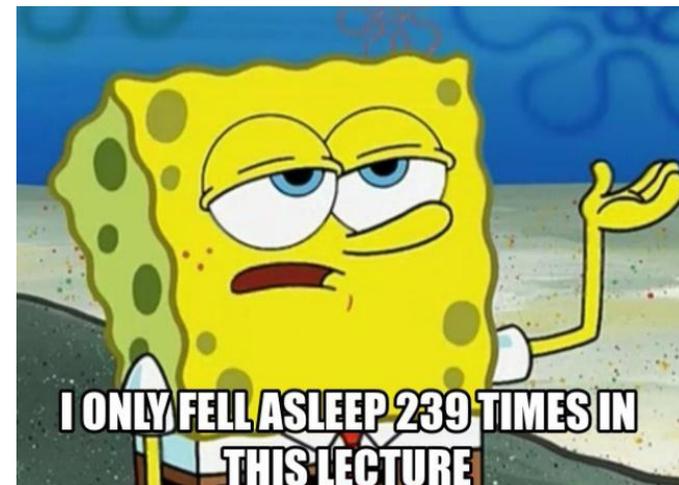
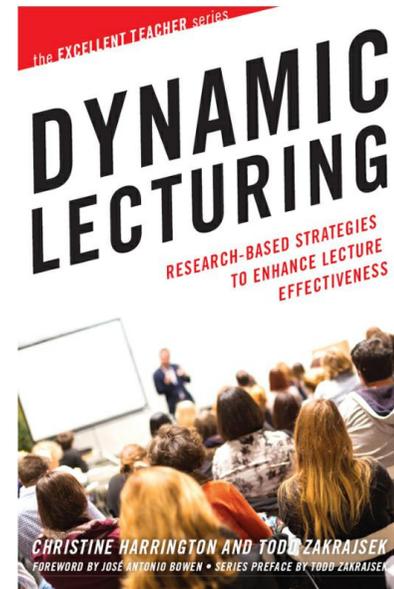
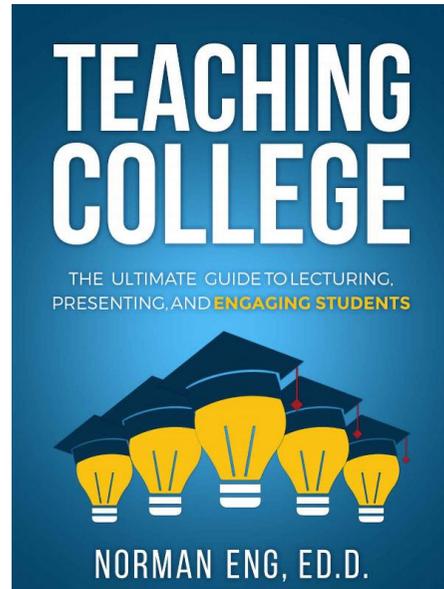


Teaching guide to interactive and engaging lectures and seminars

Peter Nagy

Department of Biophysics and Cell Biology

University of Debrecen



Ever frustrated in class?

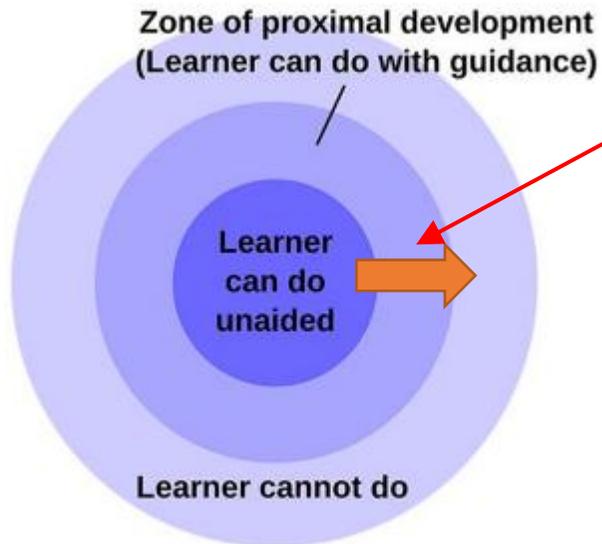
- for lack of attention?
- for students talking?
- for student chatting online?
- for students not learning?

