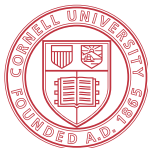# Writing Good Questions

Matthew Eichhorn

Cornell University

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Workshop Norms

- Everyone has something to contribute to the discussion.
  - ▶ Give everyone an equal opportunity to participate.
  - ▶ Be respectful of others' ideas.

- We are all here to learn.
  - ▶ Listen attentively to understand others' thoughts.
  - ▶ Acknowledge that no one here has all of the answers.

Is there anything else that we should add to this list?

Also, feel free to interrupt at any time with questions.

Why do we ask questions?

Why do we ask questions?

Questions are used as a tool of assessment.

Two types of assessment:

Formative: Student responses guide learning process

> *"... instructors elicit, interpret, and use evidence about student achievement to make decisions about the next steps in instruction with the goal of improving instruction and student learning." [Black & William, 2009]*

Summative: Evaluates student proficiency with regard to the learning outcomes.

Formative Assessments

Questions are used to help **inform** instruction.

Some examples of formative assessment:

- Reading "Quizzes"
- Polling Questions (clicker, letter cards)
- Misconception checking (spot the error)
- Post-lesson feedback (muddiest point, minute papers, exit tickets)

Do you have formative assessment strategies that you have found helpful in your classes?

Summative Assessments

What does a "good" exam question look like?

Activity (Part 1)

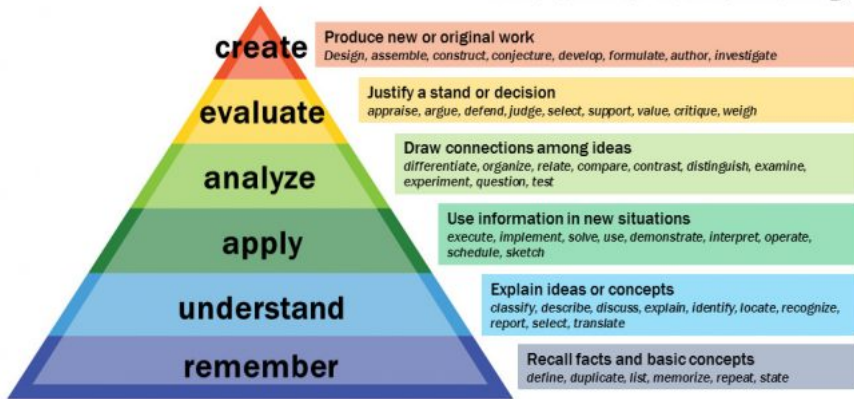**Let's write a "good question."**

- Get together in groups of 2-3. It may be helpful to pair up with people who are teaching similar courses.

- Decide on a topic that you would like to assess. Write an exam question that focuses on this topic and incorporates ideas from the previous slide.

- Later in the workshop, you'll swap questions with another group for the second part of the activity.

How can we describe the questions that we write?

Bloom's Taxonomy

The (revised) Bloom's Taxonomy breaks down learning into a hierarchy of cognitive processes.

Bloom's Taxonomy

create — **Produce new or original work**
Design, assemble, construct, conjecture, develop, formulate, author, investigate

evaluate — **Justify a stand or decision**
appraise, argue, defend, judge, select, support, value, critique, weigh

analyze — **Draw connections among ideas**
differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

apply — **Use information in new situations**
execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

understand — **Explain ideas or concepts**
classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

remember — **Recall facts and basic concepts**
define, duplicate, list, memorize, repeat, state

Vanderbilt University Center for Teaching

Types of Knowledge

Anderson et.al. (2001) introduce a second dimension for classifying questions, the knowledge dimension. They suggest that there are 4 types of knowledge:

- **Factual:** Having an acquaintance with terminology and specific facts of a discipline.
- **Conceptual:** Understanding the interrelationships among the basic elements within a theory.
- **Procedural:** Being able to appropriately apply subject-specific methods, techniques and algorithms.
- **Metacognitive:** The ability to reason about how one understands and reasons about the subject.

Categorizing a Question

We can visualize these dimensions with the following chart.

Cognitive Process Dimension

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual						
Procedural						
Metacognitive						

Such a chart can help ensure that the questions on an exam cover a broad spectrum of cognitive processes and assess student's attainment of various types of knowledge.

An Example

Consider the following linear algebra exam question:

> Let A be an $n \times n$ matrix. Here, you'll reason about the the relationship between eigenvectors of A and A^2.
>
> 1. Suppose that v is an eigenvector of A with eigenvalue λ. Argue that v is also an eigenvector of A^2. What is its associated eigenvalue?
>
> 2. Give an example of a matrix A and a vector v such that v is an eigenvector of A^2 but not A.

Where would you place this question in the chart?

Cognitive Process:

    Remember   Understand   Apply   Analyze   Evaluate   Create

Knowledge:

    Factual   Conceptual   Procedural   Metacognitive

Activity (Part 2)

Let's analyze a "good question."

- Swap questions with another nearby group.

- Read through the other group's question, and think about how you would solve it during an exam.

- Decide where you would place the question in the chart.

If you have time:

Think about how you could adjust the question to move it to different boxes in the chart.

Discussion Questions

- Which cognitive processes/types of knowledge are the easiest to incorporate into an exam? The hardest?

- Were there any rows/columns in the chart that you felt were not appropriate to include on your exam? Why?

- Do you think that filling out a diagram like this will be useful to you when writing exams in the future? Why or why not?

- Are there other strategies that you employ when writing questions for an exam?

References

- Abell, M.L., et.al., MAA Instructional Practices Guide: Project Leadership Team.. Mathematical Assn America, 2018.

- Black, P., Wiliam, D. Developing the theory of formative assessment. Educ Asse Eval Acc 21, 5 (2009). https://doi.org/10.1007/s11092-008-9068-5

- Anderson, L. W., & Krathwohl, D. R. (2001). A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives: Complete Edition. New York: Longman.

Credit also to Prairie Wentworth-Nice, who led a similar teaching seminar a couple years ago that served as inspiration for this workshop.

Bonus: Giving Good Examples

By nature, math courses are definition-heavy. Examples are how students digest these definitions. When writing examples:

- **Start simple:** The first examples should be very basic (trivial) and familiar to students.
- **Eliminate redundancy:** Each example should give students something new to think about, or highlight another aspect of the definition.
- **Include non-examples:** These are important to help delineate the "boundaries" of definitions.
- **Make connections:** Having running examples throughout the course can help students recall previous material and see how topics fit together.