students' understanding by providing various types of questions that require visualization, logical reasoning, and particulate explanations. Validation was achieved in several ways. The primary validation of the Chemistry Concept Reasoning Test was done in a General Chemistry course through correlation with students' scores on a free-response final exam and total scores in the overall course. High Pearson product moment correlation coefficients for each version of the test and relationship provide criterion-related convergent validity.


Abstract: Multiple-choice testing (MCT) has several advantages which are becoming more relevant in the current financial climate. In particular, they can be machine marked. As an objective testing method it is particularly relevant to engineering and other factual courses, but MCTs are not widely used in engineering because students can benefit from guessing. In the formation of a professional engineer, guessing must be actively discouraged and this has led to this testing method being used only rarely in engineering courses. This paper describes trials of a modification to the basic MCT which is designed to assess the students' ability to use their knowledge correctly and confidently. Students are asked to select the correct answer, as usual, then to indicate their confidence in that choice. The marking scheme does not reward guessing, and misplaced confidence is penalized. Statistical results based on over 2500 answers are presented, together with survey responses. The students' attitude to the tests has been that they are fair but challenging.

Abstract: Objective testing techniques, such as multiple-choice examinations, are a widely accepted method of assessment in gross anatomy. In order to deter cheating on these types of examinations, instructors often design several versions of an examination to distribute. These versions usually involve the rearrangement of questions and their corresponding answer choices. This study will determine whether the distribution of different versions of an examination affects student performance in a lower division anatomical science course. Students who receive the original version of an examination may be at an advantage over those that receive a shuffled version of an examination because of the systematic tendencies that go into examination construction. This study concludes that the shuffling of questions and answer choices to produce multiple versions of an examination does not affect student performance.


Abstract: The reasoning behind popular methods for analysing the raw data generated by multiple choice question (MCQ) tests is not always appreciated, occasionally with disastrous results. This article discusses and analyses three options for processing the raw data produced by MCQ tests. The article shows that one extreme option is not to penalize a student for wrong answers or for missing out questions, and the other extreme option is actually to penalize both aspects. The intermediate option of focusing on the number of questions actually attempted while penalizing wrong answers can be regarded as the fairest. In this case blind guessing will on average not help the student, although partial knowledge will lessen the negative impact on the final overall score. There are still many interesting challenges in designing techniques for MCQ tests.


Abstract: Surprising version-dependent differences are noted in student performance on certain questions in a standardized general chemistry exam. The exam in question has two versions, on which both questions and answers are ordered differently. For the questions suspected of answer-order bias, the performance is better in ten of twelve cases when students see the correct answer earlier in the list of four choices. Expansion of the study to more abundant data for the same exam from the ACS DivCHED Examinations Institute supports the interpretation of these observations as a primacy effect, characteristic of guessing, but with an aversion for the first choice. However, the single problem that shows the greatest disparity between versions in both data sets is one most chemists would view as so simple as to make guessing unnecessary, hence unlikely as an explanation.

Abstract: Active learning promotes higher-level reasoning, and it can be achieved in large classes without wholesale changes in class format. Applicable methods include in-class mini-investigations, robust multiple-choice exam questions, online quizzes or review, and cooperative learning, particularly during exams. Data gleaned from observing student performance, surveys, and interviews confirm the efficacy of these techniques.
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Improving Multiple Choice Tests

How to Write Better Tests: A Handbook for Improving Test Construction Skills
http://www.indiana.edu/~best/write_better_tests.shtml

How to Construct Better Multiple Choice Tests
http://www.uleth.ca/edu/runte/tests/multiplechoicetests.html

Designing Multiple-choice Questions
http://cte.uwaterloo.ca/teaching_resources/tips/designing_multiple_choice_questions.html

Writing Multiple-Choice Questions that Demand Critical Thinking
http://tep.uoregon.edu/resources/assessment/multiplechoicequestions/mc4critthink.html

Designing effective objective test questions: an introductory workshop
http://www.caacentre.ac.uk/dldocs/otghdout.pdf

Designing Effective Assessments
http://www.edtech.vt.edu/edtech/id/assess/assess.html