INVOLVING STUDENTS IN QUESTION WRITING: A UNIQUE FEEDBACK WITH FRINGE BENEFITS

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A contest on question writing was organized during the undergraduate medical physiology teaching program. Students were asked to write and submit multiple-choice questions of the assertion-reason type (type E) in physiology. The winners were decided after the questions submitted were graded on a six-point scale (0–5) that considered both thematic novelty and construct correctness. Of the 100 students in the class, 37 participated in the contest, and a total of 912 questions was received. The contest encouraged the students to go through their subjects critically. The questions provided the instructor with insight into the learning habits and misconceptions of the students and provided the grist for animated discussions in tutorial classes. Although several types of errors were deciphered in these questions, with suitable modifications the questions helped the faculty build up a sizable question bank.

A contest was therefore organized wherein students would write MCQs and submit them to the course coordinator. Some of the better questions, it was promised, would be included in the test papers (in class tests). In addition, the contributors of the best and most number of questions would be rewarded with certificates. The exercise, it was hoped, would stimulate the students to go through the subject thoroughly.

CONTEST

The contest was limited to writing type-E questions (7). Each type-E MCQ consists of an “assertion” and a “reason” linked with the conjunction “because.” The examinee is asked to mark

A) if both the statement and reason are correct and the reason provides the correct explanation to the statement;
B) if both the statement and reason are correct but the reason does not provide the correct explanation to the statement;

C) if the statement is correct but the reason is incorrect;

D) if the statement is incorrect but the reason, considered independently, is correct; and

E) if both the statement and the reason are incorrect.

In an introductory class, students were given detailed explanations about writing type-E MCQs, with examples from subjects other than physiology. The scoring criteria as well as other rules of the contest (deadlines for submissions, etc.) were outlined for them. The contest lasted 15 months (our physiology course spans 18 months), during which questions from various “systems” (cardiovascular, respiratory, etc.) were being submitted continuously. There was a deadline for submission of questions pertaining to each system. After the deadline, no more questions from that system were entertained and all the questions submitted were openly discussed in the tutorial classes. The questions submitted were graded shortly after their submission, and updated results were declared periodically. At the end of the contest, the final results were declared and the participants were asked to submit their opinion about the contest. Excerpts from their comments are listed in Table 1.

**GRADING OF QUESTIONS**

The questions submitted were graded on a six-point scale (0–5). In grading the questions, both the theme and the construction of the questions were taken into account (Table 2). For example, a good theme fetched five full points if the question was correctly constructed and four points if the construction was slightly flawed. A poor theme fetched no points, regardless of its construction. However, even a poorly constructed question fetched two points if it pertained to some interesting theme and was amenable to modifications. Consider the following example. (All examples quoted in this paper are drawn from the students’ contributions.)

In α-thalassemia, HbH is produced (which is formed of 4 β-chains), whereas in β-thalassemia, HbA₂

