

Team-Based Question Writing: A Higher Order Learning Exercise with Multifaceted Benefits

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The setting

- Required 2nd year medical student course on diseases of the nervous system
- 47 contact hours over 5 weeks
- ~120 students
- No TA
- Typical attendance ~40%

I was looking to increase student engagement and learning

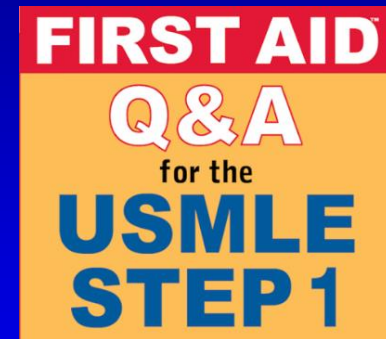
- I love writing vignette-based multiple choice questions (MCQ)
- I decided to share that love with my students

Questions for the audience

- Do any of you use study question writing in your courses?
- What might such an assignment offer?

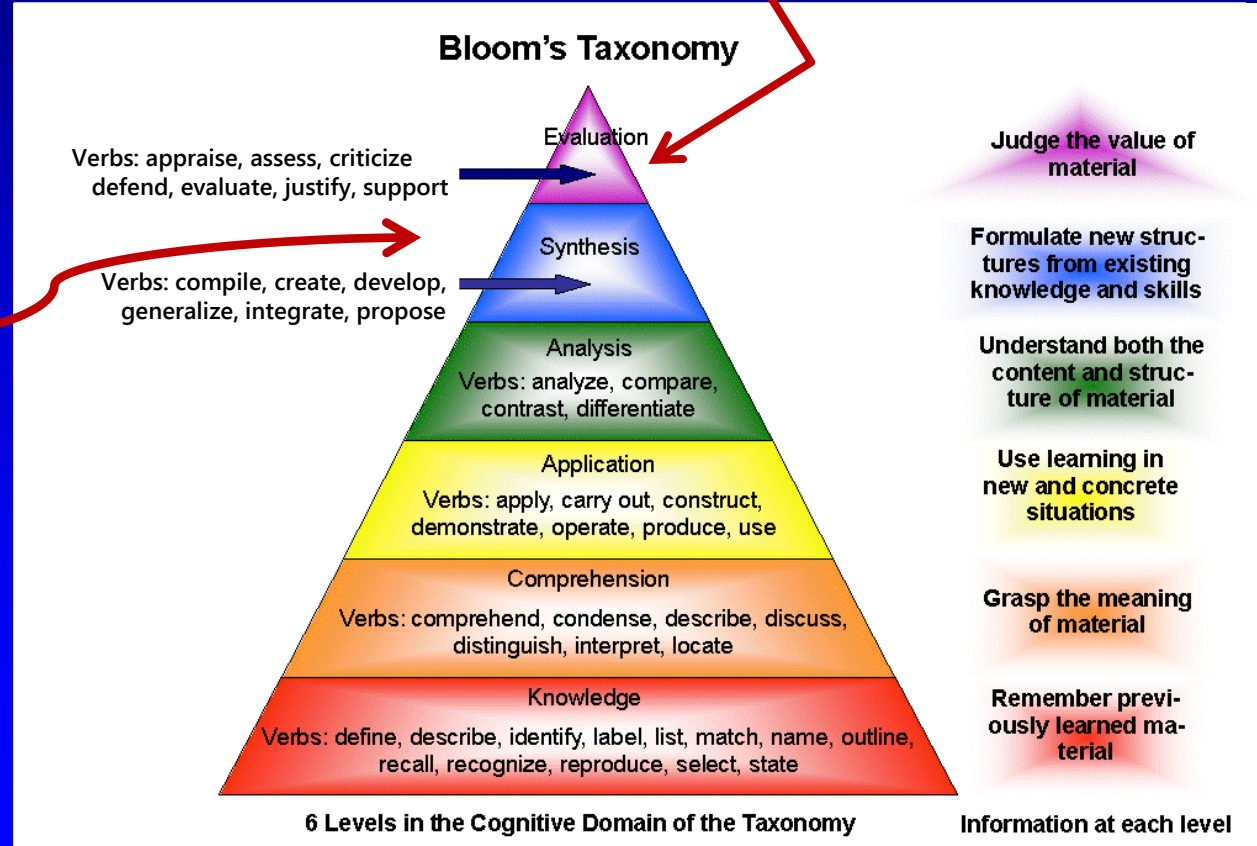
Why write questions?

