The incorrect response in multiple-choice examinations

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Summary

There are three causes for incorrect responses in multiple-choice question (MCQ) and true-false (T-F) tests: (i) guessing as a result of total ignorance; (ii) guessing as a result of partial knowledge; and (iii) so-called 'anti-knowledge', which we define as the recording of an incorrect response in the firm belief that it is the correct one.

Anti-knowledge responses may have many causes: ambiguity about the words or implied meaning of a question, differences of scientific prejudice or opinion, or because of misconceptions. Whatever the cause, however, anti-knowledge always gives rise to a score which is less than the score obtained through random guessing.

This is a major failing of the MCQ type of examination, and there is nothing that can be done about the scoring system to alleviate the problem. Essentially the type of question which might give rise to anti-knowledge responses has to be eliminated from the examination, thus ensuring that partial knowledge is always rewarded by a score equal to or greater than (but never less than) the score for random guessing.


Incorrect responses to examination questions are common in all forms of academic testing, and examination scores generally bear an inverse relationship to the number of such incorrect responses in a test. This is based on the assumption that incorrect responses are always due to ignorance.

This assumption is probably correct in the traditional essay and oral examinations but is questionable in a multiple-choice question (MCQ) or true-false (T-F) test. It is true that full or perfect knowledge (for a given level of education) is required to consistently avoid the incorrect alternatives in a MCQ or T-F test; but it is equally true that full or perfect knowledge is also required to consistently avoid the correct answers.

This property of the MCQ and T-F examinations, more than any other, severely restricts the type of questions which can be set in such tests.

Causes of incorrect responses in MCQ and T-F tests

There are three possible causes for an incorrect response in an MCQ or T-F examination, assuming that the student does not misread the question:

1. A student may be totally ignorant of the subject matter being tested by the item, and may consequently decide to choose one of the offered alternatives by guessing. This will result in both correct and incorrect answers being selected purely by chance. This may be referred to as a 'no knowledge' situation.

2. A student may have some knowledge of the subject matter being tested by the item, but is not sure of all the details. If he guesses, his choice will be less random than in the 'no knowledge' situation (by, for instance, the elimination of certain alternatives by guessing. This will result in both correct and incorrect answers being selected purely by chance. This may be referred to as a 'no knowledge' situation.

3. A student may answer incorrectly while firmly believing that he is correct. This we have called an 'anti-knowledge' situation which has many causes: the question may be worded ambiguously; the student may believe that certain missing information is implied, when in fact it had been left out deliberately to test his concern for detail, or the examiner may have omitted to supply vital information, believing it to be implied, but the student thinks the omission is intentional; the student may have been taught incorrectly (by an out-of-date...
Incompatibility of the anti-knowledge situation with the other causes of incorrect responses

Partial knowledge and anti-knowledge in MCQ and T-F tests, are, as the names imply, both the result of some degree of learning. The expression of such learning in an essay or oral examination is usually awarded a score greater than or equal to (but seldom less than) the score awarded for an omission, in recognition of the fact that all knowledge is incomplete and that there are many ways of harnessing one's incomplete understanding of the truth in problem solving. Allowance also has to be made for the fact that language, if it is not to be pedantic, is rarely used to state facts fully, exactly and unequivocally, and places heavy reliance on inferences and short-cuts in logic. Thus, the statement 'aldosterone increases the sodium salt content of the body' is, strictly speaking, incorrect, as high plasma concentrations of aldosterone cannot add sodium salts to the body, but can only prevent their loss in the urine, faeces and sweat. Yet the statement accurately describes the effects of persistently high aldosterone concentrations in the plasma in everyday practical physiology, and would be awarded (nearly) full marks if it appeared in an essay examination answer, especially if the context implied that sodium salts are constantly added to the internal environment by the ingestion of food.

When the same statement appears in a MCQ or T-F test, however, students are awarded a maximum score for that question if they indicate that it is false, and a minimum score (for that question) if they say that it is true. The difference between the true and the false responses may, however, not be due to a difference in the understanding of sodium salt homeostasis in the body, but merely to a difference in the understanding of what the examiner had in mind when he set the question. The situation is complicated by the fact that the student who truly has no knowledge of the role aldosterone plays in the sodium salt homeostasis of the body is more likely to record a correct answer (simply by guessing), and therefore to score a higher mark on average for such questions, than a student who misses the subtlety of the wording and confidently asserts that the statement is true.

This is a major failing of the MCQ type of examination and there is nothing that can be done to alleviate the problem because whichever scoring system is used, a wild guess will always be more advantageous than an anti-knowledge response of whatever cause. Essentially this type of question has to be avoided altogether, and if an examiner wishes to test this particular item of knowledge the statement has to be rephrased, e.g. 'a high concentration of aldosterone in the plasma causes a hunger for salty food'.

MCQ statements should indicate what item of information is being tested as clearly and as directly as possible, avoiding by all means available the creation of anti-knowledge possibilities in the examination. There is no room in an MCQ paper for questions which are designed to trap the unwary, unthinking or less informed student into making an incorrect response with the intention of 'separating the sheep from the goats'. We have found, however, that even after the most meticulous checking of MCQ papers by all members of staff in the department, there are still always a few questions which give rise to 'inversions' at the examination (many more incorrect responses by the students than correct ones). Such 'inversions' can only be the result of anti-knowledge, and we recommend that they all be removed from the scoring scheme in an examination.

Having eliminated all the items which might, or do, evoke anti-knowledge responses from the students, one can be sure that all partial knowledge will be of benefit to the students provided that everyone answers all the questions. Students should never be discouraged from guessing by, for instance, the imposition of heavy penalties (\( \frac{1}{n-1} \)) where \( n \) is the number of alternatives per question) for incorrect responses, as this has the effect of obscuring any partial knowledge which might exist, without discouraging anti-knowledge responses.

Addendum

Since the submission of the above article we have introduced an MCQ/T-F answer sheet which makes provision for student comments in case any question is unclear, ambiguous, or does not provide sufficient information for an unqualified answer of 'true' or 'false'.

Our experience in 10 different examinations has been that this is a useful and practical innovation which allows individual cases of anti-knowledge to be identified.

Comments are divided into two categories:
1. Remarks and queries about the questions (e.g. 'Ambiguous', 'What does fenestration mean?', 'In men or in women?', 'State time of day') are noted but do not affect the individual student's score.
2. Comments which are factually relevant to the material being examined attract a score of +1 for that question, if they are correct, or a score of zero, not -1, if they are incorrect irrespective of whether the student has recorded a correct T-F answer for the wrong reason, or an incorrect answer for anti-knowledge reasons.

It takes us about 1 hour to check through the comments of 200 students in a 100-question T-F examination.

REFERENCES