

# Assessment: The silent killer of learning



Dudley Herschbach Teacher/Scientist Lecture  
Harvard University  
Cambridge, MA, 29 October 2013



# Assessment: The silent killer of learning



**@eric\_mazur**

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Cambridge, MA, 29 October 2013



**kosten**

1. die Kosten (*pl.*)
2. kostbar

455

**krank**

1. die Krankheit, —, —en

**COW**

377

**magnificent**  
**glor**

1. magnifice
2. master

430

**das Kind, —(e)s, —er**

1. kindisch
2. kindlich

**der Kellner, —s, —**

1. der Keller, —s, —

**kennen**

kannte-gekantt *irreg.*

1. kennen-lernen
2. erkennen
3. bekannt
4. der Bekannte (*adj.* as *n.*)

07

**outh**

verba

vet!

# kosten

1. die Kosten (*pl.*)
2. kostbar

# krank

die Krankheit, —, —en

# kennen

1. kannte-gekant
2. erkennen
3. bekannt
4. der Bekannte (*adj.*, as n.)



**35% retained  
after 1 week**

kosten

1. die Kosten (*pl.*)
2. kostbar

krank

die Krankheit, —, —en

455

pedantic

adj. ostentatious in one's learning

23 of 100

kennen

1. kannte-gekant
2. erkennen-lernen
3. bekannt
4. der Bekannte (*adj.*, as *n.*)

**we only guarantee  
they'll pass the test**





**5-minute university**





What are the following...  
1. ...  
2. ...  
3. ...  
4. ...

...  
...  
...  
...

...  
...  
...

...  
...  
...

...  
...  
...

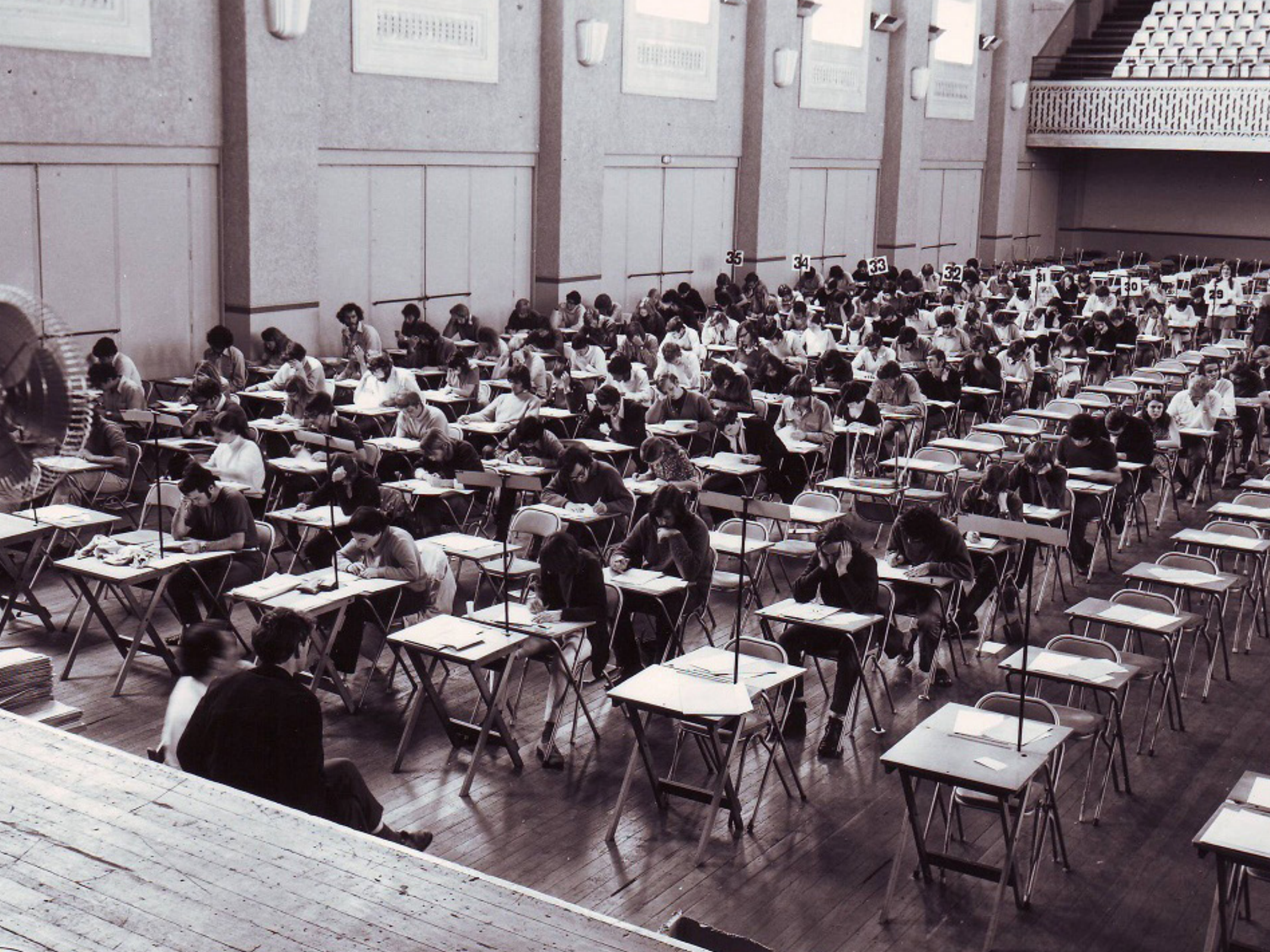
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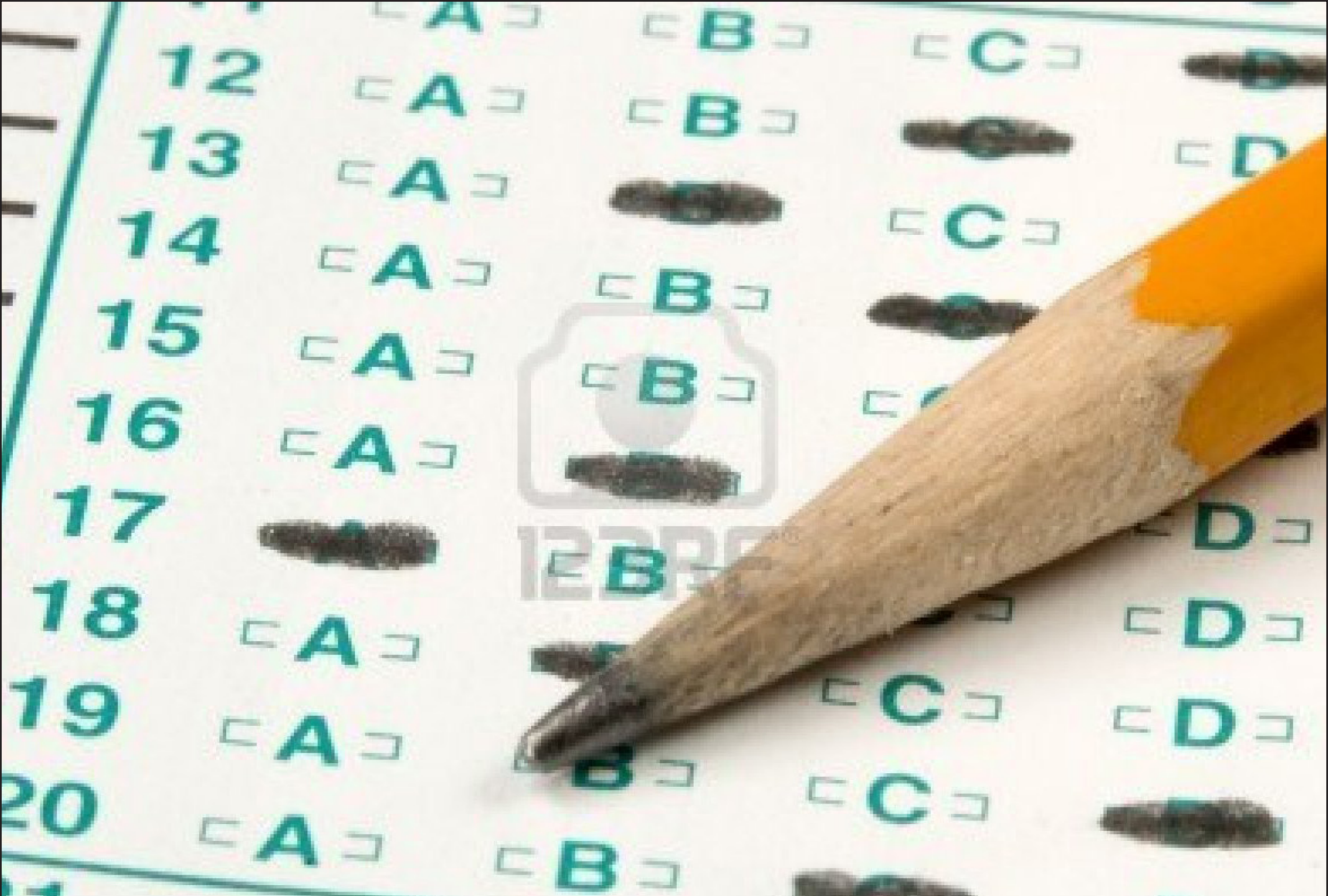




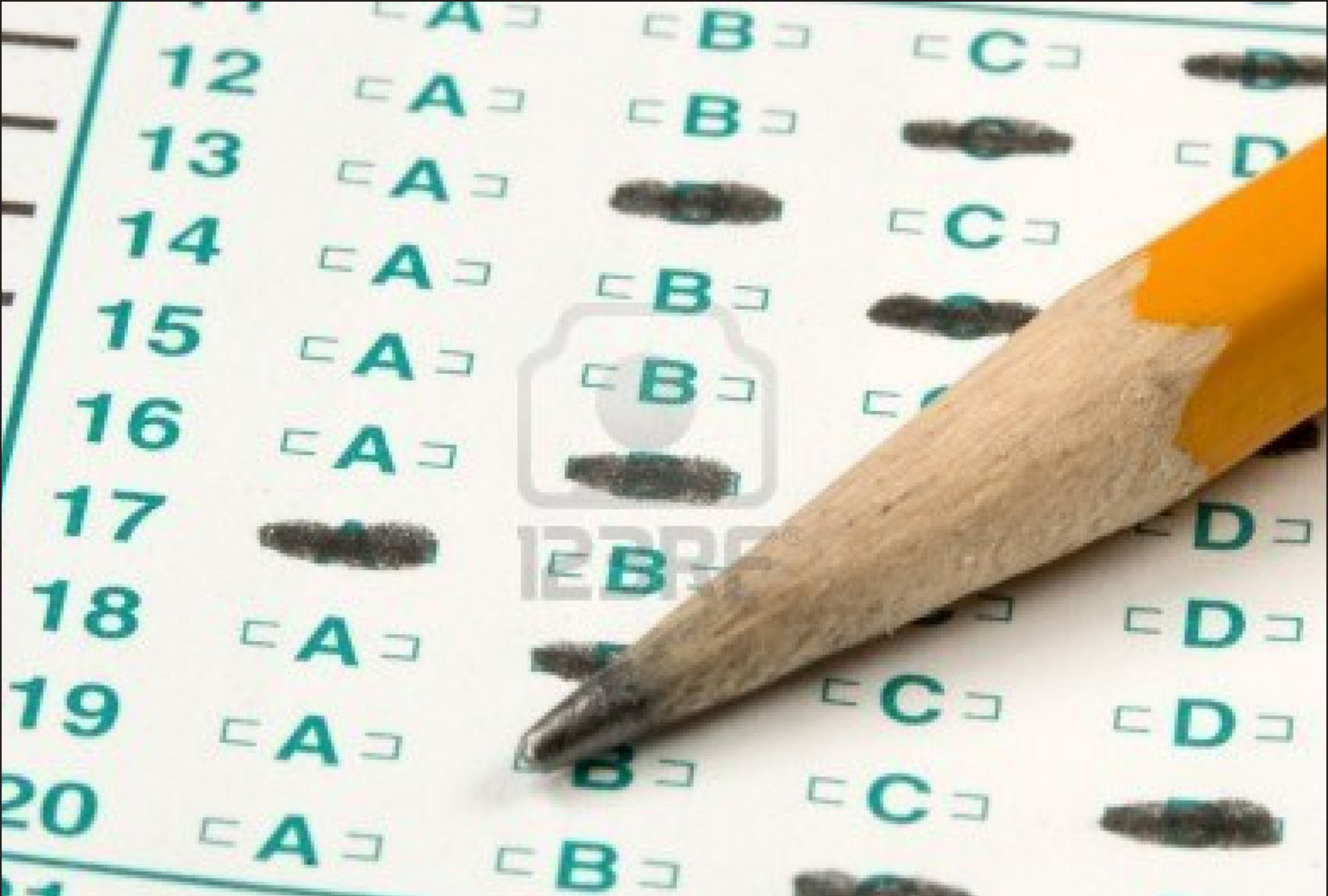




**assessment focussed on ranking and classifying,  
not on developing 21st century skills**



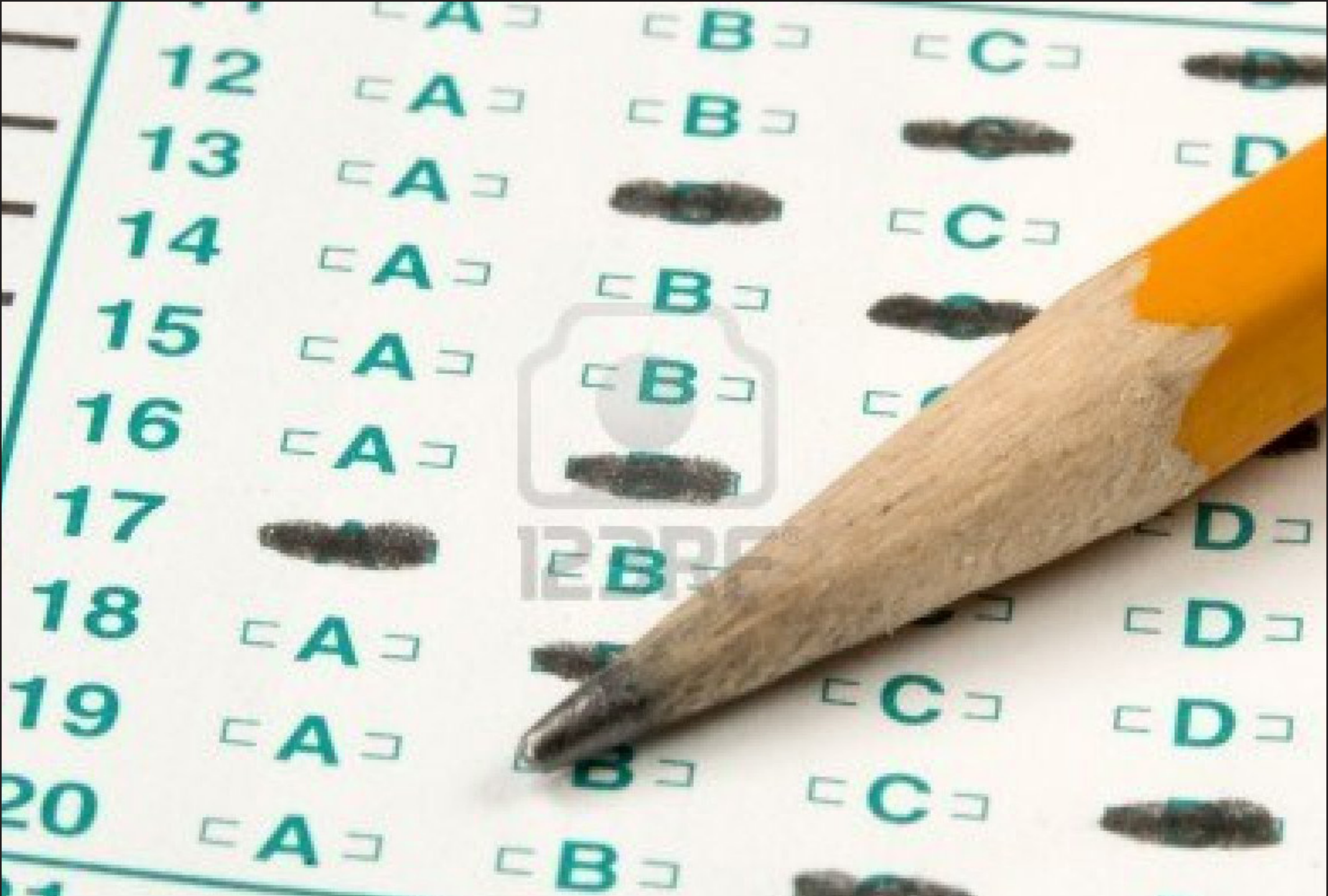
1 purposes



1 purposes

2 problems





1 purposes

2 problems

3 improvements

A pencil is pointing to a grid of assessment questions. The grid has rows numbered 12 to 20 and columns labeled A, B, C, and D. Each cell contains a question number and a letter in square brackets. The pencil is pointing to the cell containing '17 [B]'.