- Students often cite study questions as an effective learning tool
- Answering good vignette-based questions requires
 - application of knowledge
 - interpretation of data and decision making that will improve analytic (and test-taking) skills
- More bang for your learning buck if can also explain why incorrect answers are incorrect



Defending answer/explaining why distractors are incorrect should enhance learning further

Creating question, answer, and plausible distractors requires good understanding of material



Questions for the audience

- Is there any value to having students work *in teams* to create questions?

Why team-based?

- Less threatening
- Collaborative skills
- ? A better product
- Reduce time burden on course director

Questions for the audience

- How might having the assignment be team-based introduce challenges?
- Are there other challenges you can foresee with the proposed exercise?

Challenges and dilemmas

- Student lack of knowledge about writing good Q's
- Work amount/distribution among team members
- Monitoring team progress/ensuring participation by all
- Use in-class time vs. own time?
- Have Q's reflect material covered in class vs. additional topics?
- Timing of exercise relative to topic coverage in class and exam
- Motivation to do a good job

How: years 1 and 2

- Assignment
 - 2 unique questions per team of 5-6 students
 - 1 instructor-generated vignette-based MCQ provided—team collaborates to answer/write concise answer explanation with references
 - Team-generated vignette-based MCQ with answer explanation on assigned topic
- Tools for MCQ writing/mandatory class meeting during last week of class
- Instructor served as reviewer/editor
- Questions revised, compiled & distributed to class

Tools

- Writing Multiple Choice Questions: The Basic Rules
- Sample question/answer explanation
- Tutorial: Writing a One-Best Answer MCQ
- Links to online tutorials

Anatomy of the one-best answer MCQ

1) Homer Simpson's middle name is Stem

a) Abraham

b) Barney

c) Bartholomew

d) Dan

e) Jay

Distractors

Correct answer or
keyed response

Answer
choices

Which of the following is true about pseudogout?

- A. It occurs frequently in women.*
- B. It is seldom associated with acute pain in a joint.*
- C. It may be associated with a finding of chondrocalcinosis.*
- D. It is clearly hereditary in most cases.*
- E. It responds well to treatment with allopurinol.*

Following a second episode of infection, what is the likelihood that a woman is infertile?

- A. Less than 20%*
- B. 20 to 30%*
- C. Greater than 50%*
- D. 90%*
- E. 75%*

Motivation

- Required component of course—worth 2.5% of grade
- All questions/answers compiled and sent out to class with authors listed

Team-Based Neurological Study Question Writing Assignment

Group 2

Agarwal, Rashmi
Emanuel, Roy L.
Khoong, Elaine C-F
Nguyen, Alexander T. A.
Verma, Vivek

- 1) Indicate correct answer and write answer explanation with 1-3 references for Question 1.
- 2) Create vignette-based Question 2 using topic provided below. Alternatively, you may use the same vignette as in Question 1. Indicate correct answer and write answer explanation with 1-3 references.

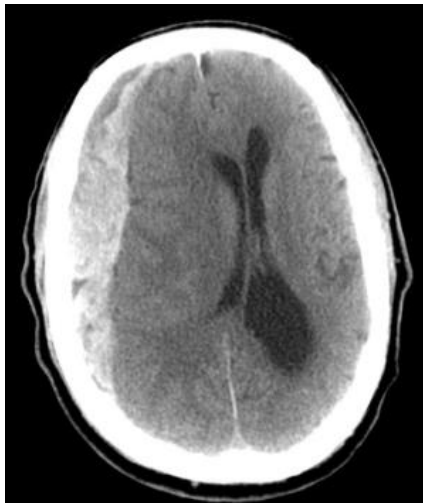
Question 1

A right-handed 55-year-old man complains of right hand weakness. His symptoms started 3 months ago with difficulty opening jars. Things have worsened, and now he can't button his shirt or tie his shoes. He denies numbness, tingling, or swallowing difficulties, but has had a 15-lb unintentional weight loss over the past 2 months. Examination reveals temporal wasting and bilateral atrophy of the thenar eminence. He has 3/5 strength on finger flexion and finger abduction in his right hand. Multifocal fasciculations are noted in the sternocleidomastoid muscle as well as in the right biceps and left quadriceps. Deep tendon reflexes are 3+ in the upper extremities and normal in the lower extremities. Plantar reflexes are extensor (upgoing toes) bilaterally. Which of the following tests will be most helpful in establishing the diagnosis?

