Below are the PDF slides from the presentation given at the CSAAPT meeting at William & Mary on October 10, 2026. Time ran out, so the last few pages weren't covered during the talk. (Also, an error pointed out during the session has been corrected.)

Thanks to everyone who came to my talk and showed interest in this idea. I've been using this method for more than two decades, and most of the feedback I've received from students has been positive. It would be great if you could adopt this idea, too, instead of using traditional multiple-choice methods, which have done a lot of harm to children's minds since they were invented.

If you have any comments or questions, feel free to drop me a line at ay9a@virginia.edu

Yoshida

Grading Multiple-Choice Questions via Partial Elimination

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A method for multiple-choice questions is presented that—by focusing on the elimination of wrong choices—considers varying levels of student (mis)understanding, offers partial credit, and allows for simple, automated grading, just like a conventional method

Disclaimer

Free-response questions are always better in assessing students than any **multiple-choice questions**, *if there is time to grade them well*.

	Conventional Multiple-Choice Questions	**Free-Response Questions**	**Multiple-Choice Method Presented Here**
Pros	• Quick grading	• Partial credit for partial knowledge • Accurate Assessment	• Quick grading • Partial credit for partial knowledge • Better Assessment
Cons	• All-or-Nothing • Luck-dependent • Easy Questions Only	• Time-consuming grading	• Initial getting used to

Rules for Answering and Grading

❖ There are 6 Choices: 5 of them wrong, and only 1 of them correct

❖ Your task is to eliminate wrong choices by crossing (✕) them out

- For each correct elimination you get **1 point**
- If you avoid eliminating the correct choice you get additional **5 points**

Corollaries:

- Full mark is **10 points**: eliminate all 5 wrong choices and leave the correct one intact
- Lowest possible mark is **0 point**: eliminate only the correct choice and leave all 5 wrong ones intact
- If you don't eliminate anything at all, you still get **5 points**
- Depending on how you eliminate the choices, the outcome can be any of the **whole number between 0 and 10**

Recommendation (or Warning) to the students

"Eliminating choices based on your educated guesses may be probabilistically advantageous, but random guesses are to be avoided: It is better to leave a wrong choice (losing 1 point) than to eliminate a correct choice (losing 5 points)."

"Do Not Gamble."

Multiple Choice Question – “Elimination Method”

Example: What is the power source of an electric shaver?

1. electricity → 5
2. steam → 1
3. natural gas → 1
4. gasoline → 1
5. nuclear fusion → 1
6. spinach → 1

} 10 points (full)

Multiple Choice Question – “Elimination Method”

Example: What is the power source of an electric shaver?

1. electricity → 5
2. steam
3. natural gas
4. ~~gasoline~~ → 1
5. nuclear fusion
6. ~~spinach~~ → 1

} 7 points (out of 10)

Multiple Choice Question – "Elimination Method"

Example: What is the power source of an electric shaver?

Suppose you know the answer is 1 or 2

1. electricity → 5
2. steam
3. natural gas → 1
4. gasoline → 1
5. nuclear fusion → 1
6. spinach → 1

If you leave them both

9 points (out of 10)



Multiple Choice Question – “Elimination Method”

Example: What is the power source of an electric shaver?

Suppose you know the answer is 1 or 2

1. electricity → 5
2. steam → 1
3. natural gas → 1
4. gasoline → 1
5. nuclear fusion → 1
6. spinach → 1

10 points (out of 10)

If you gamble Case 1: win!



1 point gain

Multiple Choice Question – "Elimination Method"

Example: What is the power source of an electric shaver?

Suppose you know the answer is 1 or 2

1. electricity → 5
2. steam
3. natural gas → 1
4. gasoline → 1
5. nuclear fusion → 1
6. spinach → 1

If you gamble Case 2: lose!

Multiple Choice Question – "Elimination Method"

Example: What is the power source of an electric shaver?

Suppose you know the answer is 1 or 2

1. electricity
2. steam
3. natural gas → 1
4. gasoline → 1
5. nuclear fusion → 1
6. spinach → 1

4 points (out of 10)

If you gamble Case 2: lose!



5 points loss

Lesson: Do Not Gamble!

Examples:

- Incorrect choices exhibit various types of misunderstanding.
- Even if you are not sure of the correct answer, you can pick up some points using your physical intuition/common sense.

35. An apple is dropped (i.e. with zero initial speed) from a certain height. When the apple is half-way to the ground (as in the picture) the speed is v_1. What is the speed when the apple hits the ground? Assume there is no air resistance.

(a) $\frac{1}{2}v_1$ ← cannot slow down

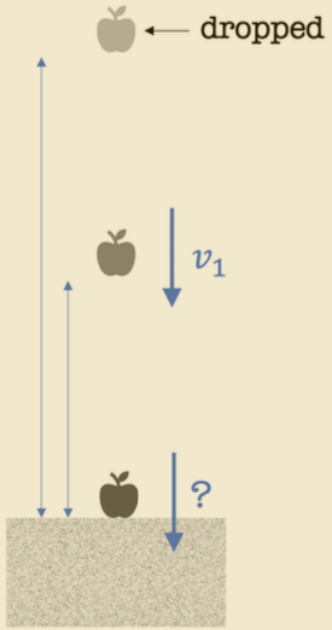
(b) v_1 ← cannot be constant speed

(c) $\sqrt{2}\,v_1$ ← correct answer

(d) $2v_1$

(e) $4v_1$

(f) ${v_1}^2$ ← wrong dimension



Examples:

- Incorrect choices exhibit various types of misunderstanding.
- Even if you are not sure of the correct answer, you can pick up some points using your physical intuition/common sense.