**how many different purposes  
of assessment you can think of?**

**1** purposes

- 1. rate students**
- 2. rate professor and course**
- 3. motivate students to keep up with work**
- 4. provide feedback on learning to students**
- 5. provide feedback to instructor**
- 6. provide instructional accountability**
- 7. improve teaching and learning**



1 purposes

2 problems

# inauthentic tests

EDUCACION

1 purposes

2 problems

**what is the meaning/definition of...?**

**EDUCACION**

**1** purposes

**2** problems

**inauthentic problem solving**

**EDUCACIÓN**

**1** purposes

**2** problems

**problem**

**1** purposes

**2** problems



**problem**

**outcome**

**EDUCACION**

**1** purposes

**2** problems

**problem**

**outcome**

**KNOWN**

**EDUCACION**

**1** purposes

**2** problems

problem



outcome

**KNOWN**

EDUCACION

1 purposes

2 problems

problem

solution

outcome

UNKNOWN

KNOWN

EDUCACION

1 purposes

2 problems

problem

solution

outcome

UNKNOWN

KNOWN

problem

1 purposes

2 problems

problem

solution

outcome

UNKNOWN

KNOWN

problem

procedure

KNOWN

1 purposes

2 problems

problem

solution

outcome

UNKNOWN

KNOWN

problem

procedure

answer

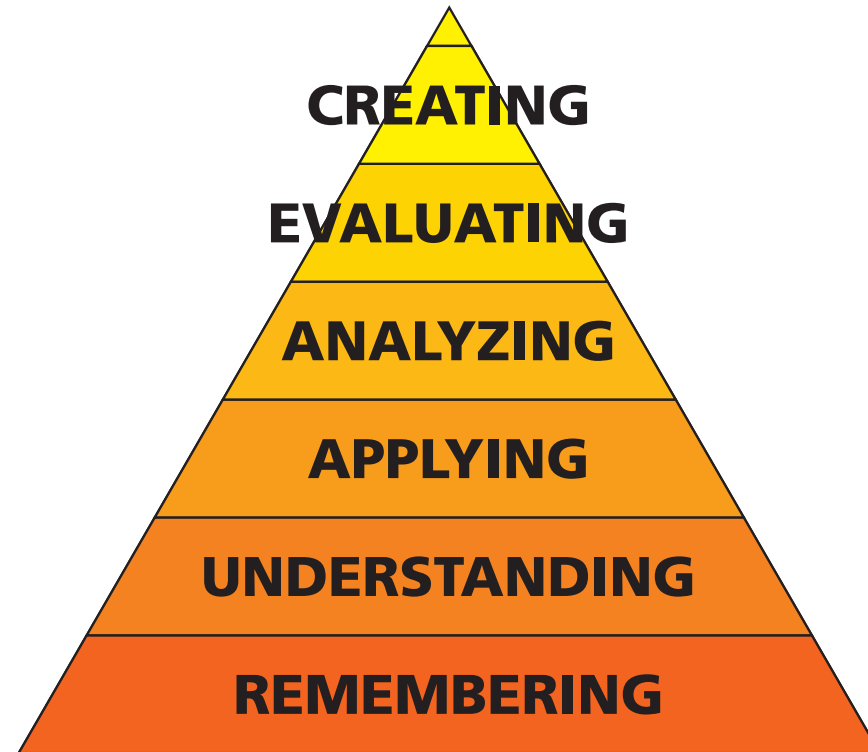
KNOWN

UNKNOWN

1 purposes

2 problems

# Thinking skills



1 purposes

2 problems



On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

1 purposes

2 problems

On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Requires:

Assumptions

Developing a model

Applying that model

On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

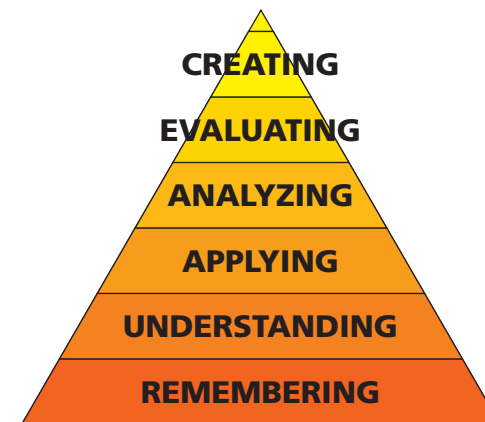
How long do you have to wait before someone frees up a space?

Requires:

Assumptions

Developing a model

Applying that model



On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. **On average people shop for 2 hours.**

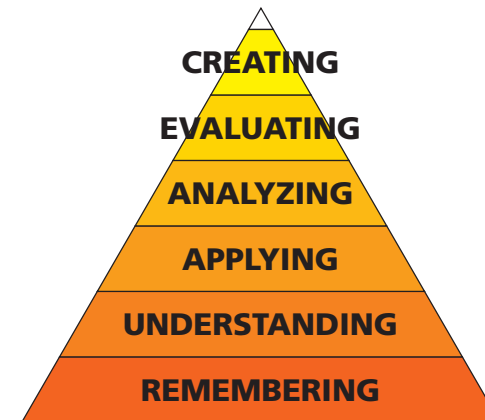
How long do you have to wait before someone frees up a space?

**Requires:**

Assumptions

**Developing a model**

**Applying that model**



On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. On average people shop for 2 hours.

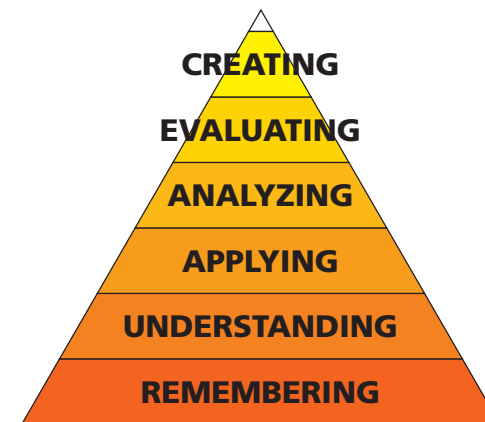
**Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?**

**Requires:**

Assumptions

Developing a model

Applying that model



On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. On average people shop for 2 hours.

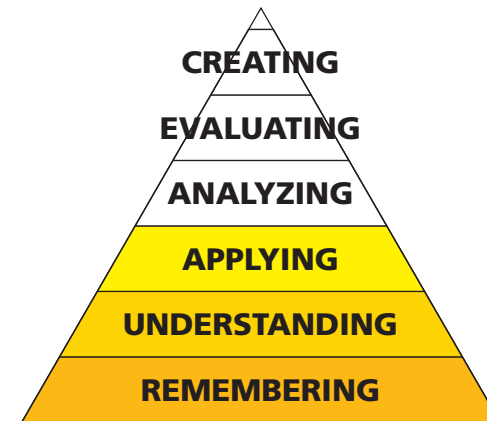
**Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?**

**Requires:**

Assumptions

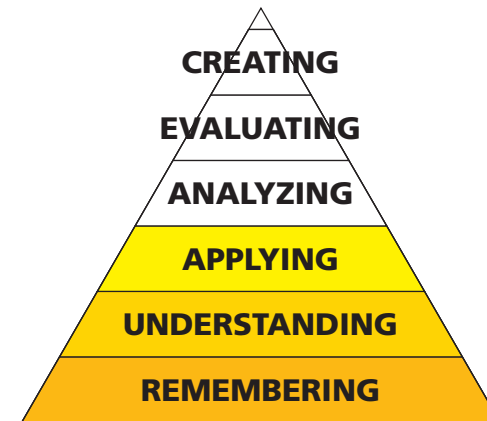
Developing a model

Applying that model



On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

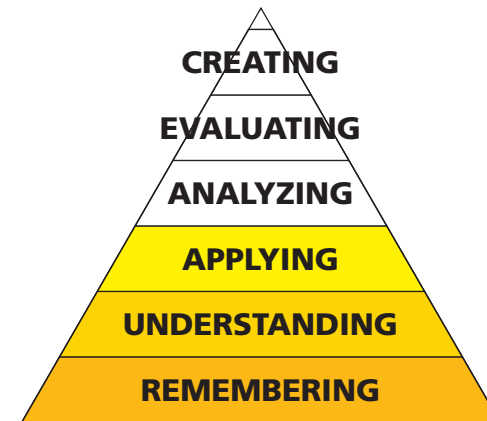




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How long do you have to wait before someone frees up a space?

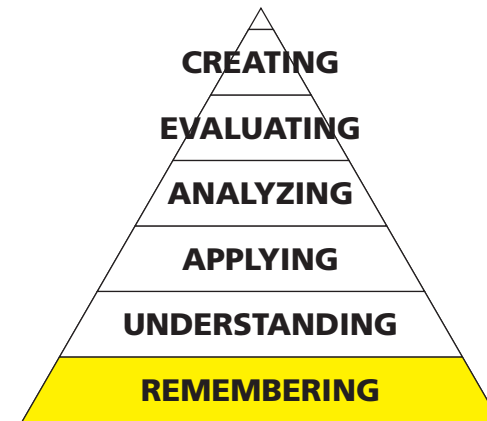
$$t_{wait} = \frac{T_{shop}}{N_{spaces}}$$

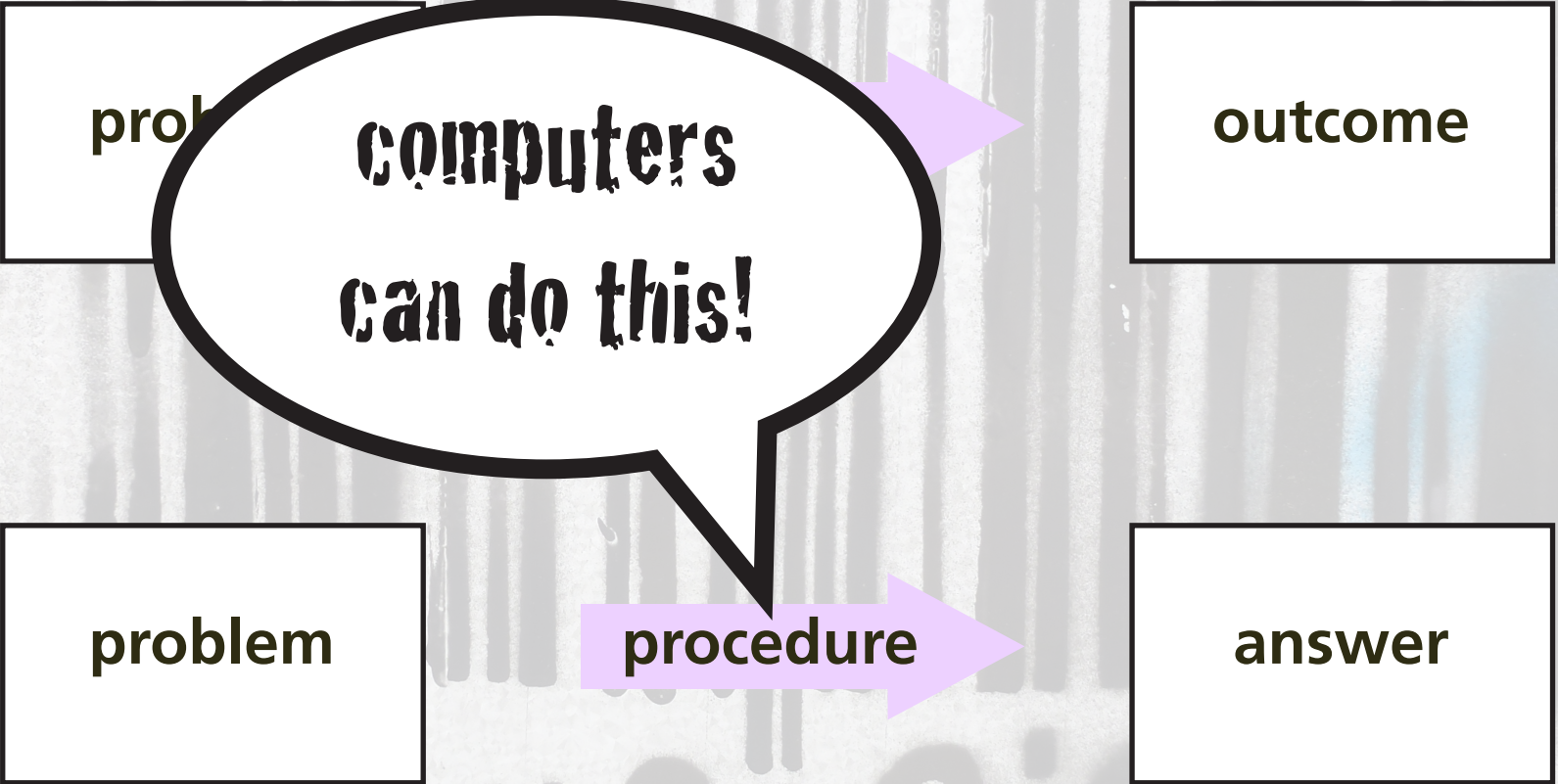


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How long do you have to wait before someone frees up a space?

$$t_{wait} = \frac{T_{shop}}{N_{spaces}}$$





**1** purposes

**2** problems



**1** purposes

**2** problems



**1** purposes

**2** problems

problem

solution

outcome

problem

pre... ver

**REAL**  
**problem solving**

1 purposes

2 problems

**problem**

**approach 1**

**approach 3**

**approach 2**

**outcome**

**1 purposes**

**2 problems**

**problem**

**approach 1**

**approach 3**

**approach 2**

**outcome**

**grading incompatible with real problem solving**

**1 purposes**

**2 problems**





1 purposes

2 problems



# isolation

1 purposes

2 problems

④ We will use spherical coordinates:

$0 \leq \rho \leq 4$ ,  $0 \leq \theta \leq 2\pi$ ,  $0 \leq \varphi \leq \pi$ . The integral is thus:

$$\int_{\rho=0}^4 \int_{\theta=0}^{2\pi} \int_{\varphi=0}^{\pi} (\rho \cos \varphi) (\rho^2 \sin \varphi) d\varphi d\theta d\rho$$

$$= \left\{ \int_{\rho=0}^4 \rho^3 d\rho \right\} \left\{ \int_{\theta=0}^{2\pi} d\theta \right\} \left\{ \int_{\varphi=0}^{\pi} \sin(2\varphi) d\varphi \right\} = \boxed{0}$$

Since the third integral equals 0.

⑤ Direction vectors for the plane are

$$(1) \quad (1) \quad (0) \quad (0) \quad (1) \quad (-1)$$

# high-stakes examinations promote cramming



**1** purposes

**2** problems

A person is sitting at a desk, writing in a notebook. A white mug is on the desk to the left. A clock is visible in the bottom left corner. The text "information stored in short-term memory" is overlaid in the center.