Problems in many classes

Many students don't or can't follow what the teacher says because

Symptom	Origin or consequence
1. Lectures are too dense or long	People can concentrate for ~20 min
2. Lectures are disconnected from students	The teacher overestimates what the audience knows and underestimates how difficult it is to learn (expert blind spot or curse of knowledge)
3. Lectures are too much Powerpoint-oriented	Can prevent interaction if abused or misused

Aims of teaching



Help students proceed across the “zone of proximal development”

- Presence is not enough
- Focus on helping students to learn instead of the material
- Provide and require hands-on experience



Xun Kuang ('ʃʊn 'kwɑ:ŋ), Confucian philosopher also widely known as Xunzi ('ʃʊn 'dzi:) c. 310 – c. 235 BC

Tell me and I forget,
teach me and I remember,
involve me and I learn.

The Hungarian education system does not really include the “involve me...” part.

Presence is not enough

Pros

- Passive learning is better than nothing
- Attendance makes some, otherwise non-attentive students pay attention

Cons

- Attention and motivation are required for learning
- Nonattentive students distract the attention of others as well

The balance is hotly debated.

Lecture Attendance, Study Time, and Academic Performance: A Panel Data Study

The Journal of Economic Education, Volume 46, 2015 - Issue 3

- significant correlation between performance and lecture attendance, ...
- most of which is lost if adjusted for confounders
- i.e. mostly those student **attend who are hard-workers anyway**

Does Lecture Attendance Matter? A Study of Exam Performance in Medical Neurobiology, The FASEB J.

- No significant relationship between students' lecture attendance and their exam scores

Many approach it subjectively:

- Why should [students] have to attend if they do not think it is [valuable]?
- There were very good reasons for monitoring and promoting high attendance, particularly in the first year
- Compulsory attendance is “contrary to the idea of higher education as a voluntary activity undertaken by adults”

<https://www.timeshighereducation.com/news/should-student-attendance-in-classes-be-compulsory>

Why do we need a paradigm change?

1. Students are exposed to new kind of stimuli



1982



2015

The kind of stimuli bringing up current students,...

... but our lectures are more like this.



Students lose interest.

Why do we need a paradigm change?

2. Customer-like attitude of students: “You can teach me if you are up for it.”
 3. Many more students enter higher education with needs different from the top 10%.
-

What to do?

1. We must not be arrogant: ~~You don't understand? Your fault.~~

We must understand the basic background of students.

2. But we must prepare them for the challenges of their professional career

- team work

new type of challenge

interactive teaching

- boring patients

- boring evaluations

- boring meetings...

old type of challenge

classical and mixed
teaching methods

- Boring facts and relationships are more important than eye-catching scenes or striking details,
- but present them colorfully, enjoyably.

Strategic solution plan

1. Know your target audience

- Create a profile of your audience (“ideal client profile”)
 - What is your audience like?
 - Why are they here?
 - What do you want them to do, and to achieve in the lecture / course?
 - How might they resist?
 - How can you best reach them?
- Are they “culturally literate”?
- What kind of students are there in the class?
 - Surface learners: want to pass only, memorize instead of understanding
 - Strategic learners: want good grades to get a good job, want procedures to follow
 - Deep learners: grapple with ideas and concepts, want to understand, open for challenges

Cultural illiteracy

- linguistic
- cultural
- scientific (lack scientific vocabulary)



Strategic solution plan

2. Consider the big picture goal of your STUDENTS

- Why are the students enrolled in the **PROGRAM**?
 - MD students: want to / need to get a deeper understanding to **become a doctor**
 - physiotherapy students: want mostly practical experience with some kind of theoretical background to perform their job

3. Figure out the benefit of the course to your STUDENTS

- How can your **COURSE** contribute to the big picture goal?