- a) Anti-acetylcholine receptor binding antibody assay
- b) Electromyography and nerve conduction studies
- c) MRI of the brain
- d) MRI of the cervical spine
- e) Serum creatine phosphokinase (CPK) level

Question 2 topic: Insomnia classification

A 64-year-old man fell out of a first story window while dreaming that he is escaping from a crashing plane. He presents to the ER the next day complaining of worsening headache and vomiting that began several hours prior to presentation. Head CT is shown in the adjacent figure. Which of these structures was most likely damaged during the fall?



- a. Anterior communicating artery
- b. Lenticulostriate artery
- c. Middle meningeal artery
- d. Cerebral bridging vein
- e. Superior sagittal sinus

Authors:

Brittanie Broersma, Ravi Gottumukkala, Andrew Jallouk, Lauren Perlin, Michael Scott

Correct answer: D

The acute onset of headache and vomiting indicates a sudden increase in intracranial pressure due to the presence of a rapidly expanding intracranial lesion. While the history of trauma is consistent with a number of different types of hemorrhage that could cause these symptoms, the crescentic hyperdense pattern on CT is most characteristic of a subdural hematoma¹. Subdural hematomas are most often caused by damage to the cerebral bridging veins and are especially common in older patients due to cerebral atrophy which results in the formation of a space between the dura and arachnoid membranes². In contrast, the anterior communicating artery is a common site of aneurysms which lead to subarachnoid hemorrhage upon rupture. The lenticulostriate arteries are small arteries which supply blood to deep structures of the brain and are often involved in hypertensive intracerebral hemorrhage³. Laceration to either the middle meningeal artery or the superior sagittal sinus would result in an epidural hematoma, although the middle meningeal artery is the most frequently involved in this condition.

What they liked

- Fun and interesting
- Encouraged in-depth attention to several topics
- Learned a lot about test writing
- Having study aid for upcoming exam

What they didn't like/what didn't work: Yrs 1-2

Complaint	How it was	Change for 2012-13
Not enough topics	2 per group	6-7 per group
Too many people doing same task	Entire group of 5-6 working on 2 questions	Each student writes independent question
Enforced class meeting	Req. 1-hour session: mini-lecture and team work	Eliminated; electronic materials substituted
Too close to exam	Last wk of course so most topics already covered	Spread out over across entire course block

Problem	How it was	Change for 2012-13
Reliance on coursemaster rather than peers	Coursemaster served as reviewer/editor	Peer reviewers; eliminated req. for coursemaster review

Student Generated Exam Questions v2

- Google Docs based
- Each team given warm up question and 6-7 topics
- Each student writes independent MCQ
- Each student comments on other 4-5 teammates' Q's;
No mandatory coursemaster review
- Final product published on class Google Docs page
- Start on day 1, provide recommended timeline
- No mandatory team mtg; tools provided electronically
- Attestation of effort
- Worth 2.5%; chance at 1-2% bonus for team

Google Docs based

The screenshot shows a Google Docs interface. The document title is "Group 06 MCQ.docx". The main text area contains a multiple-choice question (MCQ) about a 24-year-old bicyclist who suffered a head injury. The question asks for the most likely irreversible secondary injury that led to death, given that the patient recovered consciousness and was alert for a few minutes before becoming comatose again. The options are: A) Injury to left FEF, B) Uncal Herniation, C) Cerebellar Tonsillar Herniation, and D) Duret Hemorrhage. The correct answer is D. A detailed explanation follows, discussing the pathophysiology of an epidural hematoma and how it leads to Duret hemorrhages. A comment thread on the right side of the document includes comments from Naomi Jiang, Ravi Chacko, and chris.wichterman, discussing the timing and reliability of the patient's recovery of consciousness.

1) A 24-year-old bicyclist, who was not wearing a helmet, collided with a motor vehicle and suffered a blow to the right side of his head and immediately became unconscious. He later recovered consciousness and was alert for a few minutes before becoming comatose again. Upon examination you find a mydriatic pupil unresponsive to light on the ipsilateral side. An emergency craniotomy is performed, yet the patient never recovers and is pronounced dead. What is the most likely irreversible secondary injury that led to his death? (The patient recovers 2 weeks later with the right eye stuck in the lateral position. What is the event that caused the eye injury?)