**information stored in short-term memory**

**1** purposes

**2** problems

**no retention**

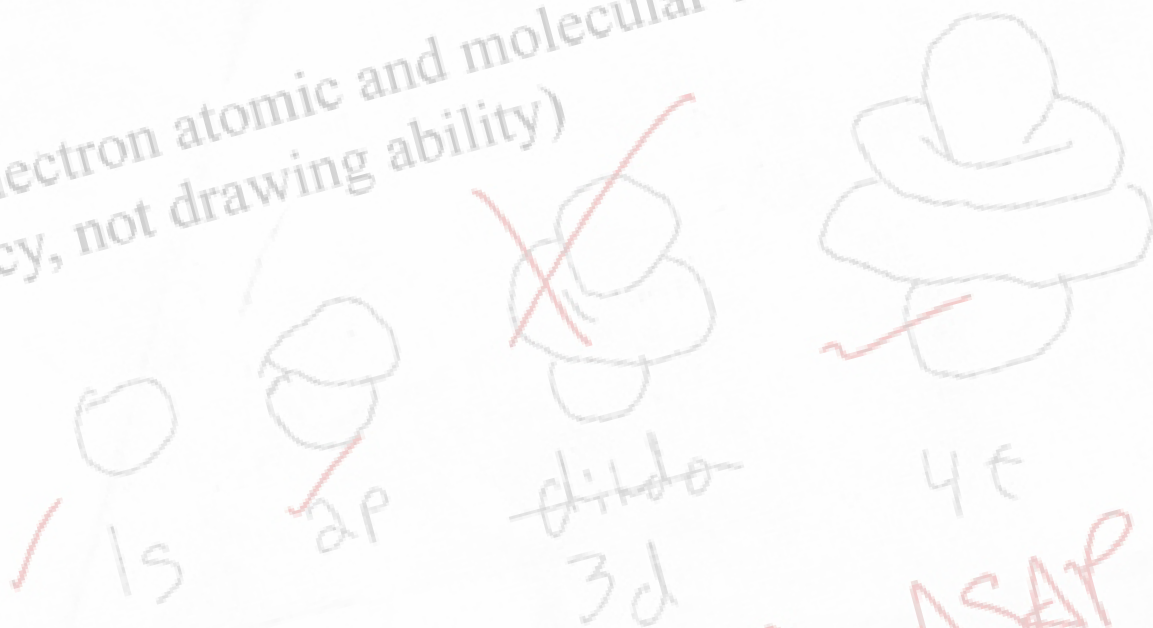
information stored in short-term memory

**no transfer**

**1** purposes

**2** problems

**grades: measure of standing relative to others**

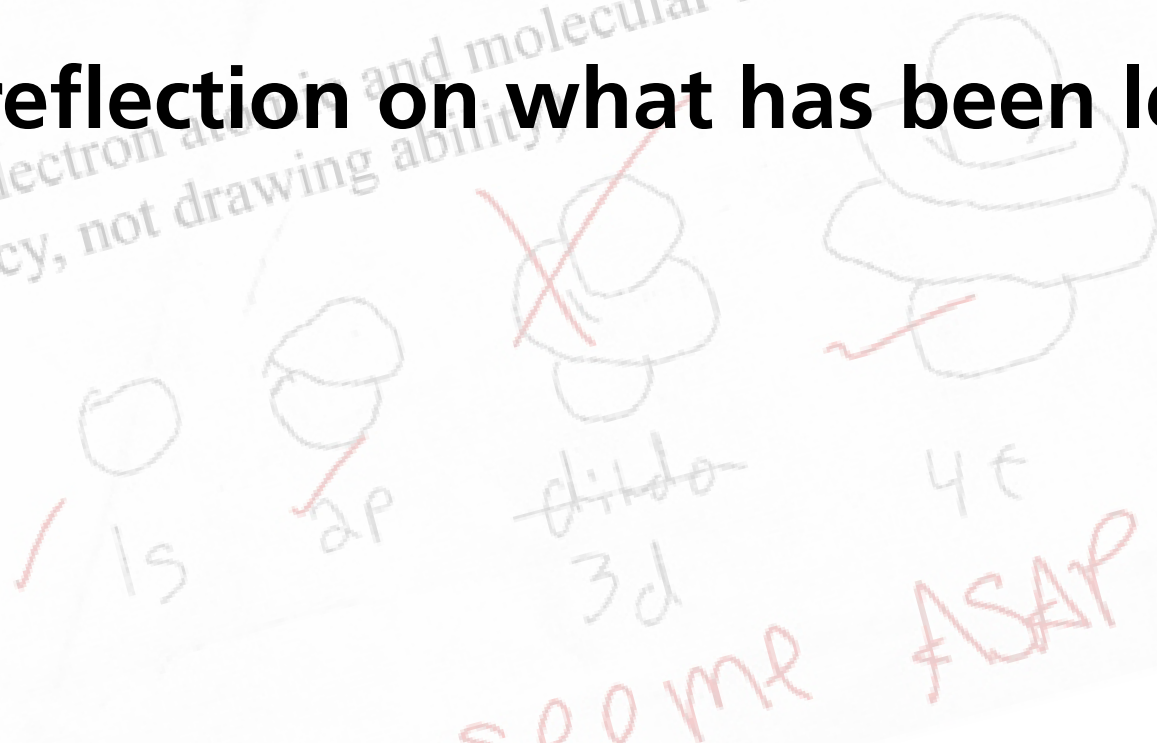


**1** purposes

**2** problems

**grades: measure of standing relative to others**

**feedback: reflection on what has been learnt**





# assessment produces a conflict

1 purposes

2 problems

assessment produces a conflict

coach or judge?

1 purposes

2 problems

conflict resolved by:

objectivity (fairness, reliability)

1 purposes

2 problems

... Makes me  
... in humanity

(also) makes me

List the three important concepts that the Law of conservation

Equilibrium (boring)  
Thermodynamics (boring)

Kinetics (bow-chicka-wow-wow)  
Describe the Law of definite composition (Dalton's Law):

A chemical compound always contains exactly the same proportion of elements by mass.

... but ...

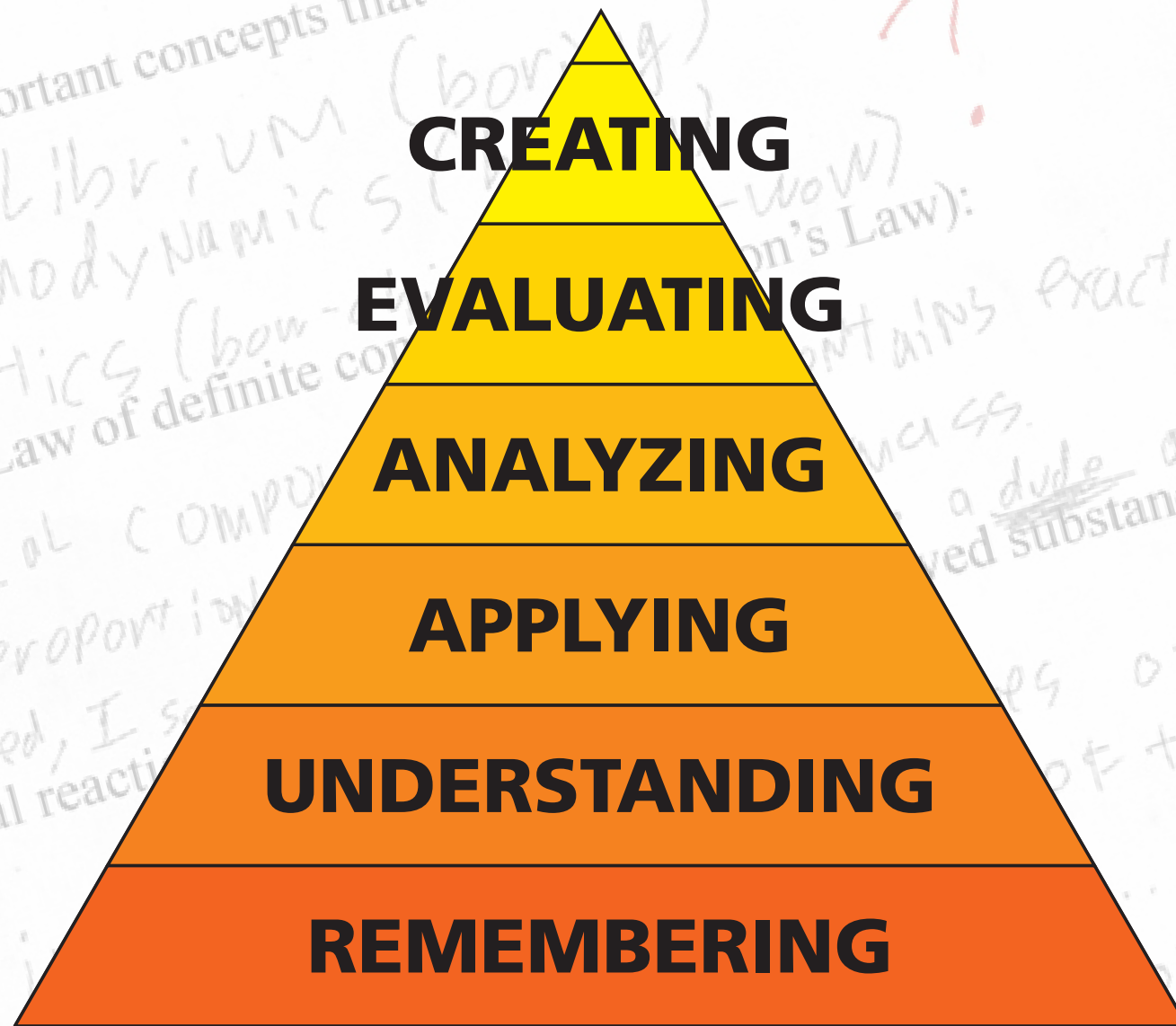
Unrelated, I saw my T.A., Jimmy, kissing a dude at a party last Friday.  
5 pts) A chemical reaction does one of two things to involved substances:

Increases or decreases the energy of the substance involved ... sometimes in the form of heat or light  
for orbitals 1s, 2p, 3d and 4f.

The chick in front of me is wearing a white ~~secret~~ state thing.

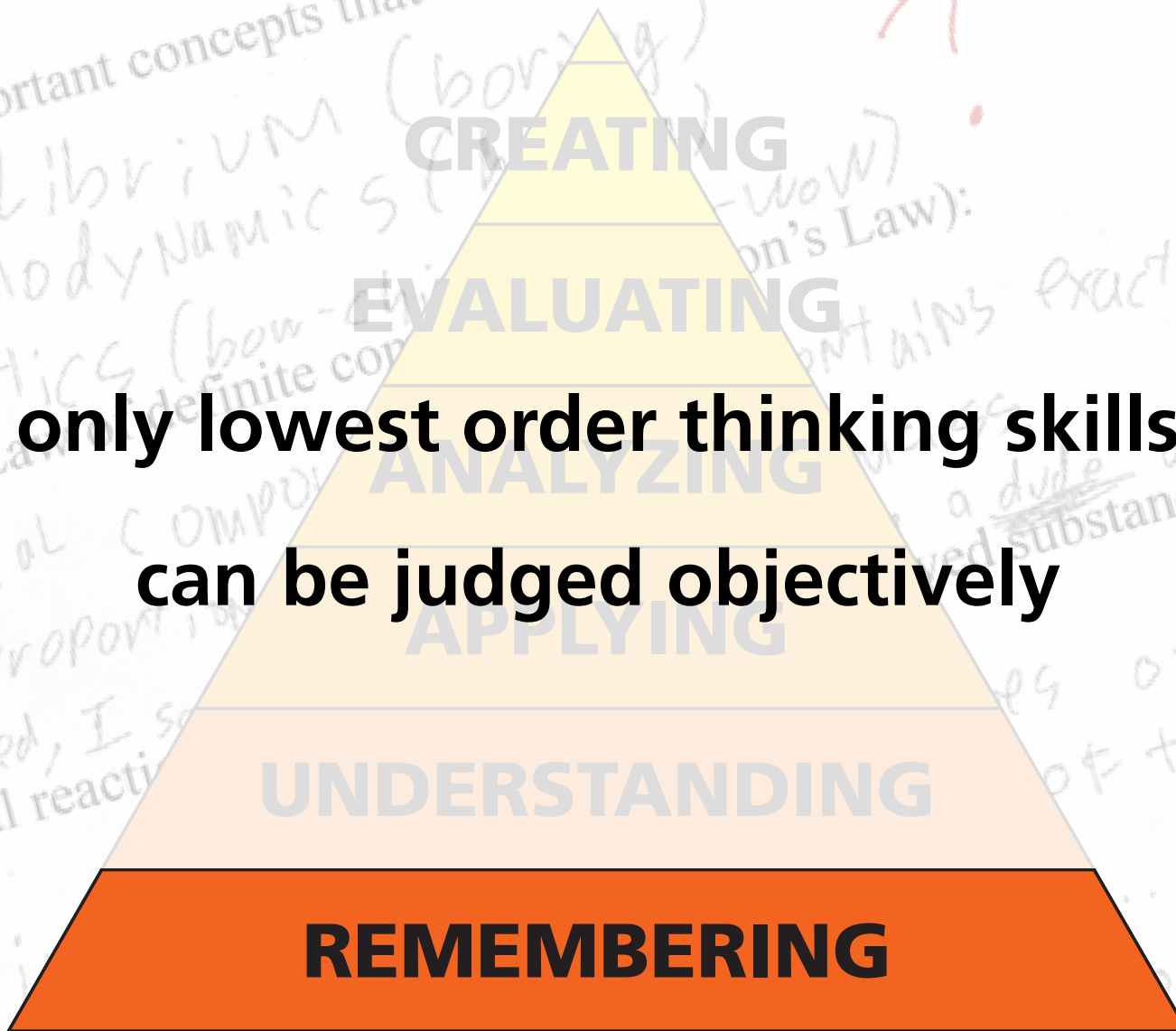
1 purposes

2 problems



**1** purposes

**2** problems



**1** purposes

**2** problems

and then there is...

