A Blueprint on how to Maximize Assessment Information and Minimize Cheating in Online Multiple-choice Tests

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“We found that students performed 10-20% better but took about twice as long on non-proctored versus proctored exams.”

Daffin, et. al. (2018)
Bloom’s Taxonomy

CREATING
EVALUATING
ANALYZING
APPLYING
UNDERSTANDING
REMEMBERING


Question Categories

CREATIVE
EVALUATIVE
ANALYTICAL
APPLICATIVE
INTERPRETATIVE / INFERENTIAL
DEFINITIONAL / FACTUAL
Question Taxonomy

1. Definitional & Factual

Test a student’s ability to recognize and recollect knowledge, definitions and facts

Average Difficulty

Definitional & Factual

Textbook Excerpt:
“Other things being equal, when the price of a good rises, the quantity demanded of the good falls, and when the price falls, the quantity demanded rises”

Source:
Principles of Microeconomics, N. Gregory Mankiw, Eight edition (South-Western Cengage Learning).
Definitional & Factual (sample question)

The law of demand states that, other things being equal, when the price of a good

a. rises, the demand for the good falls.
b. rises, the quantity demanded of the good rises.
c. falls, the demand for the good rises.
d. falls, the quantity demanded of the good rises.

Question Taxonomy

2. Interpretative/Inferential

Test a student’s ability to determine the meaning of the facts and knowledge acquired

Average Difficulty  Higher Difficulty
Interpretative/Inferential (sample question)

Which of these statements best represents the law of demand?

a. When buyers’ tastes for a good decrease, they purchase less of the good.
b. When income levels decrease, buyers purchase less of most goods.
c. When the price of a good increases, buyers purchase less of the good.
d. When the number of buyers decreases, the price of the good increases.

Question Taxonomy

3. Applicative

Test the student’s ability to carry out or use in a specific situation the knowledge acquired

Average Difficulty  Higher Difficulty
Applicative (sample question)

Please identify which of the following statements best demonstrates the application of the law of demand:

a. Maria received an increase in salary and started buying more beers at $5 per bottle than she did before her salary increase.

b. Giovanna started buying fewer bagels at $1 per bagel after the cream cheese that she spreads on her bagels became cheaper.

c. Sandra buys more bagels at $3 per bagel than at $1 per bagel, other things equal.

d. Pamela buys less cupcakes at $5 per cupcake than at $2 per cupcake, other things equal.

Question Taxonomy

4. Analytical

Test the student’s ability to examine, with methodology and in detail, the structure of the information acquired. The student may need to use spreadsheets, formulas, diagrams or any other analytical tools.

Average Difficulty  Higher Difficulty
Analytical (sample question)

Please refer to the following demand schedule for one pint of ice-cream.

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity Demanded</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5</td>
<td>125</td>
</tr>
<tr>
<td>$15</td>
<td>Q2</td>
</tr>
</tbody>
</table>

If the law of demand applies, then Q2 could be:

- a. 75.
- b. 125.
- c. 200.
- d. 350.

Question Taxonomy

5. Evaluative

The student will need to check critically information to form her own judgment

Higher Difficulty
Question Taxonomy

6. Creative

*Not specifically used.*

*Other assignments and activities focused on this taxonomy level.*

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**Equity**

Each student receives a different exam but which is made up of the same number of the five taxonomy groups and the same number of average and higher difficulty questions.

<table>
<thead>
<tr>
<th>Creative</th>
<th>Free-response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluative</strong></td>
<td></td>
</tr>
<tr>
<td>Analytical (Average)</td>
<td>5 questions</td>
</tr>
<tr>
<td>Analytical (Higher)</td>
<td>4 questions</td>
</tr>
<tr>
<td><strong>Applicative</strong></td>
<td></td>
</tr>
<tr>
<td>Applicative (Average)</td>
<td>7 questions</td>
</tr>
<tr>
<td>Applicative (Higher)</td>
<td>6 questions</td>
</tr>
<tr>
<td><strong>Interpretative/Inferential</strong></td>
<td></td>
</tr>
<tr>
<td>Interpretative/Inferential (Average)</td>
<td>7 questions</td>
</tr>
<tr>
<td>Interpretative/Inferential (Higher)</td>
<td>6 questions</td>
</tr>
<tr>
<td><strong>Definitional</strong></td>
<td></td>
</tr>
<tr>
<td>Definitional</td>
<td>5 questions</td>
</tr>
</tbody>
</table>
How Many Combinations?

• With just one group (e.g. Definitional), 5 random questions from a pool of 20 yields 15,504 possible exams.

• With all seven groups (5 of 20 questions each), there are \((15,504)^7\) possible combinations.
Challenges of Online Test Integrity (v. F2F)

• Open *everything*... book, notes, internet, etc.

• Contract cheating... paying for someone else to take the exam

• Sharing test info or *collaborating* during exam

Standard Mitigation Strategies

1. Set a *reasonable* time limit
2. Limit the window of *opportunity*
3. **Randomize** the order of questions
4. Randomly select *equal* questions from larger *pools*
5. Randomize order of *answers* (more difficult)
Dept. of Education Requirements

1. You must confirm the **identity** of the test taker

2. The online exam must be similar in rigor and ability to **assess** student learning as a face-to-face exam

Advanced Mitigation Strategies (3rd Party)

1. Use a **locked-down** or captured test environment (i.e. special web browser or software)

2. Use **webcam** proctoring (either “live proctor” or “record & review”)

3. Use **biometric** user verification (face, hand, typing patterns, etc.)
Webcam Video Sample

- Thumbnails
- Flags & Stats
- Photo ID
- Env. Scan

Image source: https://marnix.instructure.com/courses/2143784/pages/reviewing-exam-results?module_item_id=30320175

What is your opinion of webcam proctoring? (check all that apply)

- It is needed to ensure test integrity
- It is an invasion of privacy
- It is too difficult technologically
- It would be too time consuming to review
- It wouldn’t be effective in reducing cheating

Image source: https://marnix.instructure.com/courses/2143784/pages/reviewing-exam-results?module_item_id=30320175
Concerns Expressed by Students

• Privacy (webcam)
  • Live versus recorded
• Potential for malware
• Increased anxiety (due to constraints or technology)
• Must own a webcam
• Not permitted to use Chromebooks or tablets

Concerns Expressed by Faculty

• Time required to review student video
• Impact on teacher-student relationship (trust)
• Degree of effectiveness in eliminating cheating
Blueprint Solution

1. Promote clarity and transparency
2. Structure variety and size of taxonomy groups wisely
3. Time the exam appropriately
4. Make sure that the definition of cheating is not all-inclusive and unnecessarily comprehensive
5. Authenticate identity of a student who takes the test

1. Promote Clarity and Transparency
2. Structure the variety and size of taxonomy groups wisely

3. Time the exam appropriately
4. Make sure that the definition of cheating is not all-inclusive and not unnecessarily comprehensive.

5. Authenticate the identity of a student who takes the test.
Questions?

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