Design your lecture / seminar topic

1. Narrow in on the main (2-3) areas

- Quality over quantity
- Focus on what is
 - notable
 - fundamental principles
 - difficult to learn
 - often misunderstood



We need an in-depth, learnable source besides the lecture slides.

2. Generate a lesson objective or an essential question

- What will the students be able to do after the class?

3. Make it relevant to the students

- How can you make the idea (point 2) easier to understand?
- How can the students apply what they learn?

4. Provide an underlying idea or (personal) experience

- May be difficult with some of our topics
- Examples (other opening options later):

Topic	Personal experience
Slope	Skiing
Immune system	Comparisons with military, chess, etc.



adjust them to the perceived background

Two approaches to teaching

I, We, You

Step 1: I (the teacher) explain

Step 2: We (the class) practice together

Step 3: You (student) will do it

- This is how we teach, but mainly get stuck at step 1
- Sometimes, but not always, facilitates linear and inflexible thinking
 - provides protocols (in steps 1-2) to solve a task (in step 3)
 - instead of teaching principles

You, You all, We

Step 1: I (teacher) provide a dilemma, individual students try to solve

Step 2: Students work in small groups to refine the solution

Step 3: We (the class) discuss to draw conclusions

- This is how we learn as kids
- Solid, enduring knowledge
- Nonlinear thinking

- Both of them are good
- Many STEM (science, technology, engineering, mathematics) and FOUNDATIONAL courses require the “I, We, You” approach

Classical lectures vs active learning approaches

Classical: Sage on the stage

Interactive: Guide on the stage

King, 1993

- Some even advocated abandoning lectures completely.
- Lectures can be bad because
 - university teachers are not taught how to lecture
 - there is a different need of current students (higher numbers, more practical knowledge)
- If something is done badly, it is not necessarily wrong by definition.
- In foundational courses student-oriented “sage-on-the stage” lectures are useful
 - on their own
 - to provide the basis for active learning
- A mixture of classical and interactive strategies is best.
- Cognitive engagement vs. active engagement

How to involve the audience?

1. Discussion

- avoid simple “yes or no”, and “who”, “when” and “where” questions

2. Debate

- divide the class to two parts with both of them defending a viewpoint

3. Small group work

- groups of 3-5 students
- pre-form groups (!?)
- let groups work on their own, then supervise (overhear) before presenting / discussing

4. Surveys, quizzes

- if technology permits; online tools available (next slide); Twitter
- you can repeat it before and after discussing

5. Role-play

6. Demonstration

7. Student presentation

- be careful
- boring and potentially misinforming for the class
- teach them how to present

8. Case study

- An everyday example to work out
- <http://sciencecases.lib.buffalo.edu/cs/collection/>

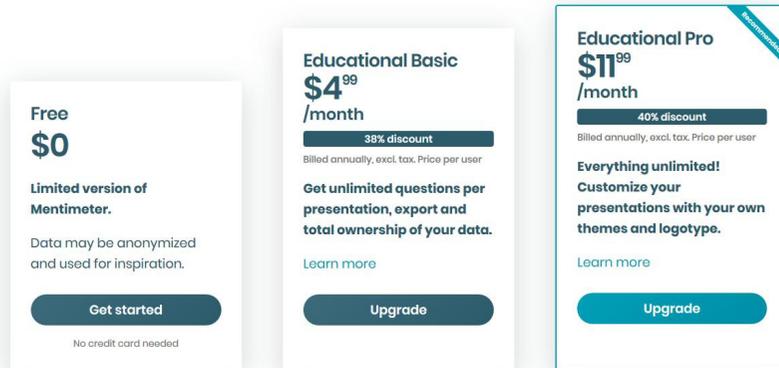
Simple online polling tools to incorporate quizzes into the lecture / seminar