- grade inflation
- cheating

1 purposes

2 problems



**1** purposes

**2** problems

**3** improvements





**1**

**mimic real life**

**1** purposes

**2** problems

**3** improvements



# open-book exam

**1** purposes

**2** problems

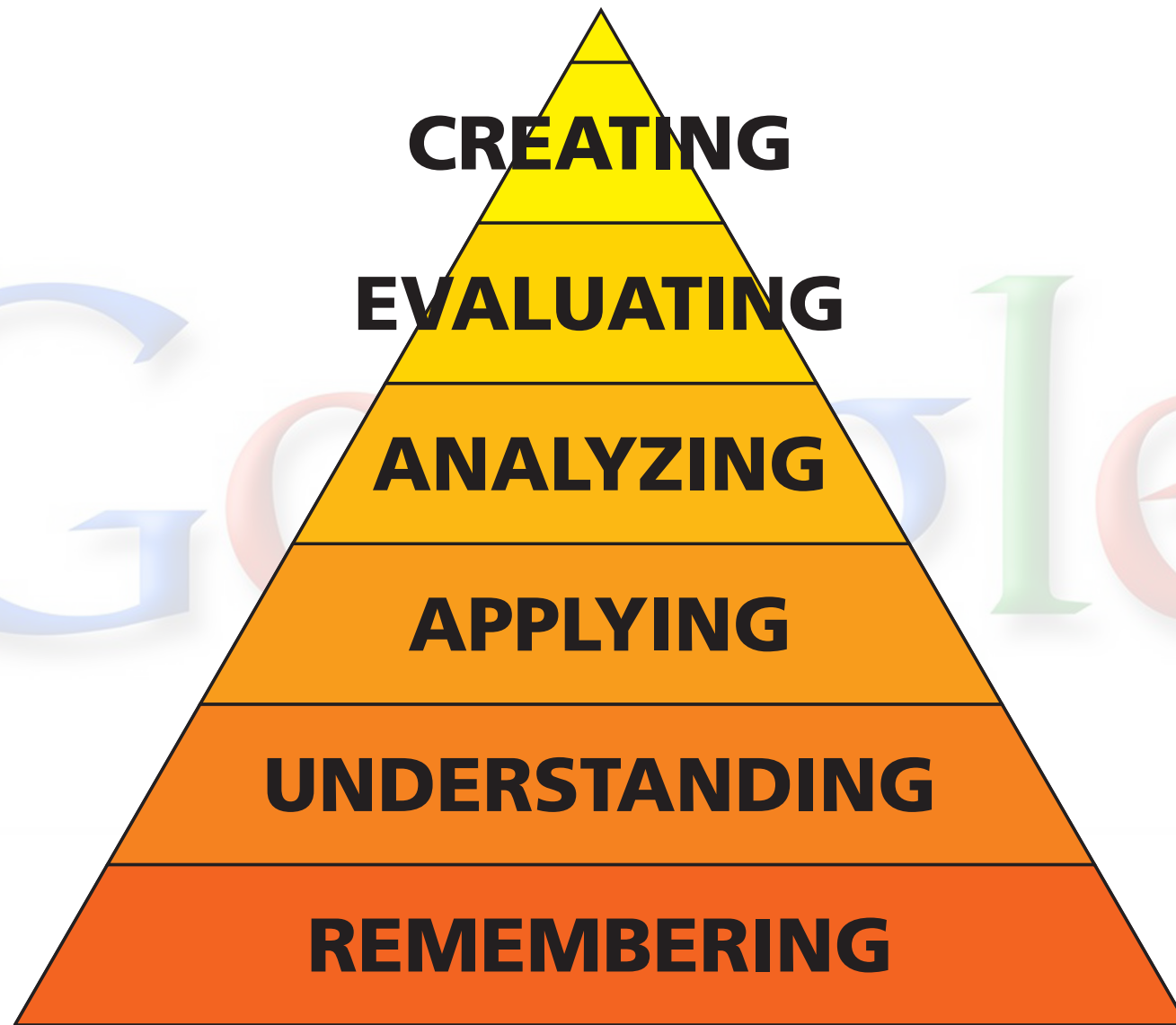
**3** improvements

Google™

1 purposes

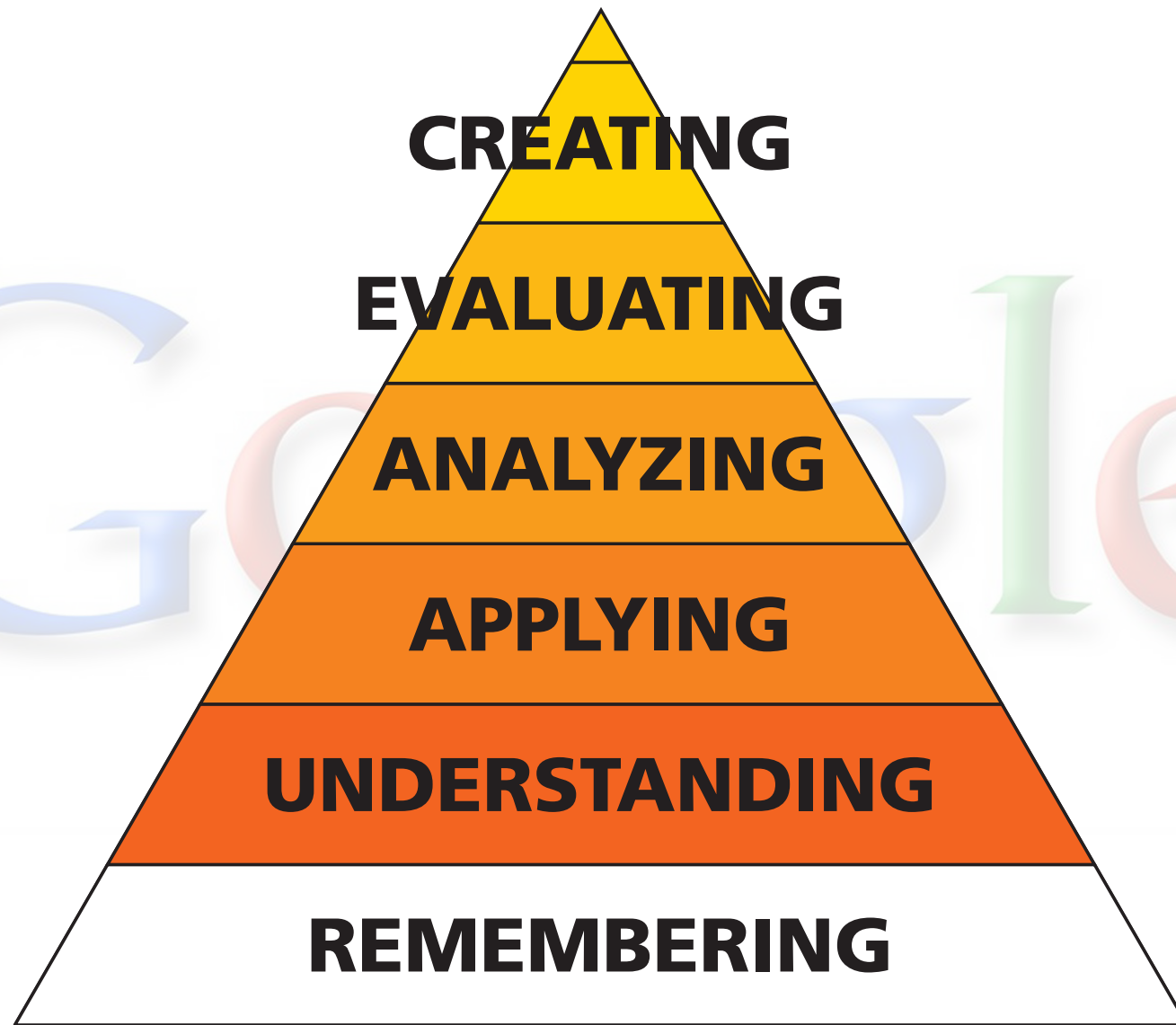
2 problems

3 improvements



1 purposes

2 problems



**1** purposes

**2** problems



**1** what

**2** how

# IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT)

Name Team # 3

Test # 1

Subject \_\_\_\_\_

Total 23

SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	Score
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>4</u>
2.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>2</u>
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<u>4</u>
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<u>1</u>
5.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>4</u>
6.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>4</u>
7.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>0</u>
8.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>4</u>
9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>    </u>
10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>    </u>

1 purposes

2 problems

3 improvements



**1** purposes

**2** problems

**3** improvements



## session 445949

This is the team round. If you respond to a question, it will count for your entire team (you, Brent Jones, Beth Sawyer, and team should respond to each question (otherwise it will count as multiple attempts).



Jump to ▾

1

2

[+ Show my team's responses](#)

6x-6  
Brian Lukoff

6x  
Brent Jones

6x-6  
Beth Sawyer

6x^2-6  
Kip Harmon

### expression question

What is the derivative of  $f(x) = 3x^2 - 6x$ ?

Submit response

For example, enter  $x^2$  for  $x^2$ ,  $\ln(y) - \sin(x)$  for  $\ln y - \sin x$ ,  $x/(y+1)$  for  $\frac{x}{y+1}$ ,  $(1/2)x$  for  $\frac{1}{2}x$ , etc.

0/2 questions attempted, 0/0 possible points so far in team round [Score details](#)

Current team: Blue team [Change team](#)

[Change seat](#)

[Send a message to the instructor](#)

[Join](#)