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**TABLE 1**

Excerpts from feedback obtained from participants in contest

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Physiology needs understanding...which needs thorough study. This analytical study contest definitely helped those who wished to understand physiology.</td>
</tr>
<tr>
<td>2)</td>
<td>It made students read books in their own way.</td>
</tr>
<tr>
<td>3)</td>
<td>It consumed a lot more time than what would have been appropriate.</td>
</tr>
<tr>
<td>4)</td>
<td>By the time I finished revising a chapter, questions of the next chapter were being submitted (by the rest of the class). I think I brooded too much over my questions.</td>
</tr>
<tr>
<td>5)</td>
<td>Demotivating factors...No extra attendance for questions...</td>
</tr>
<tr>
<td>6)</td>
<td>It would have been great if it were compulsory because then I wouldn’t have dropped out of it.</td>
</tr>
<tr>
<td>7)</td>
<td>...it sharpens the mind.</td>
</tr>
<tr>
<td>8)</td>
<td>It made students feel that they have a grip on this subject.</td>
</tr>
<tr>
<td>9)</td>
<td>I am lazy at such things so I am sorry (that I did not contribute many questions). But such contests should be promoted.</td>
</tr>
<tr>
<td>10)</td>
<td>...backed out initially but then thought if others can, why can’t I?</td>
</tr>
<tr>
<td>11)</td>
<td>It motivated me to read more than one textbook. Also, I intended to get my name known in the faculty. The only drawback was that it ate up a lot of time.</td>
</tr>
<tr>
<td>12)</td>
<td>...provided a competitive environment.</td>
</tr>
<tr>
<td>13)</td>
<td>...motivates us to develop clear concepts...one cannot make questions without (good) concepts. Although a little time consuming, but it is very good way of making the studies better.</td>
</tr>
<tr>
<td>14)</td>
<td>...lead to better retention of certain tricky aspects of the subject...</td>
</tr>
<tr>
<td>15)</td>
<td>...participation was low because most students did not have enough time to study the subject so thoroughly.</td>
</tr>
<tr>
<td>16)</td>
<td>...has really helped in better understanding of some specific, small but very important points which we generally tend to miss out in our exam preparations...</td>
</tr>
<tr>
<td>17)</td>
<td>The contest was indeed a treat for the brainstormers but was misguided...all we had to do was to study a chapter and note down certain points in the form of questions...</td>
</tr>
<tr>
<td>18)</td>
<td>The concept was good...but not planned...the (maximum) number of questions (to be submitted from each system) was not specified...</td>
</tr>
<tr>
<td>19)</td>
<td>This contest evoked a keen interest in the subject. Certificates (and a) favorable internal assessment were the (motivating) factors. But there wasn’t enough awareness about this contest among all the students...</td>
</tr>
<tr>
<td>20)</td>
<td>Many students were motivated mainly by the fact that they could expect their own questions in test which was of course a great help. It was also a novel idea...But the main drawback which put off students later on was when they came to know that the MCQ type questions were of no use to them (in the final examinations)...as there was shortage of time, students preferred not to ‘waste’ their time writing questions.</td>
</tr>
</tbody>
</table>
(formed from 2 α- and 2 β-chains) or HbF (formed from 2 α- and 2 γ-chains) are formed because in α-thalassemia, α-chain is absent and in β-thalassemia, β-chain is absent. To compensate for this, in α-thalassemia, four β-chains unite to form HbH, whereas in β-thalassemia, two α- and two β- or two γ-chains unite to form HbA2 or HbF because four α-chains cannot unite.

The question is obviously poorly constructed. However, the student has rightly identified an important concept in the pathophysiology of thalassemia for question writing. The question can be easily trimmed and included in the question bank in the following form.

HbH is present in patients with α-thalassemia because in the absence of α-polypeptide chains, two β-chains combine with two γ-chains to form HbH. [Answer: C].

The most common cause of poor construction, however, was grammatical errors, so much so that some of the questions were almost incomprehensible. An example of a less common flaw in construction is given below.

Patients with obstructive jaundice have pale-colored stools because in obstructive jaundice, urobilinogens are absent from the stool. [Answer: B]

The criteria for good, fair, and poor themes were admittedly subjective and are further illustrated in the following examples.

Good. Parkinson’s disease is treated by administering dopamine because in Parkinson’s disease, the nigrostriatal fibers are deficient in dopamine. [Answer: D]

Fair. Parkinson’s disease is treated by administering L-DOPA because L-DOPA can cross the blood-brain barrier. [Answer: A]

Poor. Parkinson’s disease is treated by administering L-DOPA because L-DOPA decreases the rigidity and tremor of Parkinsonism. [Answer: A]

The first question was considered good because it is unlikely to be answered correctly by guessing. To answer it correctly, one must know that dopamine is deficient in the nigrostriatal, and not striatonigral, fibers in Parkinson’s disease. The student must also know that it is L-DOPA, and not dopamine, that is employed to treat the disease. The answer D would probably be the last choice of someone trying to guess the answer. The second example is relatively easier. Any student who knows the therapeutic use of L-DOPA in Parkinson’s disease can correctly guess its answer. The third question is flawed (see Paraphrasing in THEMATIC WEAKNESSES IN QUESTIONS). In this question, the reason denotes almost a reassertion of the statement.

It must be conceded, though, that we did not adhere strictly to the stipulated guidelines of grading and deviated from them more often than not. Occasionally, if a student provided a wrong answer to an otherwise good question, we penalized him or her only minimally. We never lost sight of the fact that under the guise of a contest, our real goal was to make the students work hard and read about more than what we had taught them. We were therefore indulgent in awarding points not only to the good questions but also to the not-so-good ones if the effort put in by a student in writing them was obvious to us.