1. Mentimeter: insertable into PowerPoint

<https://www.mentimeter.com/>

Mentimeter for Educators

Unlimited poll size for each version



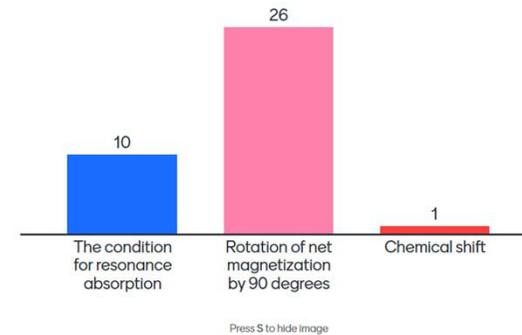
Three pricing plans for Mentimeter for Educators:

- Free \$0 /month**: Limited version of Mentimeter. Data may be anonymized and used for inspiration. **Get started** (No credit card needed).
- Educational Basic \$4⁹⁹ /month**: 38% discount. Billed annually, excl. tax. Price per user. **Get unlimited questions per presentation, export and total ownership of your data.** **Upgrade**.
- Educational Pro \$11⁹⁹ /month**: 40% discount. Billed annually, excl. tax. Price per user. **Everything unlimited! Customize your presentations with your own themes and logotype.** **Upgrade**.

Go to www.menti.com and use the code 3660 5097

What does the image below explain?

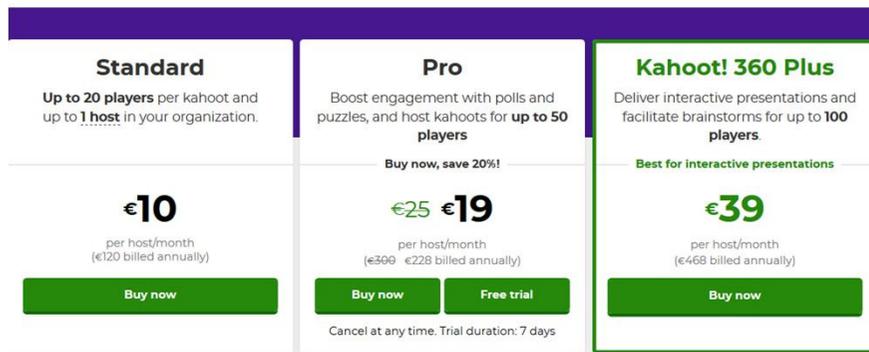
Mentimeter



37

2. Kahoot: standalone, not insertable to PowerPoint

<https://kahoot.com/>



Three pricing plans for Kahoot:

- Standard**: Up to 20 players per kahoot and up to 1 host in your organization. **€10** per host/month (€120 billed annually). **Buy now**.
- Pro**: Boost engagement with polls and puzzles, and host kahoots for up to 50 players. **Buy now, save 20%! €25 €19** per host/month (€300 €228 billed annually). **Buy now** (Free trial). Cancel at any time. Trial duration: 7 days.
- Kahoot! 360 Plus**: Deliver interactive presentations and facilitate brainstorming for up to 100 players. **Best for interactive presentations €39** per host/month (€468 billed annually). **Buy now**.

Which pathway transports hydrolytic enzymes to lysosomes?

