Bringing your Exam Questions to Bloom:

Writing Effective Open-ended Questions to Test Higher-level Thinking

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Session Objectives

• List the benefits of open-ended exam questions in testing higher-level cognitive skills
• Categorize open-ended exam questions according to levels of Bloom’s taxonomy
• Write open-ended exam questions that test higher level cognitive skills
• Construct rubrics that incorporate cognitive skill level for grading open-ended exam questions
Open Ended Questions: Rationale

Well-designed open-ended questions:

• Allow assessment of analytical and critical thinking skills

• Offer students the opportunity to demonstrate application of knowledge with “real-life” problem solving skills using their own language

• Promote deep learning rather than surface level study habits
  – more likely to focus on broad issues, general concepts, and interrelationships
Bloom’s Taxonomy

- **Remember**
  - recall
  - define, duplicate, list, memorize, repeat, state

- **Understand**
  - explain ideas or concepts
  - classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

- **Apply**
  - use information in new situations
  - execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

- **Analyze**
  - draw connections among ideas
  - differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

- **Evaluate**
  - justify a stand or decision
  - appraise, argue, defend, judge, select, support, value, critique, weigh

- **Create**
  - produce new or original work
  - design, assemble, construct, conjecture, develop, formulate, author, investigate
How high do they bloom?

• Exercise: assign Bloom’s level to example questions
## Choose your verbs wisely...

<table>
<thead>
<tr>
<th>Level</th>
<th>Explanation</th>
<th>Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Remember</strong>*</td>
<td>Recognizing and recalling information, including terms, definitions; facts, principles, theories; methods and procedures</td>
<td>Define, List, State, Label, Name, Describe</td>
</tr>
<tr>
<td><strong>Understand</strong>*</td>
<td>Understanding the meaning of information, including restating (in own words); translating from one form to another; or interpreting, explaining, and summarizing.</td>
<td>Restate, Paraphrase, Explain, Summarize, Interpret, Illustrate</td>
</tr>
<tr>
<td><strong>Apply</strong></td>
<td>Applying general rules, methods, or principles to a new situation, including classifying something as a specific example of a general principle or using a formula to solve a problem.</td>
<td>Apply, Demonstrate, Use, Compute, Solve, Predict</td>
</tr>
<tr>
<td><strong>Analyze</strong></td>
<td>Identifying the organization and patterns within a system by identifying its component parts and the relationships among the components.</td>
<td>Compare, Contrast, Categorize, Distinguish</td>
</tr>
<tr>
<td><strong>Evaluate</strong></td>
<td>Using evidence and reasoned argument to judge how well a proposal would accomplish a particular purpose; resolving controversies or differences of opinion.</td>
<td>Judge, Appraise, Recommend, Justify, Defend, Criticize, Evaluate</td>
</tr>
<tr>
<td><strong>Create</strong></td>
<td>Discovering/creating new connections, generalizations, patterns, or perspectives; combining ideas to form a new whole.</td>
<td>Develop, Create, Propose, Formulate, Design, Invent</td>
</tr>
</tbody>
</table>
The meaning of words matters most

A patient with heart failure is started on lasix, and subsequently develops hypokalemia

- **Explain** the side effects of lasix
  = List (*recall*)

- **Explain** why this patient develops hypokalemia
  = Apply your knowledge of the side effects of lasix to this patient (*apply*)
The meaning of words

A patient develops oliguria, with elevated urea and creatinine

• **Compare and contrast** pre-renal with intrinsic renal disease
  = vague, asks for recall of all you remember about both

• **Compare and contrast** how you would treat this patient if the oliguria was due to pre-renal vs intrinsic renal disease
  = Analyze the differences between the two causes as applied to this case
The meaning of words

A tennis player presents with progressive pain in the right shoulder, worse in the morning

• **Describe** the most likely diagnosis
• **List** the anatomical structures involved

• **RECALL?**

• **Categorize** the symptoms and **identify** the components - *analyze*
Application of knowledge

• To apply knowledge, need something to apply it to.... A situation, scenario, context

• In medical education, most commonly a vignette

• If you can answer the question without a vignette, it is most likely recall
OEQ’s: Potential Limitations

• Time intensive: permit only a limited sampling of content
  – *Pick content carefully (and BTW, all tests sample)*

• Can favor students with good writing skills
  – *But also promote writing skills*

• Students can go off on tangents or misunderstand the main point of the question
  – *Ensure question and expectations for answer are clear*

• Students can “guess” the application answer
  – *Ask students to explicitly state rationale*
Best Practices

• Link questions to course objectives
• Questions should be stated in simple, clear language and reflect the language that is used in course materials
• Keep questions free of nonfunctional material and extraneous clues
• Explicitly state expectations regarding length, detail of answer, etc
• Avoid separate questions that depend upon answers or skills required in previous questions
Getting started

• Select course objectives you want to test
• Write a vignette relevant to the objective(s) covered
• Create a question, and verify Blooms’ level for each item, should be “apply" or above
• Write a model answer
Check yourself

1. Bloom’s level – apply or above?
   *If you don’t need the vignette to answer the question, likely not application level*

2. Does the vignette contain important and relevant information for the question?
   *No extraneous information*

3. Does the model answer match the question?
   *Can you expect the student to provide this answer based on the question?*

4. Do the question and model answer match the objectives?
How well do they bloom?

• Review examples
Rating OEQ’s

• Rating Rubrics:
  – Holistic: to give an overall sense of student performance
  – Analytic: to detail where students perform well

• No rubric is perfect, and some subjectivity is inherent to grading OEQ’s
Holistic rubric

• Scores the answer as a whole:
  – Responses graded in terms of the accuracy, completeness, and relevance of the ideas expressed.

• Example: The answers demonstrates that student understanding is:

<table>
<thead>
<tr>
<th>Well developed</th>
<th>Adequate</th>
<th>Limited</th>
<th>Low to none</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 points</td>
<td>3 points</td>
<td>2 points</td>
<td>1 points</td>
</tr>
</tbody>
</table>
Analytic Rubric

• Scores the elements of an answer and gives discrete points for each element

<table>
<thead>
<tr>
<th>Answer contains xyz all correct</th>
<th>Answer contains xyz with minor error</th>
<th>Answer contains xyz with major error</th>
<th>Answer is missing several elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 points</td>
<td>3 points</td>
<td>2 points</td>
<td>1 points</td>
</tr>
</tbody>
</table>

• Risk: may lead to giving equal (or more) credit for recall vs application rather than favoring application
Elements of both a holistic and analytic rubric, which allows for specific feedback to students, but also provides faculty flexibility to decide what constitutes a good answer.

<table>
<thead>
<tr>
<th>Demonstrate ability to apply/evaluate/analyze/create with appropriate and complete content knowledge</th>
<th>Demonstrate ability to apply/evaluate/analyze/create but limited content knowledge or answer has errors/is incomplete</th>
<th>Demonstrate content knowledge only but does not apply/evaluate/analyze/create</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-5 points</td>
<td>4-3 points</td>
<td>2-1 points</td>
</tr>
<tr>
<td>Meets expectations</td>
<td>Borderline achievement of expectations</td>
<td>Does not meet expectations</td>
</tr>
</tbody>
</table>
Creating a rubric

• Create rubric when you write exam items, based on session objectives
• Rubric does not need to contain every possible answer, but provide an approximate guide
• Check that rubric matches question (and model answer)
• Use rubric to clarify and refine your initial question
Iterative process

- objectives
- vignette
- Rubric
- questions
- Model answer
Rate your bloomers

Does the rubric:

• Match the question?
• Match the model answer?
• Reward application over recall?
Questions?