

Designing good Multiple-choice Questions

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Assessment-driven learning

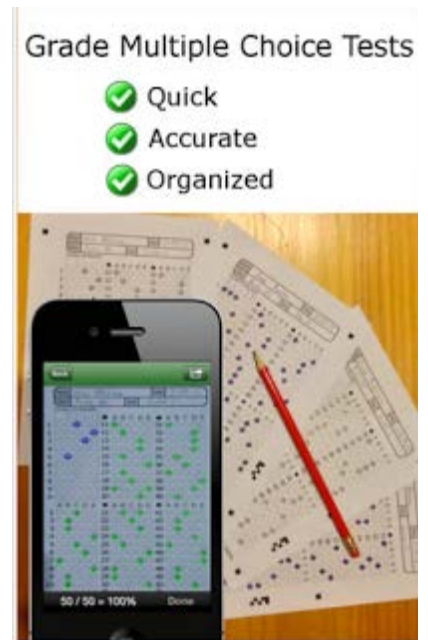
- **“Assessment drives student learning. Student assessment can be designed to foster the development of elaborated knowledge structure by making relationships and understanding—rather than isolated facts—the objects of assessment.” (Bordage, 1994)**

Assessment purposes

- **Measure student's competence in course?**
- **Develop competent physicians?**
 - **Application of knowledge**
 - **Clinical decision-making**

Advantages of using MCQs

- Accurate and efficient scoring; expedite the scoring of exams that are machinery graded (Brady, 2005; McDonald, 2002)
- Objective measurement (Brady, 2005; McDonald, 2002)
- Easier to control the difficulty level (McDonald, 2002)



Limitations of using MCQs

- Time consuming to construct a set of MCQ items (Brady, 2005)
- Being criticized as only able to test students' retention, superficial knowledge (McDonald, 2002; Scouller, 1998)



Aim higher

- Assess wide range of learning outcomes at cognitive level (*evaluation, comprehension, application and analyzing skills*) (Brady, 2005; McDonald, 2002)
- Able to challenge students' ability of critical thinking skills by using plausible alternatives (Brady, 2005)



4 Tips on Critical Thinking MCQs

Example 1: Recall Question

- The dose of intravenous heparin should be adjusted to maintain the client's activated partial thromboplastin time (APTT) at how many times the control?
 - A. Less than 1.5
 - B. Between 1.5 and 2.5 *
 - C. Greater than 2.5 and less than 3.5
 - D. Between 3.5 and 4.5

4 Tips on Critical Thinking MCQs



Example 1: Recall translated to **Application**

- A client who is receiving intravenous heparin has an activated thromboplastin time (APTT) of 2.5 times the control. In addition to documenting the finding, which of these actions would be appropriate for a nurse to take?
 - A. Call the lab for a stat repeat of the test.
 - B. Discontinue the client's heparin infusion immediately.
 - C. Continue to monitor the client.*
 - D. Alert the blood bank to have a unit of packed cells available.

(McDonald, 2002)

4 Tips on Critical Thinking MCQs

Example 2: Recall Question

- A nurse is aware that a screening test has high specificity. This means that the test
 - A. provides precise findings.
 - B. correctly identifies those who have a disease. *
 - C. accurately identifies those who do not have a disease.
 - D. has a high correlation with severity of disease.

4 Tips on Critical Thinking MCQs



Example 2: Recall translated to **Analysis**

- A nurse who is planning a health screening program identifies that a particular screening test has a specificity of 90%. The nurse should recognize that this indicates that the test accurately identifies
 - A. 10% of those who actually have the disease.
 - B. 10% of those who do not have the disease.
 - C. 90% of those who actually have the disease. *
 - D. 90% of those who do not have the disease.

4 Tips on Critical Thinking MCQs



Example 3: Using the “Best Answer Format”

- A nurse plans all of these measures for a client who was rescued from a fire and has deep burn injury of the chest and arms. To which of these measures should the nurse assign priority during the emergent phase of burn management?
 - A. Monitoring the client’s respiration. *
 - B. Assessing the client’s peripheral circulation.
 - C. Measuring the client’s urine output.
 - D. Preventing the client from developing infection.

4 Tips on Critical Thinking MCQs



Example 4: Creating the “Unique Situation”

- An elderly client is about to have a minor surgical procedure. The client says to a nurse, “ I really don’t know why it is so important for me to have this surgery.” The nurse notes that the client has signed a consent for the surgery. Before administering the client’s preoperative medication, which of these actions would be appropriate for the nurse to take?
 - A. Discuss nonsurgical treatments with the client and document the discussion in the client’s medical record.
 - B. Reassure the client that this is minor surgery and the surgeon has an impeccable reputation for performing only surgery that is beneficial for clients.
 - C. Contact the client’s adult children to determine if they understand the need for the surgical procedure.
 - D. Inform the surgeon that the client does not understand the need for the surgery.*

5 Tips on writing up

■ Constructing an Effective Stem

I) The stem should be negatively stated only when significant learning outcomes require it.