A) Injury to left FEF (Maybe change this answer to Traumatic Subarachnoid Hemorrhage)
B) Uncal Herniation
C) Cerebellar Tonsillar Herniation
D) Duret Hemorrhage

Correct Answer: D

This patient has undergone an epidural hematoma, which is almost always traumatic and likely due to injury of the middle meningeal artery. A lucid interval may occur after an epidural hematoma during which the expansion of brain tissue is compensated for. When tissue expansion can no longer be compensated by intracranial volume shift, the patient loses consciousness. As the bleed continues to displace the brain, the uncus of the temporal lobe is displaced over the free edge of the tentorium. This compresses the 3rd nerve and leads to pupillary dilatation. Uncal herniation can lead to the shearing off of some pontine branches of the basilar artery. This leads to duret hemorrhages that can occur throughout the midbrain and pons, and which are irreversible and almost always fatal.

Although uncal herniation (B) likely resulted in duret hemorrhage for this patient, it does not reliably cause duret hemorrhage and itself is not the direct cause of death, especially when an emergency craniotomy is performed, so (D) is the best answer. Given the location of the injury, it is unlikely to be cerebellar tonsillar herniation (C), which occurs at the foramen magnum and would not affect pupillary dilation. Injury to a frontal eye field (A) does not usually present with a sudden loss of consciousness and a lucid interval. Injury to the left FEF (A) would affect both eyes.

Naomi Jiang
10:39 PM Jan 28
Although it won't change the answer, it might be helpful to clarify the timeframe for when he first recovered consciousness (ex. was it a few hours or days after the initial injury?).

Ravi Chacko
11:09 PM Jan 28
Its referring to a lucid interval, it can last minutes or hours. In a real situation you probably won't know the exact time course when the pt shows up in the ER, unless there is a witness report, which probably won't be reliable anyway.

Anonymous
9:36 PM Jan 30
Duret hemorrhages are almost always fatal, so it may be better not to have the patient survive after 2 weeks. An alternative ending is suggested in red.

chris.wichterman
11:39 PM Jan 31
Pehaps changed to "down and out" ?

Positive feedback

- From the course evaluation:
“Several students mentioned that while in the beginning they thought it would be, as one student put it, ‘an unnecessary hassle,’ in the end it turned out to be a great learning experience.”

What they didn't like/what didn't work: Year 3

Complaint	How it was	Change for 2013-14
Need to comment on Qs even when nothing left to add	Requirement: comment on 4 of 5 (or 5 of 6) questions	Primary/secondary reviewer paradigm—req. to comment on 2 Qs
Final document too long	93 pages (!) with 150 questions	400-word limit on each entry

Problem	How it was	Change for 2013-14
Procrastinators	Recommended time line	Hard deadlines
Mixed quality→ coursemaster reviewing 150 Qs	4-5 people commenting on each Q→passivity/ diffusion of responsibil.	1°/2° reviewer paradigm to ↑ accountability; add neuro resident mentors

Team-Based Exam Questions v3: 2013-14

- Google Docs based
- Each team given warm up question and 6-7 topics
- Each student writes independent MCQ/explanation
- Each student serves as 1° & 2° reviewer of teammate Q's
- Instructional materials all electronic/more guidance on critical review expectations
- Start on day 1 of course, provide hard deadlines
- Neurology residents serve as team mentors
- Institute word limits
- Simple peer/self-evaluation
- Increase to 5% of course grade; still chance at 1-2% bonus

Objectives for the current iteration

- Design study questions using knowledge gained through **independent learning**
- Enhance skills as a **peer educator** and **critical reviewer**
- Incorporate **formative feedback** and **self-assess** knowledge and performance
- Contribute to an educational exercise for use by the class
- [Possibly] analyze patterns/recognize technical item flaws to **improve test-taking skills**

Warm Up: Group Question

1. **As a group**, review/research assigned group multiple choice question, determine answer, and write answer explanation that discusses why the correct answer is correct and incorrect answers are incorrect.
 - a. Be concise—in most cases a single paragraph should suffice.
 - b. Include 1-3 references to support your answer explanation (may be portion of syllabus, journal article, or textbook).