### Table 2

<table>
<thead>
<tr>
<th>Theme</th>
<th>Construction</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Correct</td>
<td>5</td>
</tr>
<tr>
<td>Good</td>
<td>Flawed</td>
<td>4</td>
</tr>
<tr>
<td>Fair</td>
<td>Correct</td>
<td>3</td>
</tr>
<tr>
<td>Fair</td>
<td>Flawed</td>
<td>2</td>
</tr>
<tr>
<td>Good</td>
<td>Poor</td>
<td>2</td>
</tr>
<tr>
<td>Fair</td>
<td>Poor</td>
<td>1</td>
</tr>
<tr>
<td>Poor</td>
<td>Correct/flawed/poor</td>
<td>0</td>
</tr>
</tbody>
</table>

Patients with obstructive jaundice have pale-colored stools because in obstructive jaundice, urobilinogens are absent from the stool. [Answer: B]
THEMATIC WEAKNESSES IN QUESTIONS

Scrutiny of the questions contributed by the students revealed inadequacies in most of them. There were far too many types of inaccuracies to be recounted here. One common defect in the questions was that the reason was not a plausible explanation to the assertion: the assertion and the reason appeared to be completely disassociated. Several such questions were submitted. However, they are too inane to be reproduced here or discussed any further. Only some of the more interesting ones are given below, along with suggestions for modifying them.

**Teleological reasoning.** This was by far the most common mistake. Consider the following example.

Hemoglobin is enclosed within the erythrocyte because if present freely in the plasma, it will increase blood viscosity.

The reason merely expatiates the functional significance of what has been stated in the assertion. It does not explain its cause, if any. These questions are not easy to modify, because the assertion usually does not have a straightforward reason. However, by taking a cue from the theme, a related question can be written.

An increase in the hemoglobin level in blood will not increase the blood viscosity because normally, hemoglobin is not present in blood outside the erythrocyte. [Answer: A]

Another example is cited here.

The blood testes barrier prevents the free movement of substances between blood and the testes because it is important to protect the developing spermatozoa from toxic substances.

**Far-fetched reasoning.** The following example illustrates far-fetched reasoning.

The presence of HbS causes sickling of erythrocytes because in HbS, valine is present in place of glutamic acid in the 6th position from the NH2 terminus in the β-chain.

Can the reason be considered an adequate explanation of the assertion? Conversely, can it be said with absolute certainty that it is not? In other words, should the answer be B or A? Some more examples are given below. In each case, although the answer A can be justified with a far-fetched reasoning, the answer B would be just as correct.

Hypotonia is a characteristic feature of cerebellar disorders because the anterior lobe of the cerebellum stimulates the Ay-fibers through the cerebelloreticular and the reticulospinal tracts.

The EEG pattern during REM sleep resembles the EEG pattern during wakefulness because dreaming is associated with REM sleep.

**Paraphrasing.** Quite often, the assertion and the reason convey the same meaning, as in the following examples.

Just after a meal, the alkalinity of blood increases (postprandial alkaline tide) because the HCO3 content of the blood increases after a meal.

An increase in lactic acid concentration dilates the capillaries because lactic acid is a local vasodilator.

The stretch reflex is monosynaptic because there is only one synapse in the reflex arc of stretch reflex.

**Subjective terms.** The following are examples of questions with subjective terms.

Rectal instillation is a highly practical route for drug administration because the absorptive capacity of the large intestine is great.

“Highly practical” and “great” are subjective terms. The question could be modified as follows.

Rectal instillation results in quicker drug absorption than oral ingestion because the absorptive capacity of the large intestine is greater than that of the ileum. [Answer: C]

In another example, a student used the term “efficiency” in place of “concentrating ability.”
Juxtaglomerular nephrons have more efficiency than cortical nephrons because juxtaglomerular nephrons have longer loops of Henle. [Answer: A]

BIAS IN ANSWERS TO QUESTIONS

The list of answers provided by the students along with their questions showed a plethora of A’s, C’s, and E’s, in that order. There were very few D’s and fewer B’s. Of the 912 questions submitted, there were 392 A’s, 27 B’s, 261 C’s, 39 D’s, and 156 E’s. The remaining 37 questions were submitted without answers. However, if the questions were to be suitably modified, there could be more B’s and D’s in the answers. Consider the following question with the answer A.

Patients who are in a state of shock should be kept in a cold room because elevated temperatures cause vasodilatation and aggravate shock.

This question becomes more challenging when modified to make the answer D.

Patients who are in a state of shock should be kept wrapped in a blanket because in circulatory shock, the skin temperature becomes low.

Or consider another question with the answer A.

Ovulation occurs around the 14th day of the menstrual cycle because there is a sudden rise in the plasma LH levels around the 14th day of the menstrual cycle.

By simply swapping the assertion and the reason, the answer can be changed to B.

There is a sudden rise in the plasma LH levels around the 14th day of the menstrual cycle because ovulation occurs around the 14th day of the menstrual cycle.