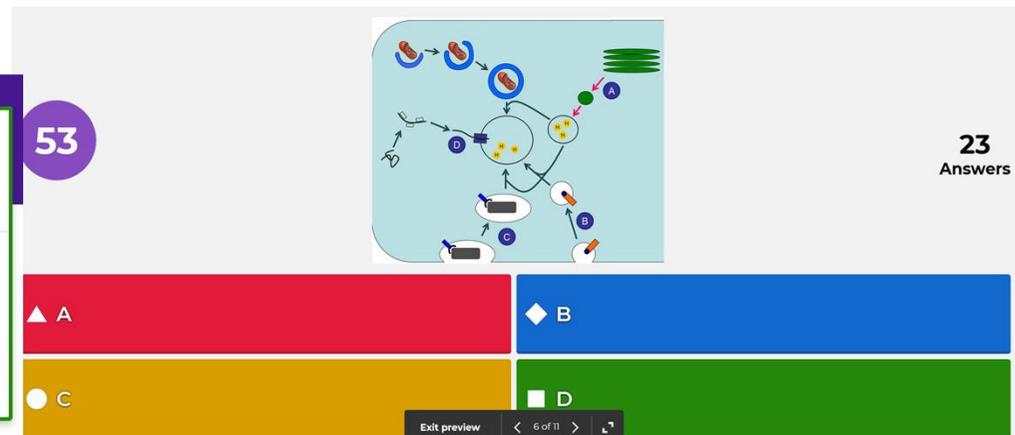


Diagram showing the transport of hydrolytic enzymes to lysosomes. The diagram illustrates the Golgi apparatus and lysosomes, with arrows indicating the movement of enzymes. The diagram is labeled with A, B, C, and D.

53

23 Answers

▲ A

◆ B

● C

■ D

Exit preview < 6 of 11 >

<https://www.presentation-guru.com/how-to-get-instant-feedback-from-your-audience/>

Simple online polling tools to incorporate quizzes into the lecture / seminar

3. Poll Everywhere: insertable into PowerPoint

<https://www.polleverywhere.com>

Poll size

Higher-Ed Free	Student Pays	Instructor	Institution-wide
Free	\$14 year per student	\$349 semester	Custom
Sign up	Sign up	Sign up	Contact us
40	Limit based on class-size	400	Custom

4. Participoll

<https://www.participoll.com/>

Individual

1 presenter licence

\$199 USD/year

+VAT in EU, annually recurring payment

Team

5 presenter licences

\$799 USD/year

+VAT in EU, annually recurring payment

Unlimited

Unlimited presenters

Ask Us

Ideal for enterprises and academic institutions

5. Ombea

<http://www.ombea.com/>

Price?

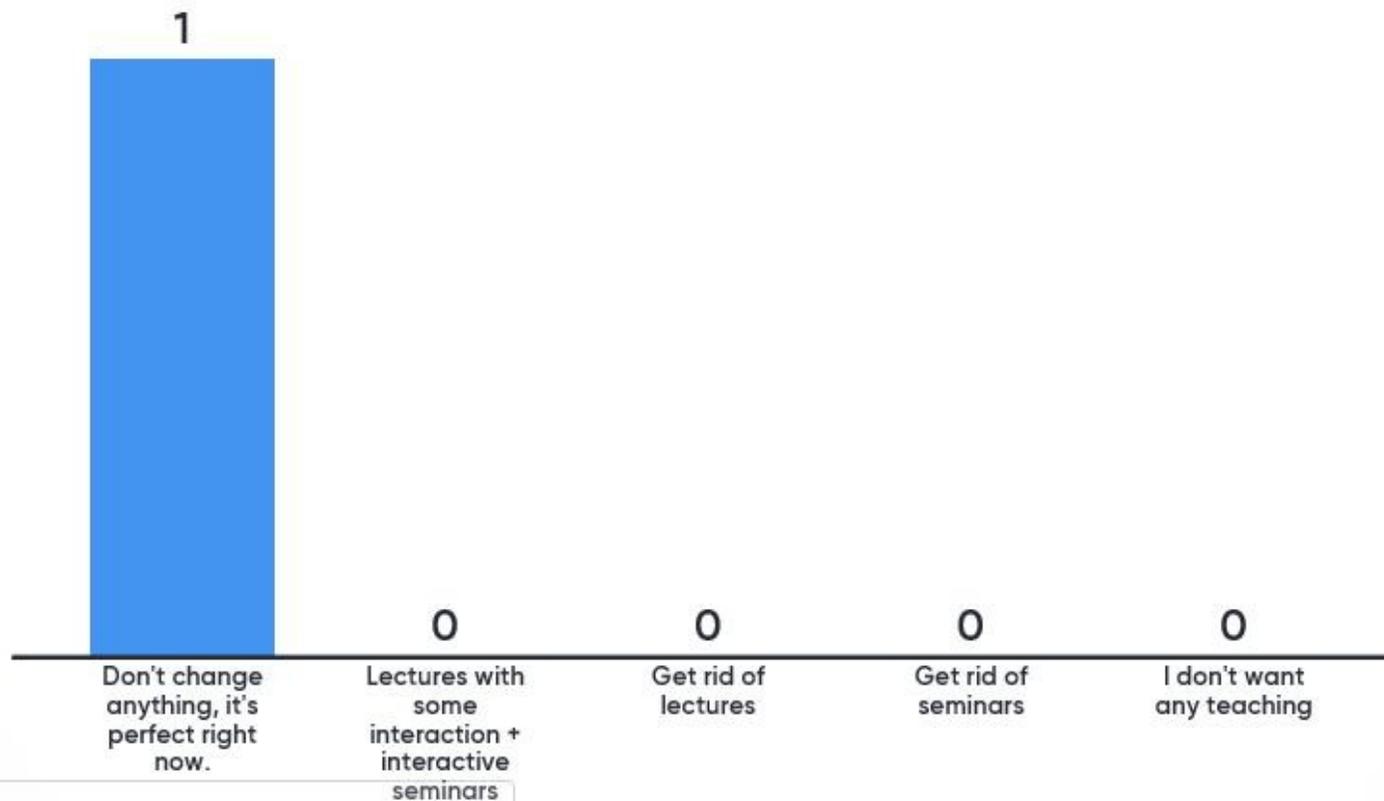
<https://www.presentation-guru.com/how-to-get-instant-feedback-from-your-audience/>