Group 1 question

A 24-year-old man comes to the office because of a 4-year history of headaches with nausea and photophobia. His headaches occur approximately once a month, and he has had to leave work on several occasions because of incomplete relief with over-the-counter medications. His headaches usually improve with sleep. He has no significant past medical history. Blood pressure is 110/80 mm Hg, and pulse rate is 64/min. Neurologic examination is normal. Which of the following medications would be most appropriate for this patient?

- a) Amitriptyline
- b) Propranolol
- c) Sumatriptan
- d) Topiramate
- e) Verapamil

Individual Question

2. Next, each team member will **independently** create his or her own vignette-based multiple choice question with answer explanation as in #1 above from the list of topics provided to the team and upload to your team's Google Docs page for review by other team members.
 - a. Each topic may be used by only one student (there will be one topic left over).
 - b. All questions should be answerable based on course content rather than requiring outside knowledge, i.e., they should be appropriate as DNS exam questions.
 - c. **At least 1 of your group's questions should include a figure, e.g., pathology, imaging, exam finding.**

Group 1: Individual question topics:

Hydrocephalus

Neuromuscular junction disorder

Secondary stroke prevention

Complex partial seizures

Psychogenic unresponsiveness

Aseptic meningitis

Parkinson's disease—clinical manifestations

Critical review

3. Each student will **critically review the content and clarity** of his/her teammates' questions/answer explanations on Google Docs.
- a. Each student will be assigned as primary reviewer for one teammate's question and secondary reviewer for another, like in this example:

Student	Primary reviewer for	Secondary reviewer for
Kapalka, Kristen	Yedda	Zach
Li, Yedda	Zach	Shawgi
Meyer, Zach	Shawgi	Georgia
Silver, Shawgi	Georgia	Kristin
Wilke, Georgia	Kristin	Yedda

The **primary reviewer** is responsible for leading the discussion of the question and providing comments/critique as in (b) below. The primary reviewer will also need to ensure that the question-writer addresses all comments/critiques as necessary and that the revised question is acceptable to the group.

The **secondary reviewer** is responsible for providing comments/critique as in (b) below.

Other team members (Shawgi and Georgia in the example above) are welcome/encouraged to contribute to the review of Kristen's question as tertiary reviewers, especially if they think the primary and secondary reviewers missed something, but this is not a required step if they do not feel they have anything to add.

Critical review

- Content over style
- Ensure team questions are well written, accurate, and test important concepts rather than minutia
- Correct factual mistakes, improve clarity, cut out unnecessary or confusing information from vignette, offer alternative question structures, distractors, or image
- Check references provided or alternate sources to verify accuracy
- Not "Good job!"

Hard deadlines

Deadline	Task
Monday, January 13	Group question answered and answer explanation written.
Tuesday, January 21	Individual question and answer explanations written.
Tuesday, January 28	Primary and secondary reviewer feedback provided. (Feedback for other questions/answer explanations optional.)
Tuesday, February 4	Individual question/answer explanations revised/finalized. Final questions/answers uploaded to class Google Docs page. Peer/self-evaluation.

Anonymous peer & self evaluation

Team-Based Neurologic Study Question Writing Peer Evaluation

Please place a checkmark in one of the two columns next to the name of each student in your group, **including yourself**, signifying whether you believe that student should receive full credit or less than full credit for their contribution to this exercise. Full credit should be given if the student participated fully—made a good effort to write a decent question and answer explanation, provided constructive feedback as critical reviewer, and responded appropriately to feedback. If you select less than full credit for any student, a checkmark will still suffice—you do not need to suggest how much credit you think the student should receive; however you are encouraged to leave a comment as to why you thought that student should not receive full credit. I will investigate any “Less than full credit” responses by looking at the Google Docs contributions, talking to the Neurology resident or fellow mentor, etc. and make final grade determinations. All your responses will be collected anonymously.

Student Name:

Abraamyan, Torgom

Full Credit

Less Than Full Credit

Student Name:

Benjamin, Lawrence

Full Credit

Less Than Full Credit

Student Name:

Chen, Simon

Full Credit

Less Than Full Credit

Student Name:

Lalchandani, Gopal

Full Credit

Less Than Full Credit

Student Name:

Min, Jaspur

Full Credit

Less Than Full Credit

Student Name:

Xiao, Daphne

Full Credit

Less Than Full Credit

General Comments:

Questions for the audience

- Would you have addressed the challenges differently?
- One unaddressed challenge is the necessity for many students to write questions days or weeks prior to hearing about that topic in class—any ideas?

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"Let's try two apples a day and see how that goes."