USEFULNESS OF THE CONTEST

Question writing motivates students to study. It goes without saying that a thorough knowledge of the subject is a prerequisite to writing good MCQs. The content of most of the questions suggested that the students had gone through the subject thoroughly and analytically in a bid to write some impressive questions. In their feedback, many students voiced similar opinions (see Table 1, comment 11).

The questions lead to lively discussions in the tutorials. In the tutorial classes, the discussions were centered round the questions submitted by the students. Students attempted to answer the questions contributed by their friends. The author of a question had to justify its answer, which often lead to lively debates.

The questions may reveal misconceptions. The students often provided incorrect answers to their own questions. Misconceptions revealed in this way are likely to far outnumber those revealed through tests designed by the faculty. The following question exemplifies this.

Pancreatectomy leads to steatorrhea, i.e., presence of ketone bodies in the stool, because insulin deficiency and reduced glucose metabolism lead to gluconeogenesis and ketosis.

The answer suggested by the student was A. The student was under the mistaken belief that the term “steatorrhea” referred to the presence of ketone bodies in the stool.

The questions reflect the learning habits of students. It was apparent from the questions contributed that some of the students were always well ahead of the class. Some who contributed late were probably lagging behind the classes (see Table 1, comment 4). There were some who had shunned the approaches discussed in the class and preferred the ones given in other books (see Table 1, comments 2 and 11). Some had delved in great detail into areas that were not stressed in the lectures (see Table 1, comment 16). On the other hand, some had contributed a large number of unintelligible questions (see Table 1, comment 17), which made it obvious that these students were given to memorizing facts rather than developing concepts.

The questions constitute resources for development of a question bank. The questions came in a wide variety. About 20% of the questions were considered admissible to the question bank after minor

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modification. Another 40% of the questions was not amenable to modification; however, they provided cues for writing questions on a related topic. Examples of such questions can be found in Teological reasoning in THEMATIC WEAKNESSES IN QUESTIONS. The systemwise breakup of the questions is given in Table 3.

The questions reveal some common errors. Most of the inadequacies detected in the students' contributions can be categorized into a few broad types. These have been discussed above. Teachers writing questions would do well to guard against these errors.

FACTORS CRUCIAL TO A SUCCESSFUL CONTEST

The contest was judged successful on the basis of the quality and quantity of contributions and the extent of participation (37% of the students participated) in what was entirely a voluntary exercise with no effect on the course grade. It remains a debatable point as to whether participation in such a contest should be made compulsory (see Table 1, comment 6). The success of this type of contest should be contingent on the following factors.

Nonavailability of printed books with type-E questions. The contest might have become farcical if books with type-E questions in human physiology were readily available; at least, we are not aware of them. It is doubtful whether a similar contest based on type-A (5 options with 1 correct answer) or type-K (4 options, one or more of which are correct) MCQs would have been just as successful. Given the easy availability of several books with such MCQs, the students might have been tempted to plagiarize those questions. Indeed, there were accusations that some students were “hacking” at type-A MCQs and reframing them into type-E questions. After some discussions with the students, it was decided not to forbid hacking, which in itself would be quite challenging.

Ploughing back questions into test papers. The incorporation of some of the questions contributed by the students into the class test had a tremendous effect on the enthusiasm of the students. Students whose questions had been “honored” by inclusion in the test paper were instant heroes in the class. However, an unavoidable constraint was that our rules did not permit us to include MCQs in the final (university) examinations, which took its toll on the enthusiasm of the participants (see Table 1, comment 20). Most students felt that it was not worth spending so much time and effort on something that would not have a direct impact on their performance in the university examinations, which are largely based on essay-type questions; many students pointed out that essay-type questions do not test adequately for concepts. In universities at which all examinations are based on MCQs, this type of contest should have more takers.

Availability of adequate time to the students. The medical curriculum in India has generally been discredited for overburdening the students. Quite a few students echoed such sentiments (see Table 1, comments 3, 11, and 15). Contests like these would be more successful if students had more time to themselves for self-study.

Maiden effort. The contest may not be as successful if continued over several years. One of the reasons is that students might develop their own question bank by compiling the questions contributed by their senior friends. If that happens, it will be difficult to decipher the counterfeit questions from the original ones. The only way out, then, would be to limit the contest to a smaller group of honest and motivated students, who would participate not for rewards but only to involve themselves in greater interactive learning.

