

# Does Educator Training or Experience Affect the Quality of Multiple-Choice Questions?

Emily M. Webb, MD, Jonathan S. Phuong, BS, David M. Naeger, MD

**Rationale and Objectives:** Physicians receive little training on proper multiple-choice question (MCQ) writing methods. Well-constructed MCQs follow rules, which ensure that a question tests what it is intended to test. Questions that break these are described as “flawed.” We examined whether the prevalence of flawed questions differed significantly between those with or without prior training in question writing and between those with different levels of educator experience.

**Materials and Methods:** We assessed 200 unedited MCQs from a question bank for our senior medical student radiology elective: an equal number of questions (50) were written by faculty with previous training in MCQ writing, other faculty, residents, and medical students. Questions were scored independently by two readers for the presence of 11 distinct flaws described in the literature.

**Results:** Questions written by faculty with MCQ writing training had significantly fewer errors: mean 0.4 errors per question compared to a mean of 1.5–1.7 errors per question for the other groups ( $P < .001$ ). There were no significant differences in the total number of errors between the untrained faculty, residents, and students ( $P$  values .35–.91). Among trained faculty 17/50 questions (34%) were flawed, whereas other faculty wrote 38/50 (76%) flawed questions, residents 37/50 (74%), and students 44/50 (88%). Trained question writers' higher performance was mainly manifest in the reduced frequency of five specific errors.

**Conclusions:** Faculty with training in effective MCQ writing made fewer errors in MCQ construction. Educator experience alone had no effect on the frequency of flaws; faculty without dedicated training, residents, and students performed similarly.

**Key Words:** Multiple-choice questions; educator experience; question flaws; education.

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Physicians are rarely trained to properly write multiple-choice examinations, including those working in academic settings. However, this skill set has become much more relevant in recent years. With the transition to the new written format of radiology board certification examinations (1), the development of more rigorous self-assessment requirements for maintenance of certification examinations (2–4), and the greater inclusion of radiology into integrated medical student curricula (5), multiple choice radiology questions are in great demand.

Well-constructed multiple-choice questions (MCQs) follow a set of parameters that ensure the question tests what it is intended to test (6–8). Questions that violate widely agreed on rules are described in the education literature as flawed (9–13). In simple terms, a flawed question tends to test “how good of a test taker” someone is, rather than the relevant knowledge

intended, which can disadvantage some students (10). Previous literature examining MCQs has revealed that such mistakes are common within continuing medical education (CME) materials (14,15) and on health care sciences examinations (10,16).

Previous authors have found that MCQ writing is improved after dedicated faculty training (17). However, to our knowledge, there has been no previous assessment as to whether educator experience level otherwise affects the quality of MCQs.

We sought to determine how often MCQ writing rules were violated among questions submitted for use in our primary medical student radiology elective, and whether the prevalence of flawed questions differed significantly among question writers with varying levels of experience and training. Our hypothesis was that faculty with prior training in question writing would perform best, and that of those without training, educators with those most experience (faculty > residents > students) would perform better than those with less experience.

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From the Department of Radiology and Biomedical Imaging, University of California, San Francisco, 505 Parnassus Avenue, M-391, San Francisco, CA 94143-0628 (E.M.W., J.S.P., D.M.N.). Received May 28, 2015; accepted June 27, 2015. Address correspondence to: E.M.W. e-mail: [emily.webb@ucsf.edu](mailto:emily.webb@ucsf.edu)