1 purposes

2 problems

3 improvements



**1** what

**2** how



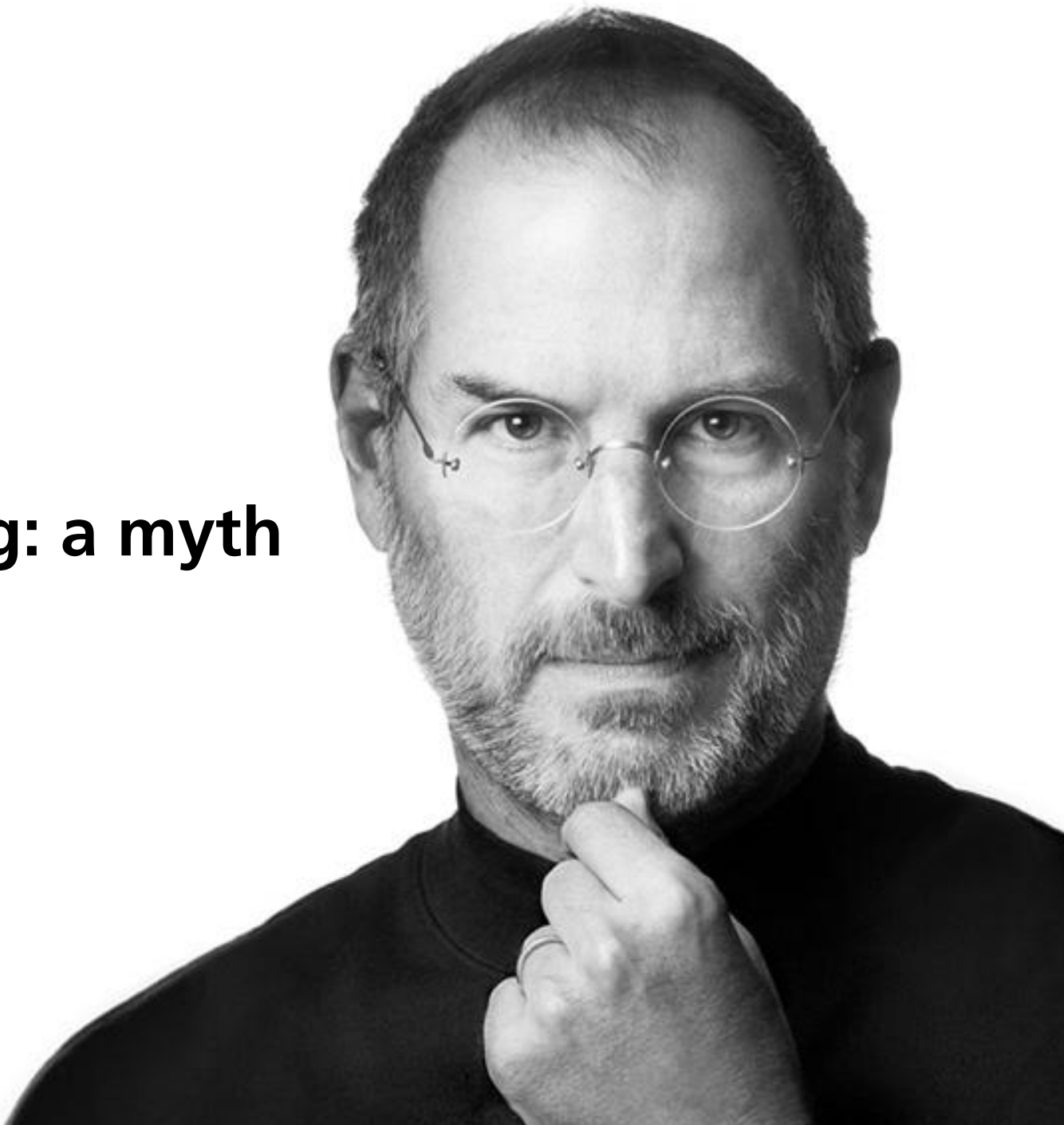
**focus on feedback, not ranking**

**1** purposes

**2** problems

**3** improvements

# objective ranking: a myth

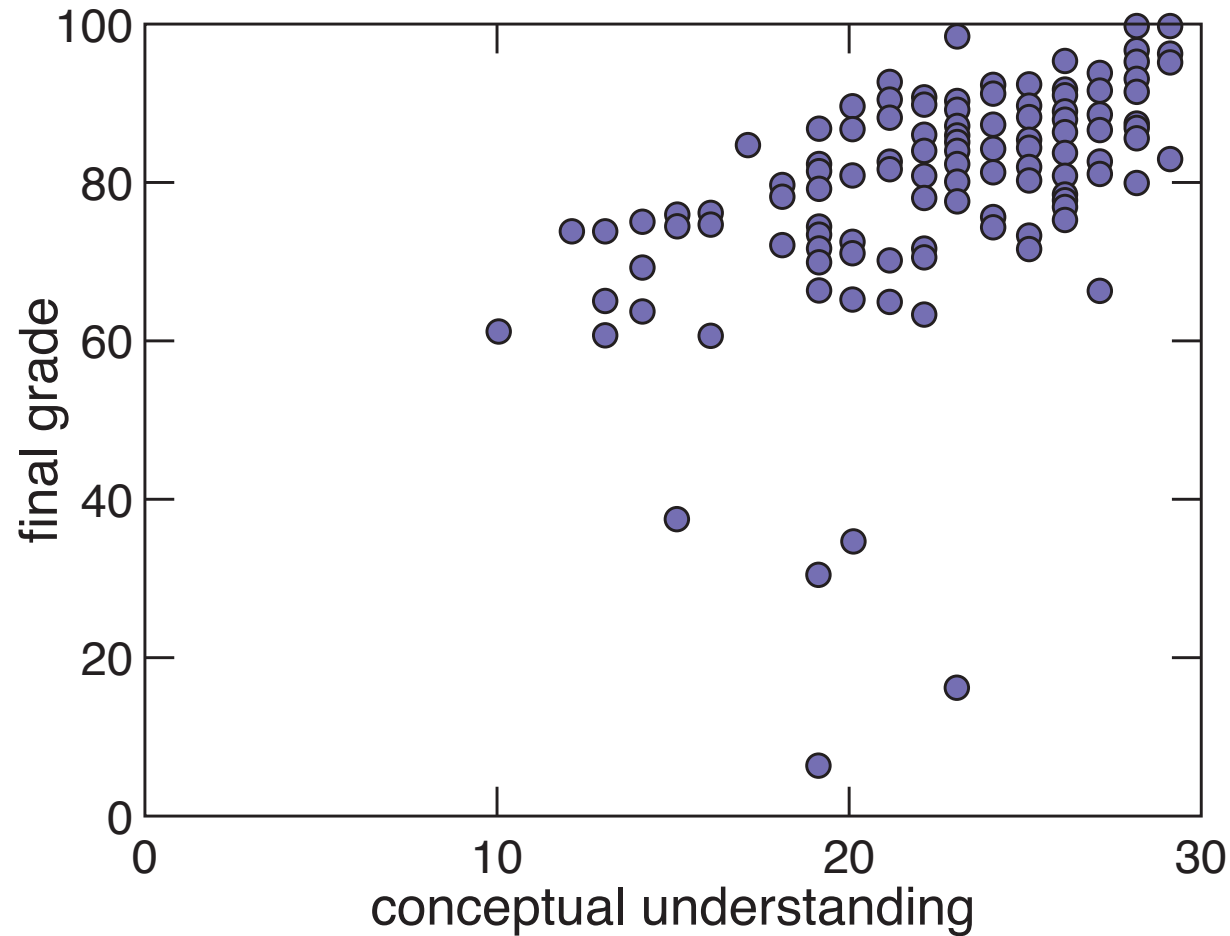


**1** purposes

**2** problems

**3** improvements

# 2 metrics, 2 results

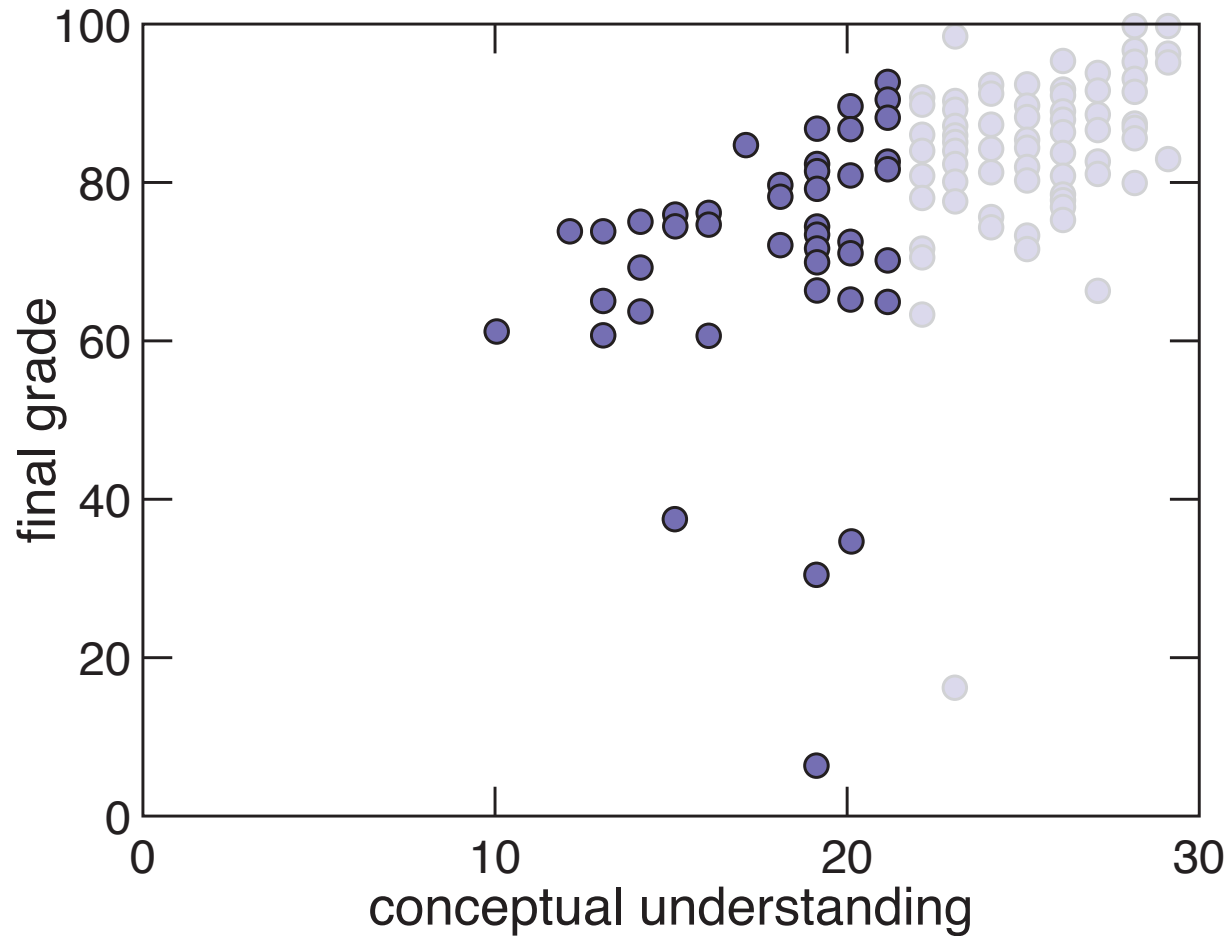


1 purposes

2 problems

3 improvements

# Aristotelian thinkers

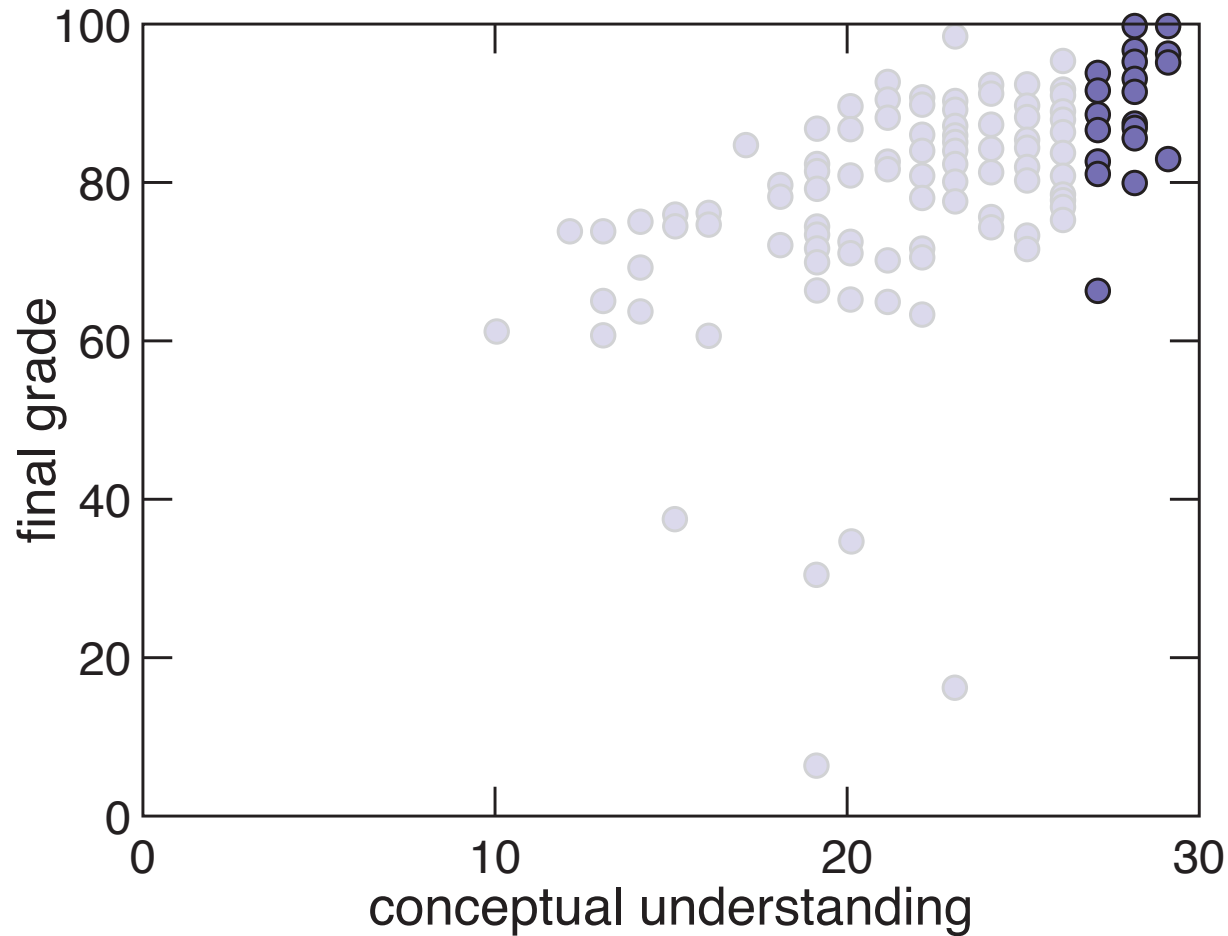


1 purposes

2 problems

3 improvements

# top performers, broad grade distribution

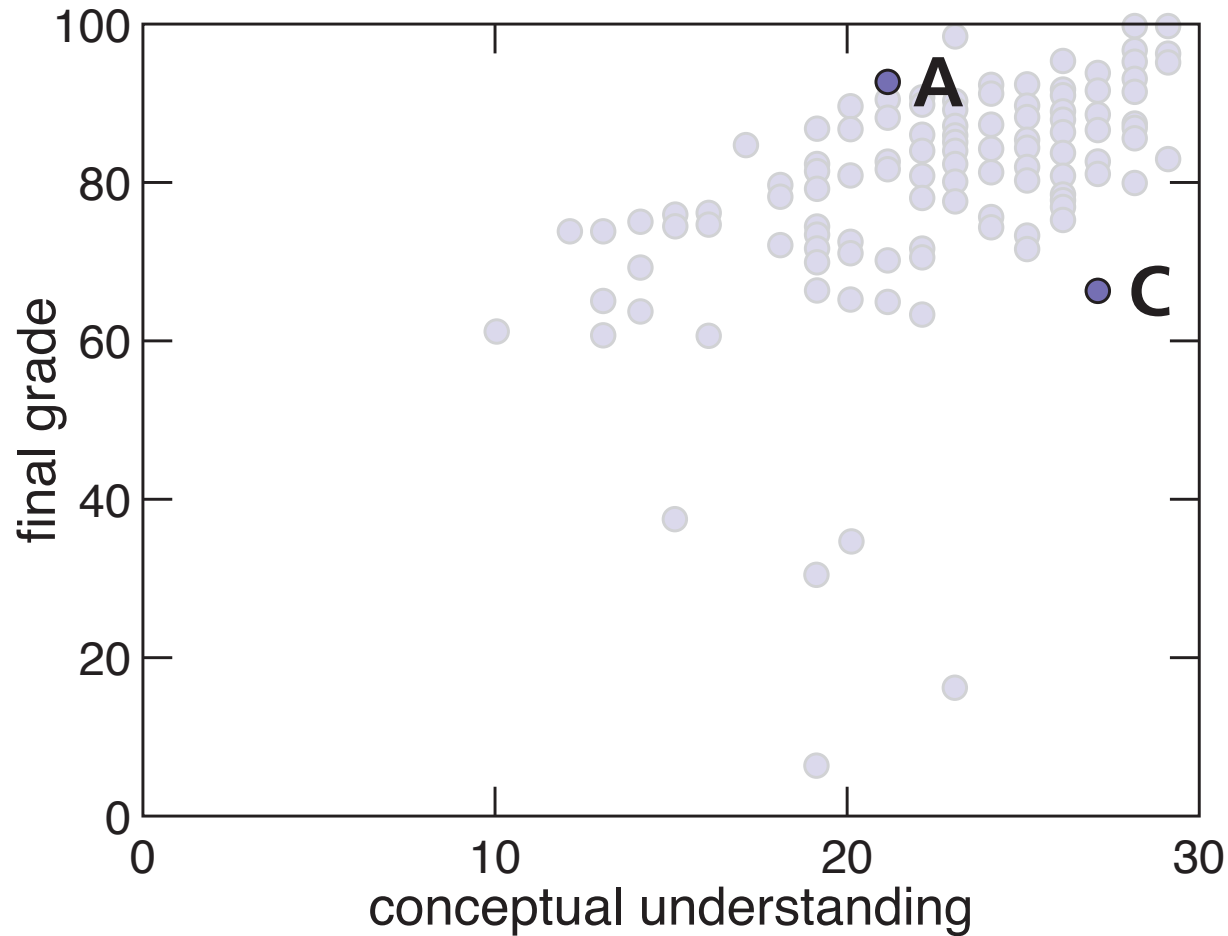


1 purposes

2 problems

3 improvements

# objectivity or injustice?



1 purposes

2 problems

3 improvements



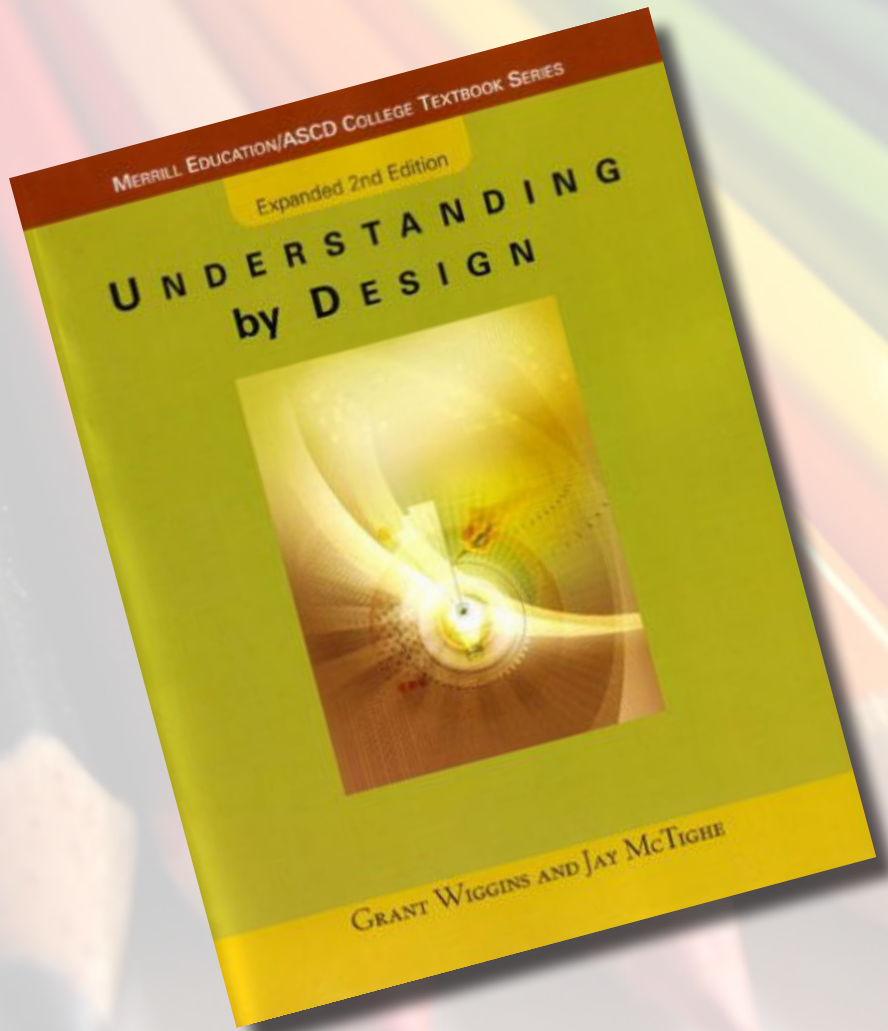


**focus on skills, not content**

**1** purposes

**2** problems

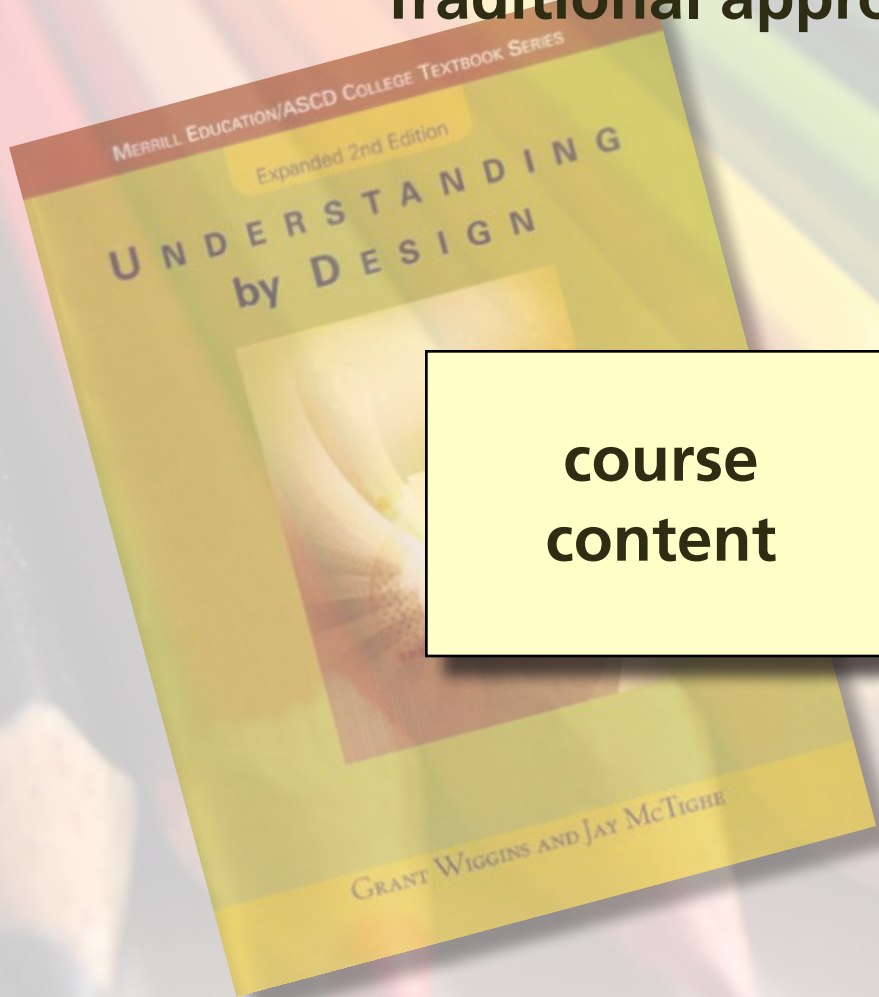
**3** improvements



Grant Wiggins and Jay McTighe, *Understanding by Design* (Prentice Hall, 2001)