Go to www.menti.com and use the code



Mentimeter

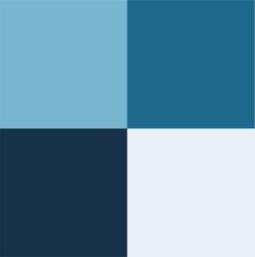
What kind of educational structure would you like to see in our department?



Slide is not active

Activate

1



To show this poll

1

Install the app from
pollev.com/app

2

Start the presentation

Still not working? Get help at pollev.com/app/help
or

[Open poll in your web browser](#)



Importance of engagement

- Three groups were compared (S – study, T – test):
 - SSSS
 - SSST
 - STTT
- Each part lasted for 5 min.
- After the 20-min experiment students were tested twice
 - in 5 min
 - and then again in a week
- Results:

tested in	SSSS	SSST	STTT
5 min	83%	78%	71%
a week	40%	56%	61%

Class outline: classical lecture with or without interaction

1. Opening

- important first impression, the audience decides if you are boring or exciting
- connect with the audience in no more than 1-2 min
- Examples:

Provocative question	Do you think that human cloning is ethically acceptable?
Striking statistic or fact	Do you know that just a couple of decades ago only classical X-ray was available for medical doctors?
Anecdote	This is the X-ray of my broken ankle ...
Quotation	“It is very difficult to predict — especially the future” (Niels Bohr)
Analogy	Our cellular organelles are often likened to factories because ...
Scenario/problem	Let’s say a patient explains to you that ...

Class outline: classical lecture with or without interaction

2. Middle

- don't cram too much information
- divide into parts, interspersed with breaks (less intense or interactive parts)
- summarize each part briefly
- and remember:
 - PEOPLE RETAIN ONLY 20-30% OF WHAT THEY HEAR.
 - PEOPLE'S ATTENTION PEAKS AT 20 MIN AND THEN DECLINES.
- more later...

3. End

- Never just end with your last "Result" or "Teaching" slide and then say thank you.
- Connect the end with the beginning
- State your take-home message
 - what the students learned
 - how their attitude to some problems changed based on what we discussed
- Quiz?
- Reflect on some of the questions the student / the lecturer raised

What to do during the break between the lecture parts?

- Summary
- Relax with a video or with presenting a case
- Quiz testing knowledge
- Poll about what was understandable – not understandable, important – not important, etc.
- Ask students to think the previous part over and write a short summary
- Discussion of a question (continued on the seminars?)