DISCUSSION

The main idea of the contest was to encourage students to go through the subject matter critically

<table>
<thead>
<tr>
<th>System</th>
<th>No. of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>142</td>
</tr>
<tr>
<td>Nerve muscle physiology</td>
<td>65</td>
</tr>
<tr>
<td>Cardiovascular system</td>
<td>64</td>
</tr>
<tr>
<td>Respiratory system</td>
<td>46</td>
</tr>
<tr>
<td>Gastrointestinal tract</td>
<td>91</td>
</tr>
<tr>
<td>Excretory system</td>
<td>93</td>
</tr>
<tr>
<td>Endocrinology and reproduction</td>
<td>157</td>
</tr>
<tr>
<td>Central nervous system and special senses</td>
<td>254</td>
</tr>
<tr>
<td>Total</td>
<td>912</td>
</tr>
</tbody>
</table>

TABLE 3
Systemwise breakup of questions contributed by students
and make them read about more than what we taught them. An unstated objective was to collect raw materials for a question bank. The idea of using the questions for discussion in tutorial classes occurred to us as an afterthought. Insights into students’ misconceptions and the types of construction errors accrued as incidental benefits.

We are inclined to believe that question writing can be a good learning tool, although we do not have any objective proof to that effect. Part of our uncertainty stems from the fact that we were unable to prosecute the contest exactly as we wanted to (see Ploughing back questions into test papers), a result of which was that many of the students did not put their whole-hearted efforts into it. However, we do feel that some of the ancillary aspects of the contest were certainly beneficial. While discussing the MCQs in tutorial classes, we stumbled on several gray areas of a subject. Perhaps the carefully thought out and unambiguous questions written by experienced teachers would not have thrown up as many controversies as those raised by the naive questions of the students. In addition, the questions brought to our notice such misconceptions of the students as would have defied our wildest imagination. For example, it was obvious from one of the questions that the student believed platelets to be nonliving because they were formed by “fragmentation” of megakaryocytes. A quick survey proved that the misconception was more common than we would have liked to believe. Weeding out such misconceptions would be akin to searching for needles in a haystack. Certainly few would think of asking a student of physiology the question, “Are platelets living things?” In this contest, however, such misconceptions came to light quite regularly and in no small numbers—the students themselves came up with ideas that belied grave misconceptions.

There are reports that emphasize the role of solving MCQs as a learning tool (2, 4, 11, 13). Our experiment goes a step further in making students write out the MCQs. A question-writing exercise teaches the student to differentiate those areas of a subject that matter from those that are relatively bland. In a way, question writing can be viewed as an exercise that initiates students to the art of identifying the problem areas of a subject. A “problem-identifying” exercise contrasts with a “problem-solving” exercise in that the latter, for all its merits, has an element of spoon feeding: the students are actually fed with ready-made problems. Problem-identifying ability should enable a student to decipher problems where none are obvious. It is an ability that must complement problem-solving ability for innovative research. Problem-solving ability without problem-identifying ability would probably create a researcher who must always be “assigned” a problem.

In yet another useful spin-off to this contest, we gained valuable insight into the types of errors in the construction of MCQs. There is, of course, a voluminous amount of education literature on MCQs and constructing test questions (1, 5, 8, 9, 14, 16, 17). However, such papers focus mostly on type-A, type-K, and true/false questions, and few papers discuss type E other than in passing mention. The common errors in constructing type-E questions therefore should interest those working with type-E MCQs. Physiology teachers should also observe how patently suited type-E questions are to a subject like physiology, in which the “cause-effect” relationship is a mainstay. It is quite another matter that type-E questions may not be as suitable for some other subjects like anatomy (12) or radiology (19) or that they may be unacceptable for big examinations (15), but type-E questions have certainly been grossly underutilized in revision exercises in physiology.

Finally, the contribution of the students constitutes a valuable material for teachers to work with. As mentioned earlier, some of the questions may set even the best teachers to pondering. In addition, the prolific contributions made by a large body of students can never be matched by a much smaller faculty, even after intense brainstorming. It is of obvious advantage to capitalize on some of the ideas provided by the students, because “it is wise to cast one’s net as widely as possible... in the initial construction of questions” (3). Certainly, a contest like this is a clever way of building a large question bank.

We thank the following students who, between them, contributed nearly one-half the total number of questions submitted, contributing greatly to the success of the contest: Gobind Rai Garg, Bhuvan Chanana, Sulabh Goel, Kapil Chaudhary, Swati Agarwal, Pranjul Kulshreshtha, Rohit Agarwal, Vivek Kumar, Neetin Leekha, Sujoy Neogi, Himanshu Gupta, and Shakti Agarwal.
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References