- 1 purposes
- 2 problems
- 3 improvements

## Traditional approach to course planning



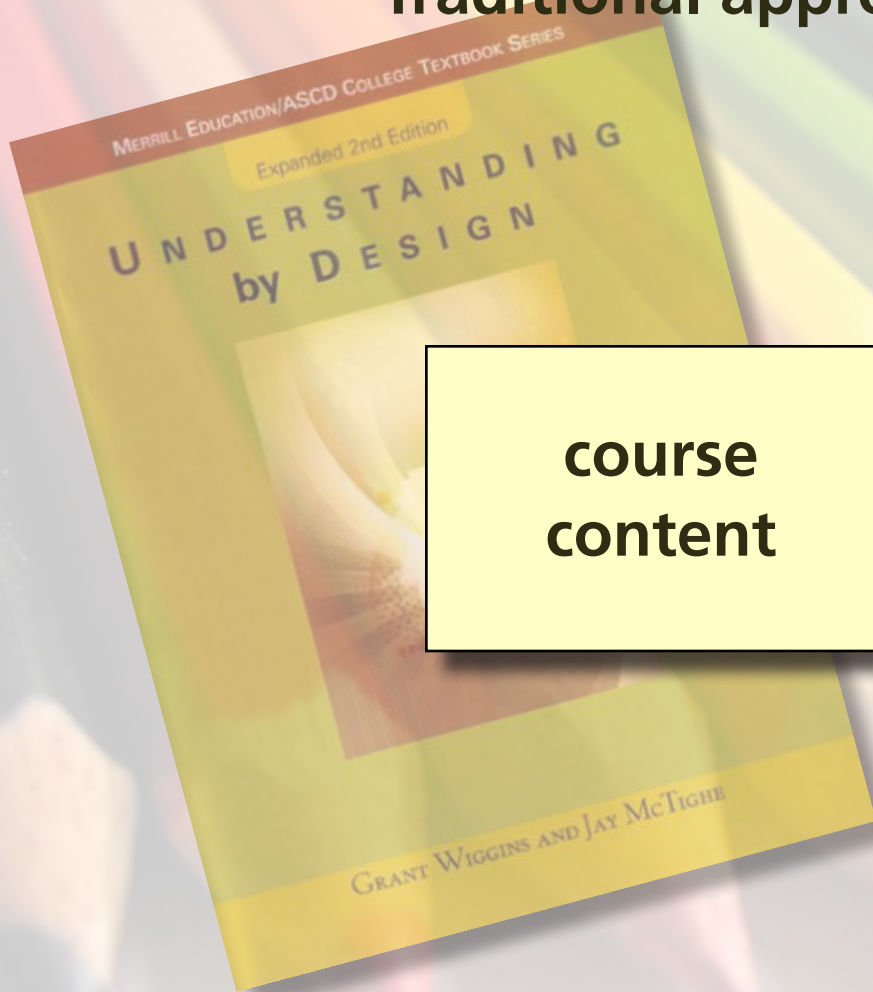
**course  
content**

**1** purposes

**2** problems

**3** improvements

## Traditional approach to course planning



**course  
content**



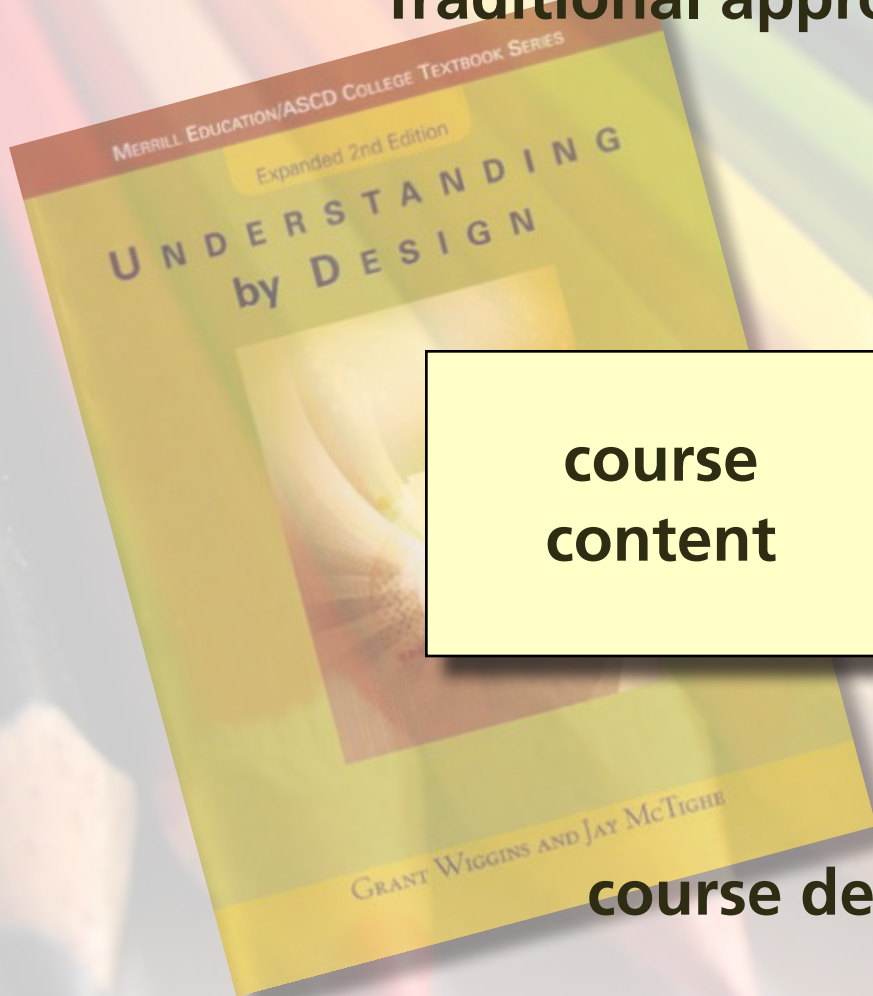
**assessment**

**1** purposes

**2** problems

**3** improvements

## Traditional approach to course planning



**course  
content**



**assessment**

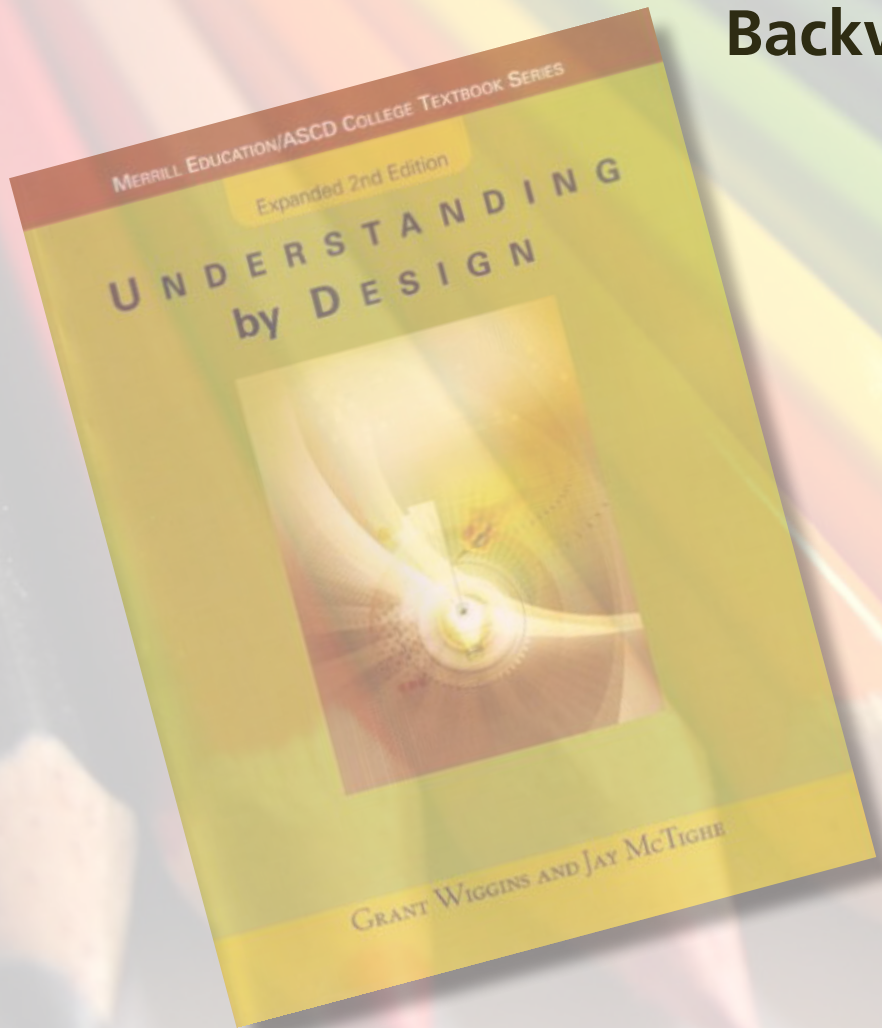
**course defined by content**

**1 purposes**

**2 problems**

**3 improvements**

## Backward design



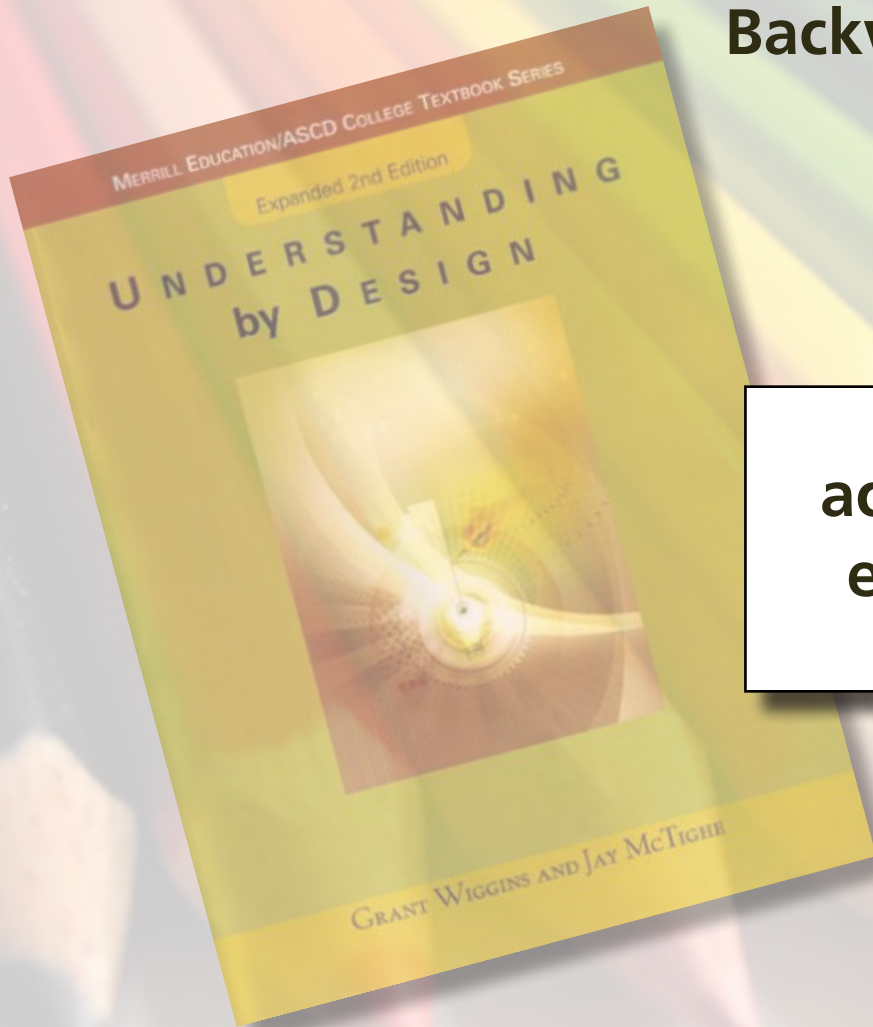
**desired  
outcomes**

**1** purposes

**2** problems

**3** improvements

## Backward design



acceptable  
evidence



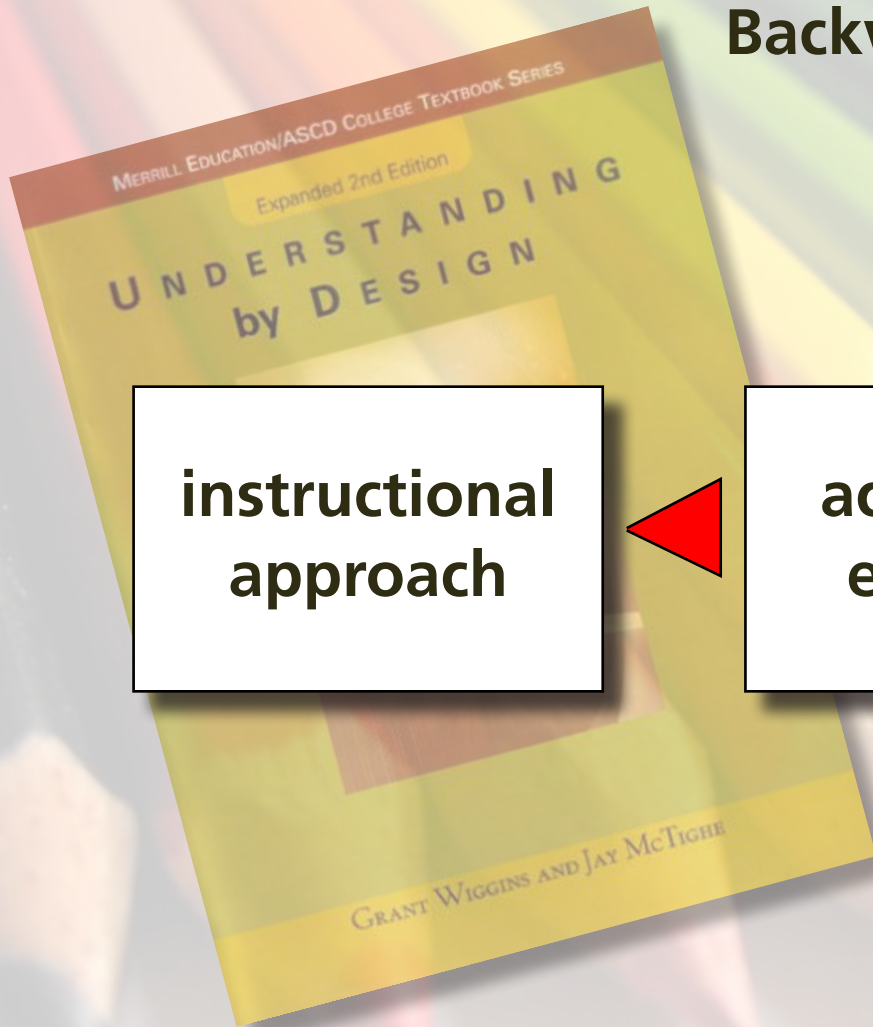
desired  
outcomes

**1** purposes

**2** problems

**3** improvements

## Backward design



**instructional  
approach**

**acceptable  
evidence**

**desired  
outcomes**



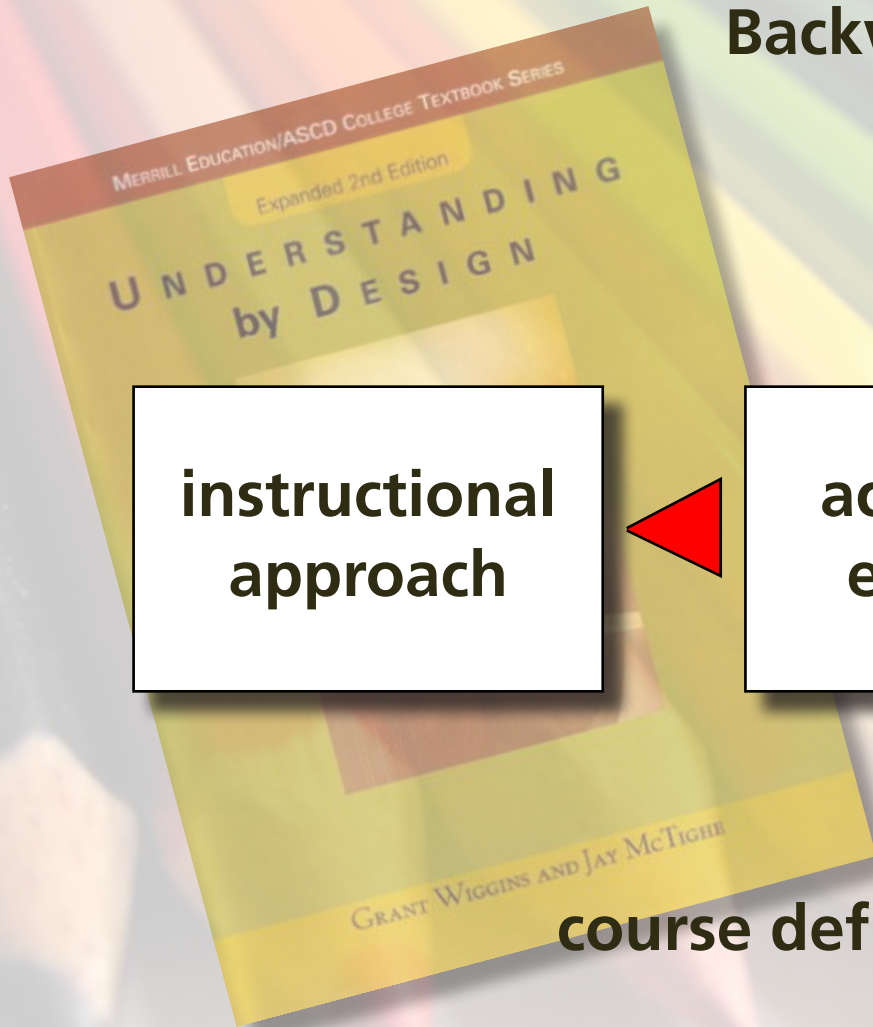
**1 purposes**

**2 problems**

**3 improvements**



## Backward design



**instructional  
approach**

**acceptable  
evidence**

**desired  
outcomes**

**course defined by outcomes**

**1 purposes**

**2 problems**

**3 improvements**



**4**

**resolve coach/judge conflict**

**1** purposes

**2** problems

**3** improvements

use external evaluators

1 purposes

2 problems

3 improvements

# peer- and self-assessment

1 purposes

2 problems

3 improvements

# Calibrated Peer Review

## Step 1: assignment & rubric

[cpr.molsci.ucla.edu](http://cpr.molsci.ucla.edu)

1 purposes

2 problems

3 improvements

# Calibrated Peer Review

*(Also) Make a list of conservation concepts that are the three important concepts that...*

*... Makes me... in humanity*

Rubric for Calibrated Peer Review

## Structure

Title

Opening

Paragraph length

Organization

Closing

## Content/Ideas

Scientific facts

Sources/evidence

Creativity

Audience awareness

## WRITING RUBRIC

**1 = needs improvement**  
does not meet expectations entirely

**2 = satisfactory**  
meets expectations  
(what you should aim for)

**3 = admirable**  
exceeds expectations  
(rarely selected)

Basic title

Wordy, long, unimaginative, or inappropriate title

Missing a "hook" or a lead in the first paragraphs AND does not orient reader to subject

Many paragraphs are long (6 or more sentences)

Lacks organization, no logical headings, no transitions between paragraphs

Does not end compellingly or with an important idea AND does not tie back to opening

Contains incorrect, misstated, irrelevant, or unnecessary facts

Does not back up facts with proper, convincing, or interesting sources or evidence

Mostly predictable based on available material

Material inappropriate OR not aimed at target audience; Contains unexplained scientific jargon, colloquialisms, or acronyms

Hook or lead present OR first few paragraphs orient reader to subject

Some paragraphs are long (6 or more sentences), most are short (1-5 sentences)

A few headings OR most paragraphs linked by transitions

Summary-like closing, but does not tie back to title or opening hook

All facts are 100% correct, relevant, and necessary

Most, but not all, facts backed up with proper, convincing, or interesting sources or evidence

Some originality apparent

Material appropriate and aimed at target audience AND mostly avoids scientific jargon, contains no colloquialisms or acronyms, and mostly uses clearly defined scientific terms

Catchy title drawing audience into article

Compelling audience appropriate hook or lead present AND first few paragraphs orient lay reader to subject

All paragraphs are short (1-5 sentences)

Headings structure paper in organized, logical way AND paragraphs linked by transitions

Ends compellingly with an important idea or though provoking question AND ties back to title and opening hook

Includes fact-checked expert and/or lay testimony (newspaper article only)

Original presentation of material; uses the unexpected to capture attention

Material appropriate and aimed at target audience AND relates to practical/everyday concerns AND uses analogies or other techniques to relate unfamiliar content to familiar concepts; no jargon, colloquialisms, or acronyms

**1** purposes

**2** problems

**3** improvements

# Calibrated Peer Review

Step 2: upload

Step 3: review

[cpr.molsci.ucla.edu](http://cpr.molsci.ucla.edu)

1 purposes

2 problems

3 improvements

# Calibrated Peer Review

UPLOAD

[cpr.molsci.ucla.edu](http://cpr.molsci.ucla.edu)

- 1 purposes
- 2 problems
- 3 improvements



# Calibrated Peer Review

UPLOAD



CALIBRATION

[cpr.molsci.ucla.edu](http://cpr.molsci.ucla.edu)

1 purposes

2 problems

3 improvements

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CALIBRATION

**MEDIUM**

**HIGH**

**LOW**

## The New York Times

January 20, 2009

OBSERVATORY

### Spectacular Supernova Observed

By John Glenn

New York, N.Y. – People around the world witnessed the brightest new addition to our sky, which outshines the brightest star at night and continues to shine alongside the sun during the day. None of us have seen such a sight in the course of our lives and for many it has served as a jarring reminder of the violent and powerful cosmic events that occur in what often appears to be a calm and constant sky.