Class outline: activity-driven interactive class (You, You all, We)

1. Opening

- A problem or a case-study presented by the teacher
- Students work individually

2. Middle

- In 5-10 min students continue to work in small groups of 4-5 to refine their ideas
- The teacher must facilitate and guide their thinking without foisting his/her ideas on the group

3. End

- Each group presents their ideas
- The teacher teaches / preaches at the very end: clarify, summarize, evaluate
- Take home message, etc., like in the previous case

PowerPoint strategies and timing

Interaction-intensive approach (“guide on the stage”)

- leave as much as 40-70% of the time for interactions

Classical approach (“sage on the stage”)

- leave 10-30% for interactions

General rules for slides

- Be concise, don't write full sentences
- Don't write every detail, the speaker provides the rest (next slide)
- Avoid sub-bullets. (Do you need bulleted lists at all?)
- Animate the slides
- Leave plenty of empty space
- Do you need words? Picture or video better (?)
- 10-20-30 rule: max 10 slides, max 20 min, font size no less than 30 pt (?)

PowerPoint strategies

Race in U.S. Public Schools

Minority students will become the **majority** (projected 2025 numbers):

- White: 46%
- Black: 15%
- Hispanic: 29%
- Asian/PI: 6%
- Others: 5%



Not bad

Race in U.S. Public Schools

Minority students will become the **majority**:

White	46%
Black	15%
Hispanic	29%
Asian/PI	6%
Others	5%



Even better



By 2025:
55%

The best (I don't agree)

PowerPoint strategies

Herbert Spencer
(1820-1903)

- Spencer's ideas about education influenced by Darwin's *Theory of Evolution*: Survival of the fittest.
- Wanted schools to compete against each other.
- Believed people in an industrialized society needed a utilitarian education.
- Introduced rationale for curriculum development based on promoting health, social relationships, and economic productivity.



The law is the survival of the fittest . . . The law is not survival of the 'better' or the 'stronger,' . . . It is the survival of those which are constitutionally fittest to thrive under the conditions in which they are placed; and very often that which, humanly speaking, is inferiority, causes the survival.

- Herbert Spencer

- too much to read (?)
- but if slides are available for download (?)
- two different things

- better because less (factual detail) is more (but consider the remark on the left)



slide set is a standalone source

slide set only supports what the teacher says

Structure of a PowerPoint slide set

1. Opening

1. Connect with the students, raise interest in 1-2 min (provocative question, striking fact, anecdote, quotation, analogy, problem)

- Do you know that a single human cell contains $\sim 10^5$ different proteins? How can a cell produce this many from $\sim 20,000$ genes?

2. State the objective

- You will learn (what) by (how) so that (benefit)
- You will learn how proteins are modified after their synthesis in order to understand and appreciate their immense variety.

3. How is the outcome of the class relevant to students?

- Why is it meaningful? How will students apply it? Make it more understandable for them.
- These processes, called post-translational modifications contribute to cancer development and to even genetically identical individuals responding differently to drugs.

Structure of a PowerPoint slide set

2. Middle

- connect to
 - previous knowledge, if possible, at the beginning and throughout
 - to the interest of the students several times (to make it relevant)
- not too dense, not too long
- divide into 15-20 min sections separated by easier/interactive parts

• each part: beginning, middle and end

-
- identify subtopic
 - you may ask a question
 - elaborate the subtopic
 - summarize
 - interactive part (quiz, survey, discussion)

- mark the most important ideas
- don't read from the slide continuously
- animate the slides
- A picture is worth a thousand words

Structure of a PowerPoint slide set

3. End

- **Connect the end with the beginning**
- State your **take-home message**
 - what the students learned
 - how their attitude to some problems changed based on what we discussed
- Quiz?
- Reflect on some of the questions the student / the lecturer raised
- You learned different post-translational modifications.
- You should appreciate how they influence cellular phenotype.
- Why Linda responded differently to the treatment from how Susan did?