11. Compare the two situations:
(i) A sound source is at rest, and you are running towards the source with speed v.
(ii) You are at rest, and the sound source is approaching toward you with speed v.

Assuming that the original frequency of the sound emitted from the source is the same in (i) and (ii), which of the following correctly describes the sound you hear?

(a) You hear a higher pitch in (i) and a lower pitch in (ii)

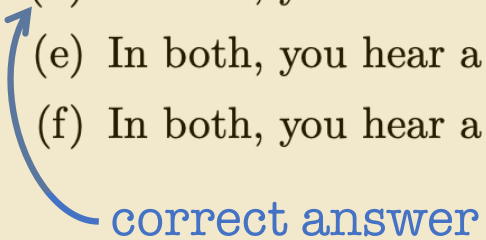
(b) You hear a lower pitch in (i) and a higher pitch in (ii)

(c) In both, you hear a higher pitch than the original, but you hear higher pitch in (i) than (ii).

(d) In both, you hear a higher pitch than the original, but you hear higher pitch in (ii) than (i).

(e) In both, you hear a lower pitch than the original, but you hear lower pitch in (i) than (ii).

(f) In both, you hear a lower pitch than the original, but you hear lower pitch in (ii) than (i).



Examples:
- Incorrect choices exhibit various types of misunderstanding.
- Even if you are not sure of the correct answer, you can pick up some points using your physical intuition/common sense.

14. There is a hole on the wall of a cylindrical water tank and the water leaks out horizontally. The tank is open to the atmosphere at the top and is filled to h_1 deep. The hole is at h_2 from the bottom. Find the distance x at which the water falls on the ground. Assume no air resistance and the water is ideal. Assume further that the water level of the tank does not change substantially in the process.

(a) $\sqrt{{h_1}^2 + {h_2}^2}$

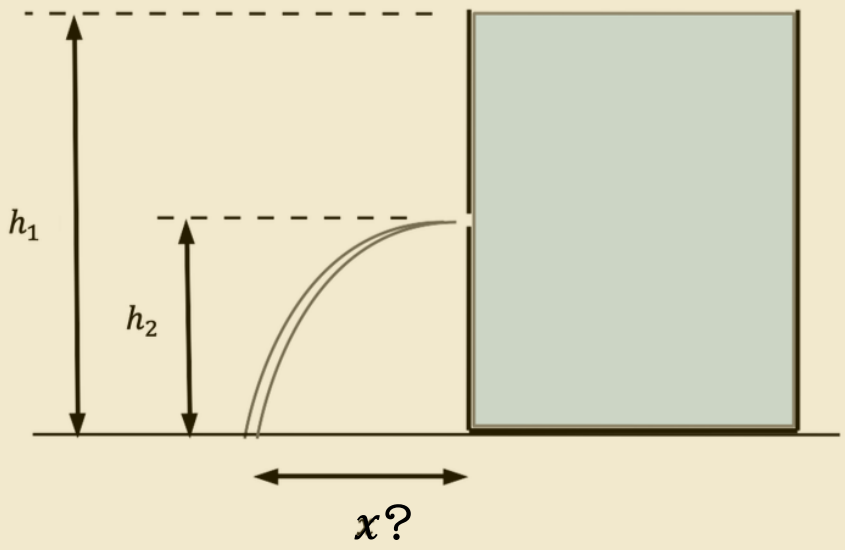
(b) $\sqrt{{h_1}^2 - {h_2}^2}$

(c) $2\sqrt{h_1(h_1 + h_2)}$

(d) $2\sqrt{h_2(h_1 + h_2)}$

(e) $2\sqrt{h_1(h_1 - h_2)}$

(f) $2\sqrt{h_2(h_1 - h_2)}$ ← correct answer



What if : (i) $h_2 = 0 \longrightarrow x = 0$

(ii) $h_2 = h_1 \longrightarrow x = 0$

Benefits to the Students:

- Hone the habit to distinguish true and false information.
- Build resilience to work on one's partial knowledge
- Clearly differentiate, "what you know" and "what you don't know"

  ⟶ "Know Thyself"

Cons of this method:

"Initial Getting Used-To" (Why? Such a logical rule!)

Gambling nature of students (which is fostered from primary school onward by the conventional multiple-choice questions) is hard to remove!

One way to make students aware of their gambling tendency:

→ "Estimate your score"

"If you know what you are doing, you know what score you will get the moment you turn in your quiz."

FAQ: Why is it worse to eliminate the correct answer (→ equal or less than 4 points) than to leave the question unanswered (zero knowledge → 5 points)?

Answer:

Knowing that one does not know is a piece of solid knowledge rooted in humility, meanwhile insisting a wrong fact as true is a hazard to self and possibly to the community as a whole, and it's a sign of hubris. The conventional mutliple-choice method does not distinguish humility from hubris, but this method does and naturally penalizes hubris more than humility!

```
def calculate_score(k: int, x: list[int]) -> int:

# Calculates the score based on target index k and a
list of 6 binary inputs x

# k: index for the correct choice (integer between 0 and 5)

# x: list of six numbers, x[0] to x[5] with values 0 (if the student
leave the choice) or 1 (if the student eliminate the choice)

 S = 5

# Generate y_i values

 y = [-5 if i == k else 1 for i in range(6)]

# y: list of six numbers, y[0] to y[5] with value 1 for five incorrect
choices or -5 for the correct choice

# Run the loop to calculate the final score
for i in range(6):
    S += x[i] * y[i]
return S
```

```
def calculate_score_fast(k: int, x: list[int]) -> int:

# k: index for the correct choice
(integer between 0 and 5)

# x: list of six numbers, x[0] to x[5] with values 0
(if the student leave the choice) or 1 (if the student
eliminate the choice)

return 5 + sum(x) - 6 * x[k]
```