Traffic was interrupted in New York City, as early-risers awoke to look up at the amazing sight. As of press time, the event was classified as consisting of eight planets (Pluto, etc.), various

Galileo

20 January 2008

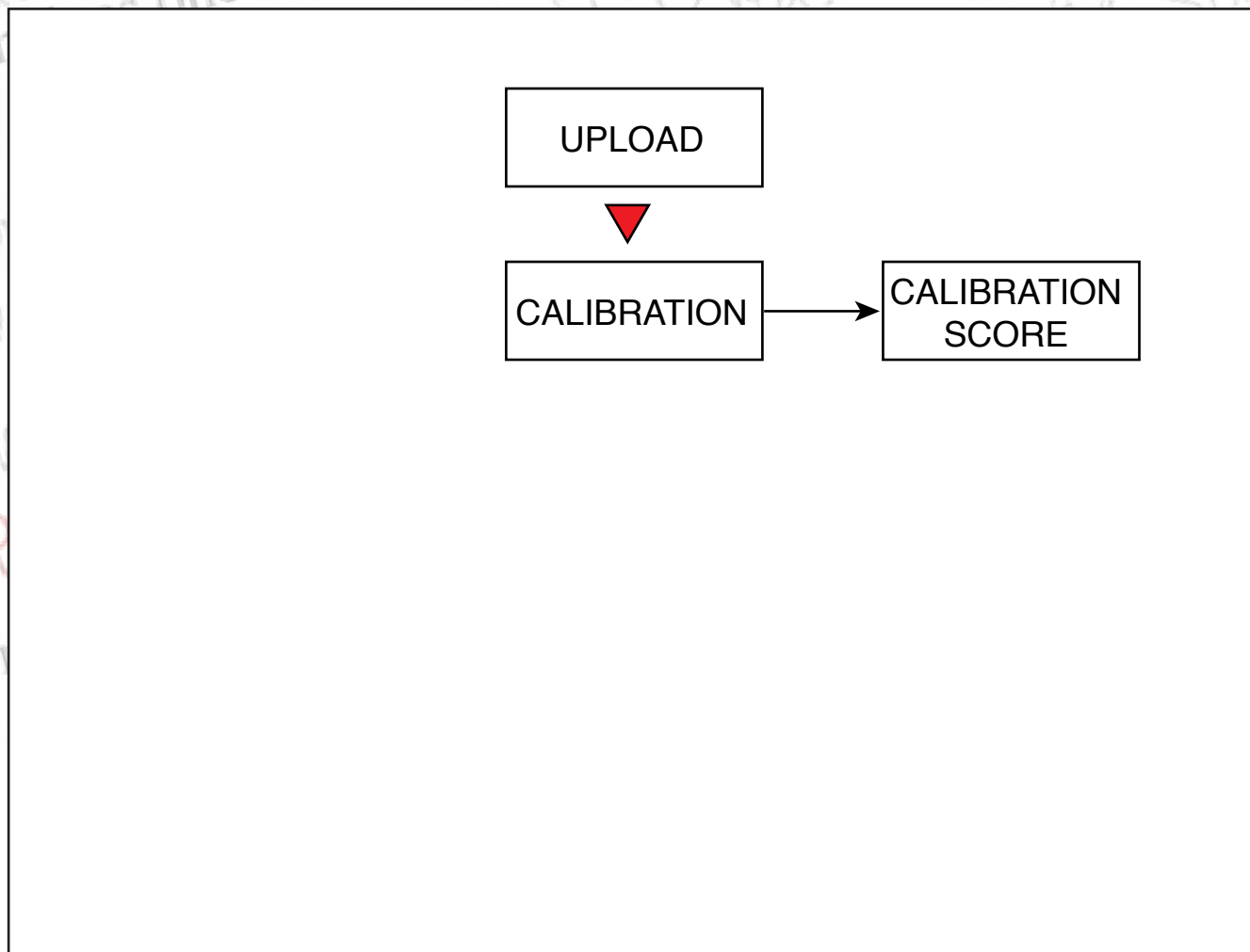
Yesterday at about 4 p.m., I observed a peculiar object appear in the sky. A glowing flash emitted a few seconds, accompanied its appearance. The object was visible even in broad daylight. How did this unprecedented event affect the consequences for Earth? In order to understand its consequences for Earth, we have to look at the galaxy. To fully appreciate it and not be alarmed, we must understand the life cycle of stars and how they are classified as consisting of eight planets (Pluto, etc.), various

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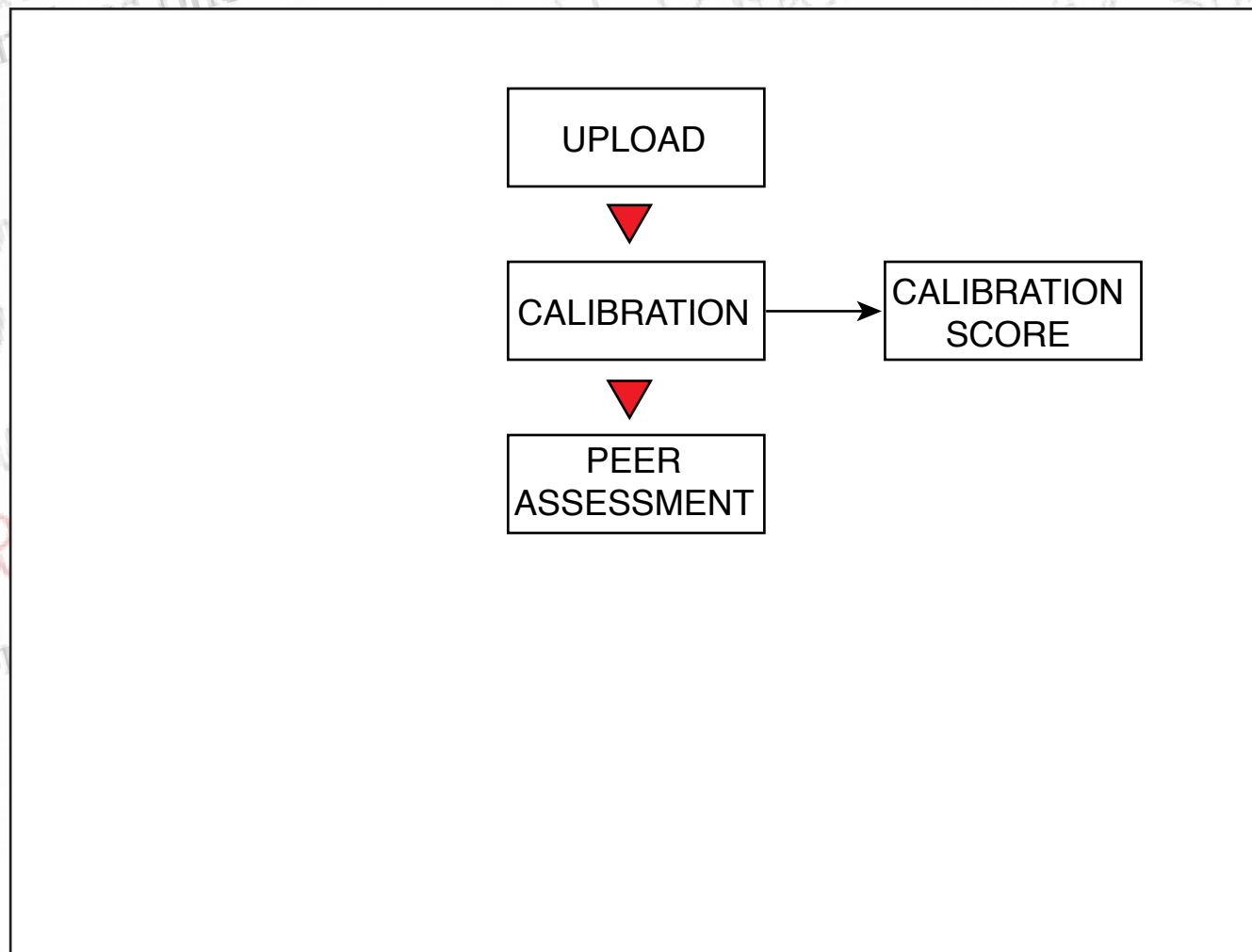
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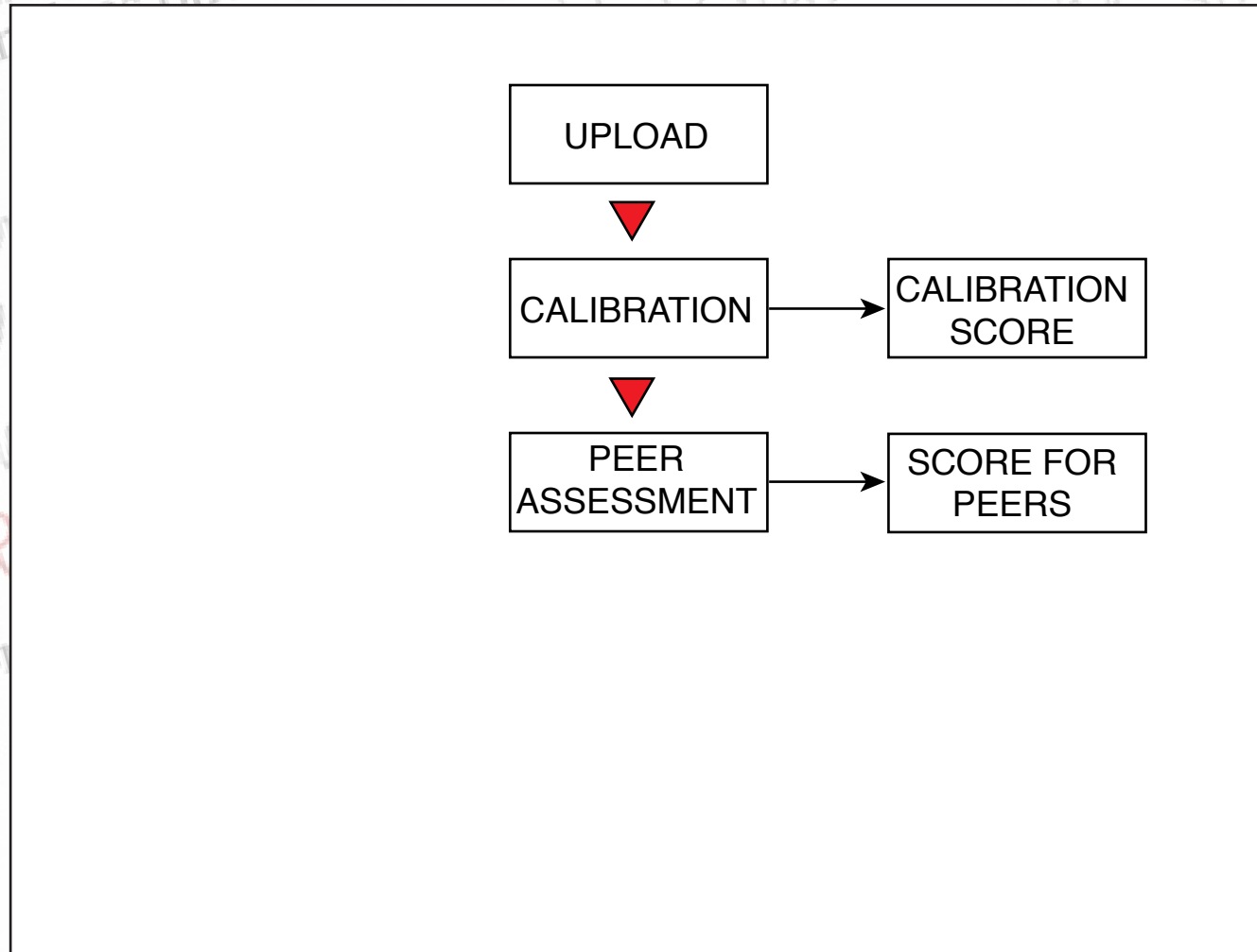
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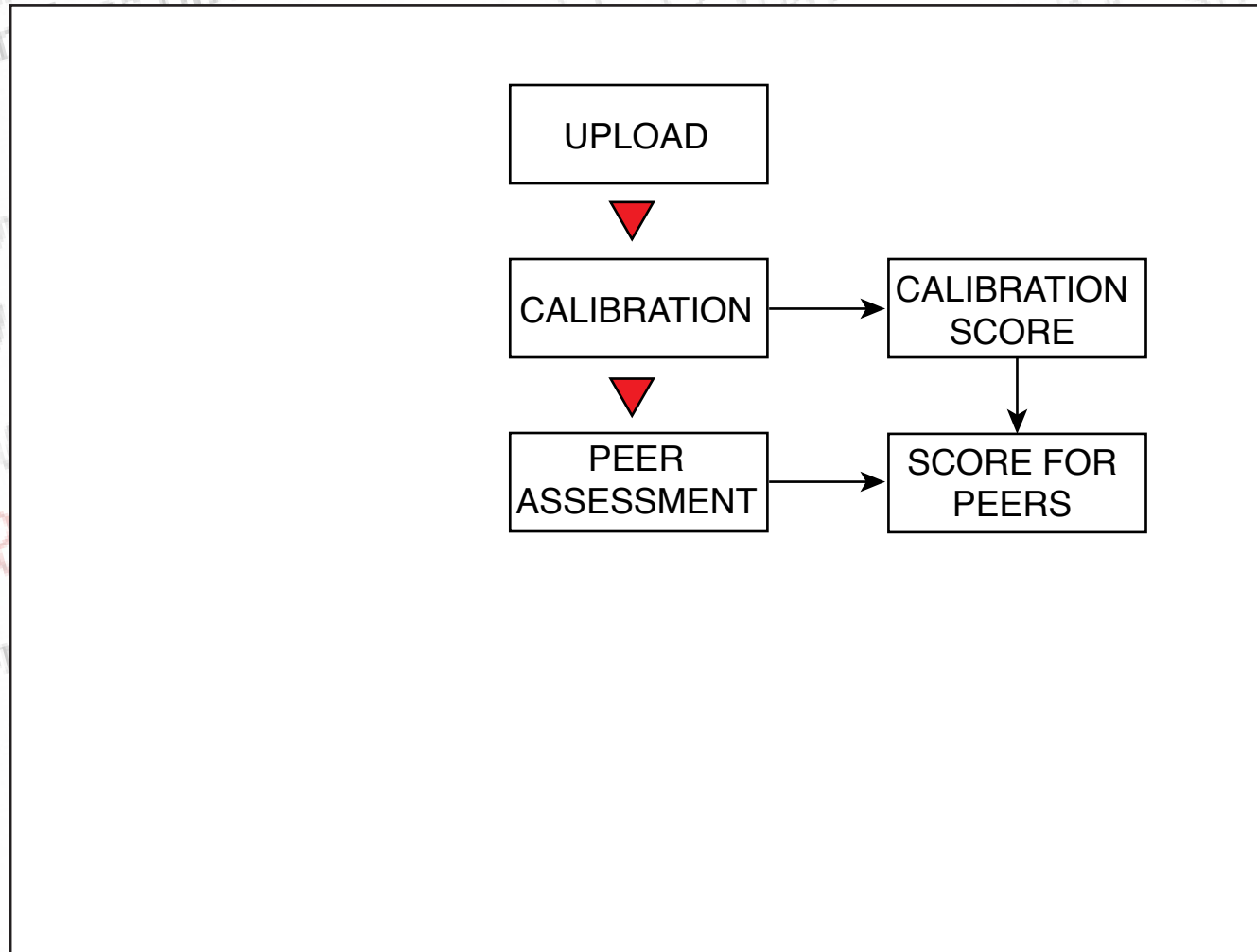
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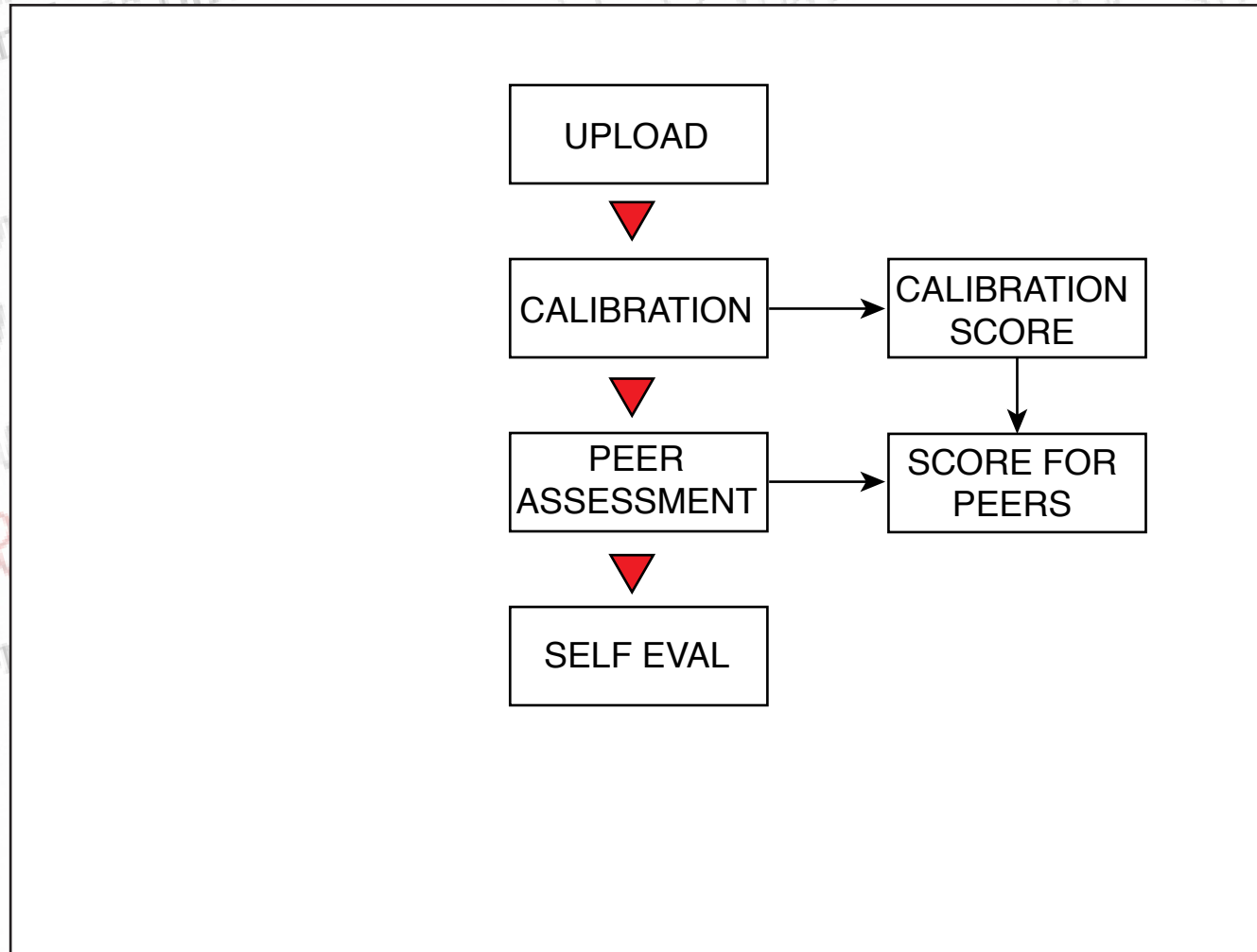
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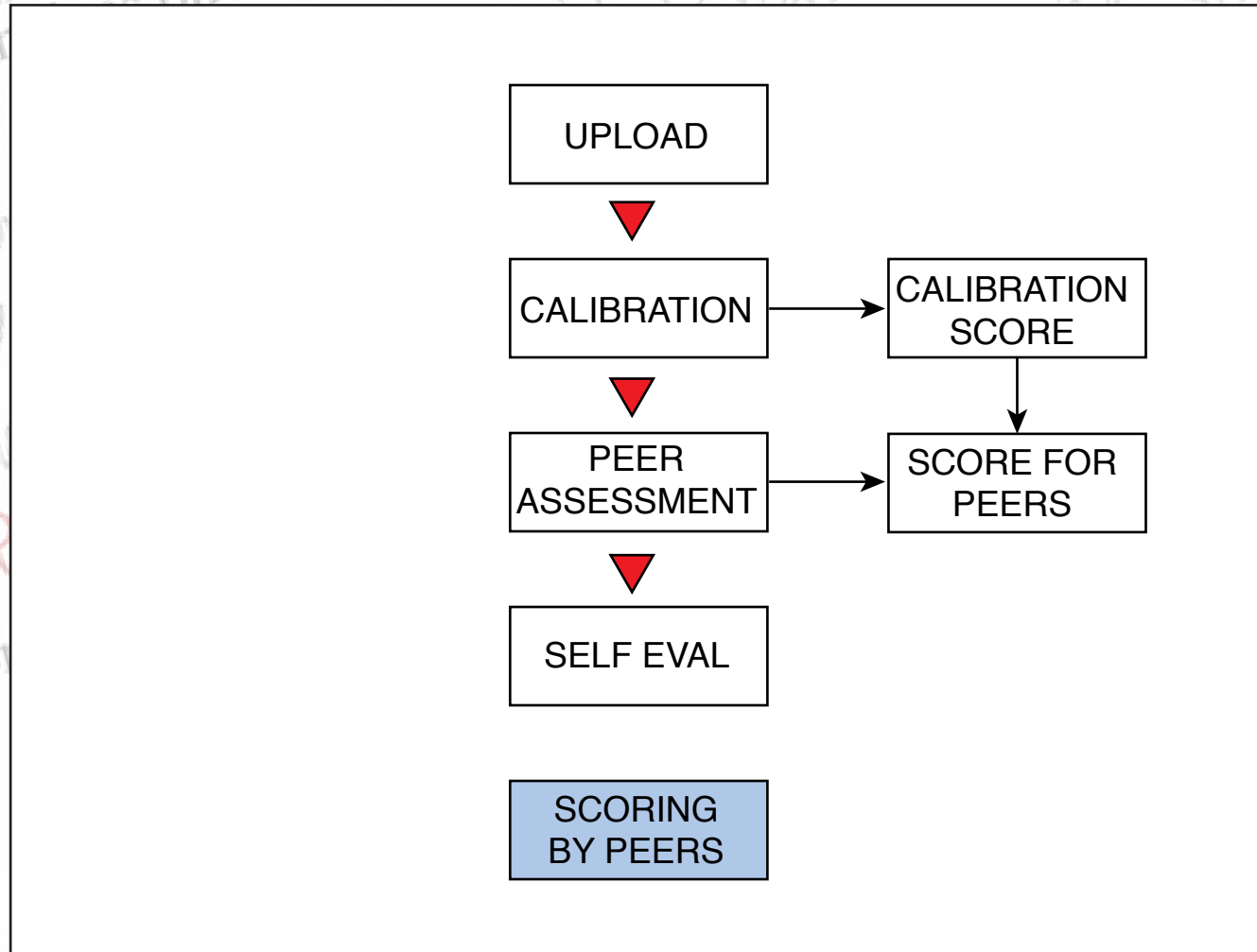
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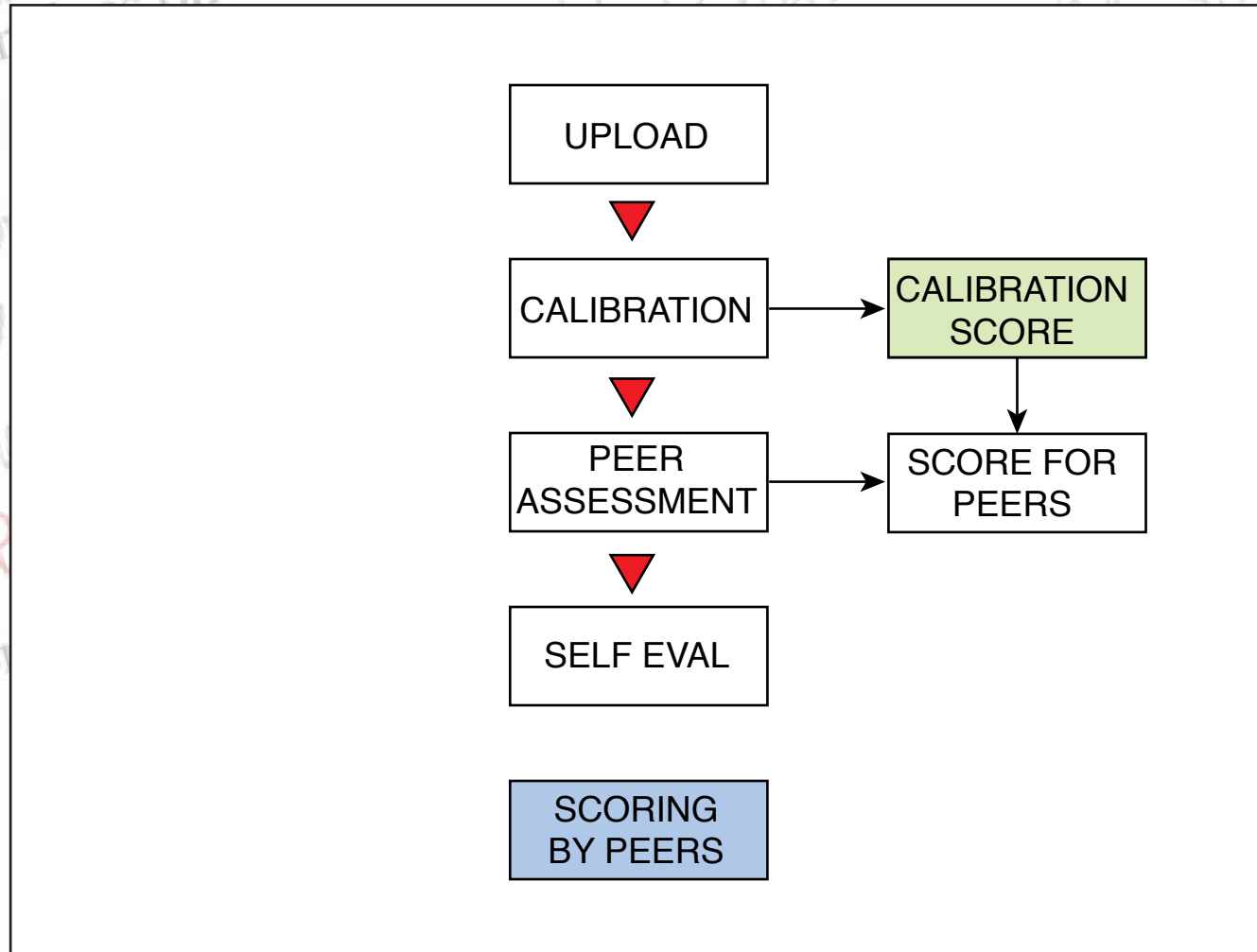