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## MATERIALS AND METHODS

### Study Design

At our institution, we have access to a large bank of internally generated MCQs that were previously submitted for use in

our main medical student radiology elective by (a) core education faculty in the Department of Radiology who have had dedicated training in question writing, (b) other radiology faculty, (c) third and fourth year radiology residents, and (d) fourth year medical students. “Core education faculty” was defined as those instructors who held leadership positions in departmental educational endeavors and had previous instruction in MCQ writing. Three faculty members, with subspecialty training in nuclear medicine, cardiopulmonary, and abdominal imaging, met this description. One core faculty member was the medical student elective course director and Co-Director of Medical Student Education for the Department of Radiology, second core faculty member was the curriculum steward for radiology for the School of Medicine and Co-Director of Medical Student Education for the Department of Radiology, and the third was the Director of CME for the Department of Radiology. The three core instructors had 4, 9, and 9 years of faculty educator experience, respectively, whereas general faculty was comparatively comprising educators with a wide range of experience from 1 to >30 years. Previous training in question writing among the core education faculty varied. One core faculty member completed an institutional 2-hour faculty development workshop on MCQ writing that was intended for medical school teaching faculty. One completed a 1-hour WebEx training session on MCQ writing provided by the American Board of Radiology. The third received 2 hours of one-on-one mentoring in MCQ writing from medical school faculty as part of a junior faculty mentoring program. All three core faculty also previously completed independent review of published MCQ writing resources (18–20).

Questions used on our graded radiology course examinations are all vetted and edited by the course directors. The question bank, however, also includes the initial, unedited versions of all questions submitted for consideration for the course ( $n =$  approximately 400). Unedited questions are categorized into separate files by the rank of the author (faculty, resident, student, and so forth), but have no other identifying author information. Given that the questions written by core education faculty had to be parsed out from other faculty submissions, the radiology medical student education coordinator, who was not otherwise involved in the study, separated the faculty questions into two different files, based on email records of initial question submission. Given overlapping topics and rotation in course instructors, the other question writers could not reasonably be identified by the questions alone. Questions covered all radiology subspecialty areas. Topic areas were not specific to educator level.

Relatively fewer resident written items were available in the question bank (approximately 50), so 50 unedited questions from each of these four educator groups were randomly selected. The questions were assembled together in a single 200 question PowerPoint presentation, with the question sequence randomized. A key to the “educator level” of each question writer was maintained by one author who did not

evaluate the questions. The PowerPoint formatting of each question slide was identical.

The core education faculty who contributed questions consisted of three writers. The questions from the other groups (noncore faculty, residents, and students) were selected consecutively and anonymously, so the exact number of distinct authors in each group is unknown. However, the number of authors contributing to the question bank was >20 for each of these three categories.

### MCQ Flaws

The list of question flaws was generated by a literature review (11–13,16), referencing a local institutional guideline for MCQ writing (18), review of the American Board of Radiology item writers’ guide (19), and the National Board of Medical Examiners’ item writing guide (20). All commonly cited independent “flaws,” which violate standard evidence-based principles of effective item writing, were included in the analysis. “Repeat wording” in answer options was omitted as an independent flaw as it overlaps considerably with the concept of “element repetition,” which was included in a separate rule. It was felt that all questions exhibiting repeat wording would be identified through the more general rule. Additionally, some recommendations including organization of the sequence of answer options (alphabetized vs. logical order) were not included as there are conflicting recommendations (18,19).

Eleven common MCQ writing flaws were included and defined as follows:

1. Content not important  
Examination questions should be based on concepts that are important for the learners to “take away” from the session. In other words, they should focus on main points, not minutia.
2. Open-ended or unfocused stems  
MCQs have two components: the “stem” and the answer choices. The stem is the question or incomplete statement. Most of the information pertinent to the question should be in the stem, so that a test taker can reasonably determine the correct answer before even reading the possible answer choices. However, when a stem is unfocused, the test taker must read all the options before they can determine what the question is asking. An example of an open-ended stem is, “Nuclear medicine tests are....”
3. Negative stem or negative answer options  
Question stems should avoid negative phrasing such as, “Which of these is NOT,” “...EXCEPT,” “...FALSE,” and so forth. Negative wording in answer options should be avoided as well. Negative terms often make a question unnecessarily confusing.
4. Inclusion of superfluous information  
The goal is to present the information in a manner that is concise and uncomplicated. Avoiding superfluous

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