- Students often have difficulty understanding items with negative phrasing.
- If a significant learning outcome requires negative phrasing, such as identification of dangerous laboratory, the negative element should be emphasized with *italics* or CAPITALIZATION.



NEGATIVE PHRASING

Which of the following is not true about mitochondria?

- A. They contain DNA.
- B. They make some of their own proteins.
- C. They are static.



BETTER USE OF NEGATIVE PHRASING

A water-type extinguisher is suitable for putting out a fire caused by burning all of the following EXCEPT

- A. alcohol
- B. cotton
- C. paper
- D. wood

5 Tips on writing up

■ Constructing an Effective Stem

2) A question stem is preferable.

- It allows the student to focus on answering the question rather than holding the partial sentence in working memory and sequentially completing it with each alternative.



INTERIOR BLANK

In addition to the nucleus, _____ are organelles that contain DNA.

- A. Golgi bodies
- B. Mitochondria and chloroplasts
- C. Ribosomes



BETTER

In addition to the nucleus, which organelles contain DNA?

- A. Golgi bodies
- B. Mitochondria and chloroplasts
- C. Ribosomes

5 Tips on writing up

■ Constructing Effective Alternatives

3) **Alternatives should be stated clearly and concisely.**

- Items that are excessively wordy assess students' reading ability rather than their attainment of the learning objective.



WORDY ALTERNATIVES

The term hypothesis, as used in research, is defined as

- A. A conception or proposition formed by speculation or deduction or by abstraction and generalization from facts, explaining or relating an observed set of facts, given probability by experimental evidence or by factual or conceptual analysis but not conclusively established or accepted.
- B. A statement of an order or relation of phenomena that so far as is known is invariable under the given conditions, formulated on the basis of conclusive evidence or tests and universally accepted, that has been tested and proven to conform to facts.
- C. A proposition tentatively assumed in order to draw out its logical or empirical consequences and so test its accord with facts that are known or may be determined, of such a nature as to be either proved or disproved by comparison with observed facts.

Source: Steven J. Burton, Richard R. Sudweeks, Paul F. Merrill, and Bud Wood. *How to Prepare Better Multiple Choice Test Items: Guidelines for University Faculty*. 1991.

5 Tips on writing up

■ Constructing Effective Alternatives

4) The alternatives “all of the above” and “none of the above” should **NOT** be used.

- When “all of the above” is used, test-takers who can identify more than one alternative as correct can select the correct answer even if unsure about other alternative(s).
- When “none of the above” is used, test-takers who can eliminate a single option can thereby eliminate a second option. In either case, students can use partial knowledge to arrive at a correct answer.



Heparin


1. Acts as an anti-platelet
2. Acts as an anti-thromboplastin
3. Acts as an antithrombin
4. All of the above
5. None of the above

5 Tips on writing up

■ Constructing Effective Alternatives

5) **Avoid complex multiple choice items.**

- Alternatives consist of different combinations of options.
- As with “all of the above” answers, a sophisticated test-taker can use partial knowledge to achieve a correct answer.



COMPLEX MULTIPLE CHOICE

Who received a Nobel Prize for discovering the structure of DNA?

- A. Francis Crick
- B. James Watson
- C. Rosalind Franklin
- D. A and B
- E. B and C
- F. A and C

Making judgment

- **Subjective methods**
- **Item analysis: performance of MCQ in an exam**

Difficulty factor

Proportion of respondents selecting the right answer to that item

$$D = c / n$$

D = difficulty factor

c = number of correct answers

n = number of respondents

- Range 0 -1
- The **HIGHER** the difficulty factor – the **easier** the question is

Discrimination index

How well the item discriminates between students who performed highest on the exam (e.g. top 25%) and students who performed lowest on the exam (bottom 25%).

- $DI = (a-b) / n$
- a=correct responses of the High group
- b=correct responses of the Low group
- n-number of respondents in each group

Interpretation

- The most effective questions will have moderate difficulty and high discrimination values.
- Questions having low or negative values of discrimination need to be reviewed very carefully.

<http://www.schreyer institute.psu.edu/Tools/ItemAnalysis/>

Example

Q	n	D.I.	top 25%	bottom 25%	D.F.	A	B	C	D	E
1	105	81	100	59	0.43	0	19	85	1	0
2	93	81	96	63	0.31	14	4	75	0	0
3	93	70	96	54	0.40	13	65	10	1	4
4	93	75	92	67	0.21	1	1	19	2	70

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