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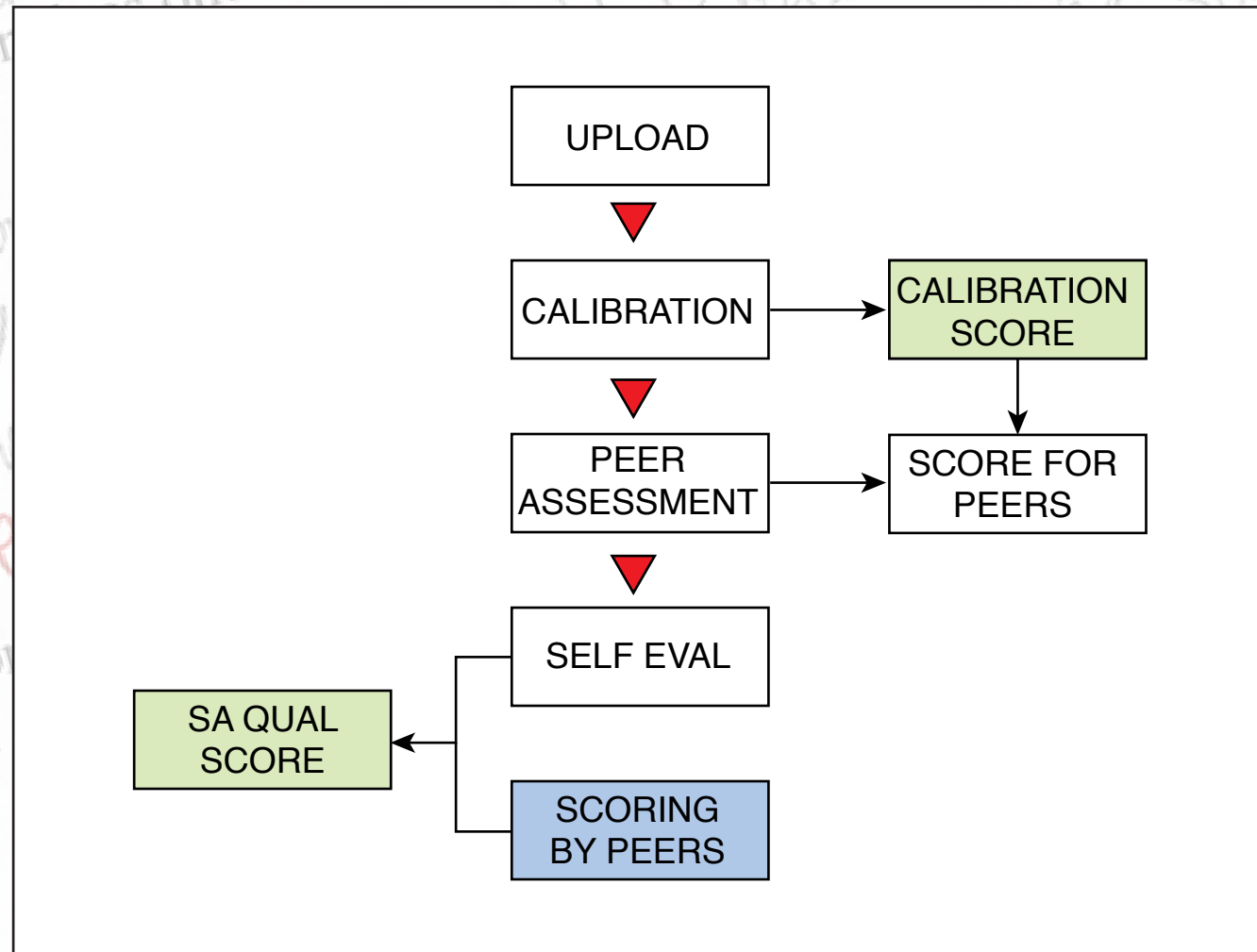
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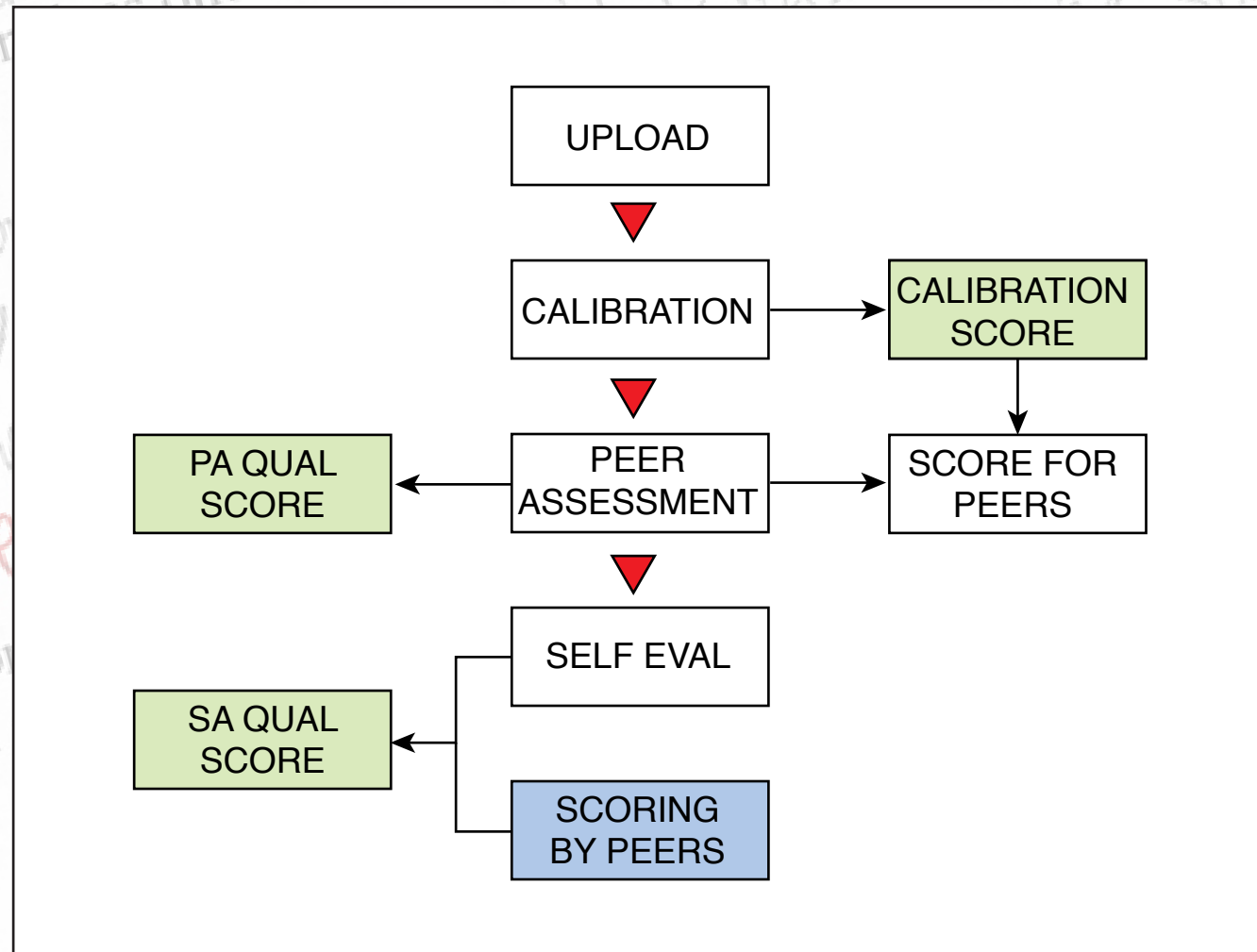
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A large, empty classroom with rows of desks and chairs. The room has a light blue floor with yellow and red lines. The walls are light-colored wood paneling. The text "rethink assessment" is overlaid in the center in a large, bold, black font with a blue outline.

**rethink  
assessment**



[mazur.harvard.edu](http://mazur.harvard.edu)

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