Optimizing discussions

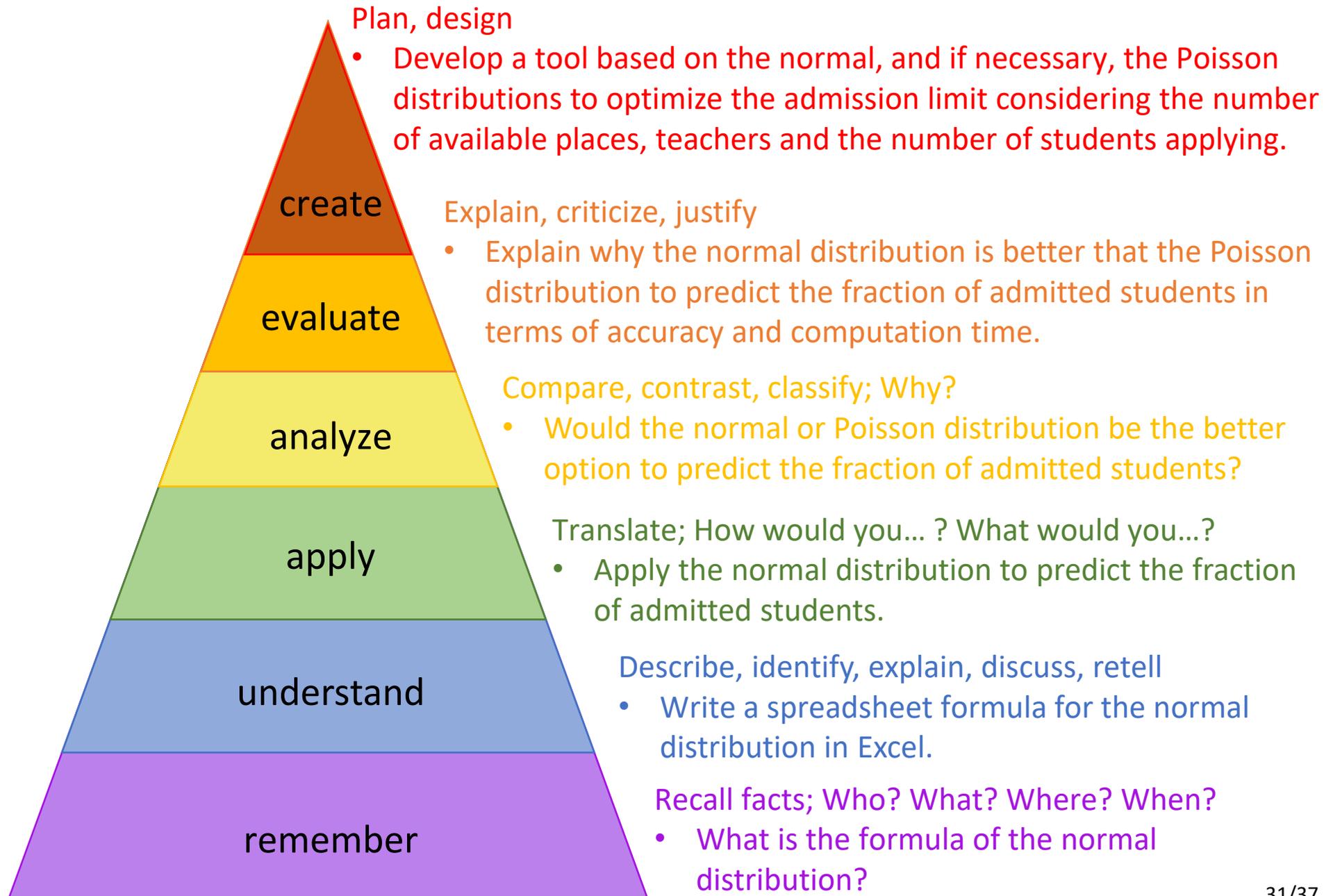
“What did you do in the class yesterday?”

“Nothing, we just spent the whole class talking.”

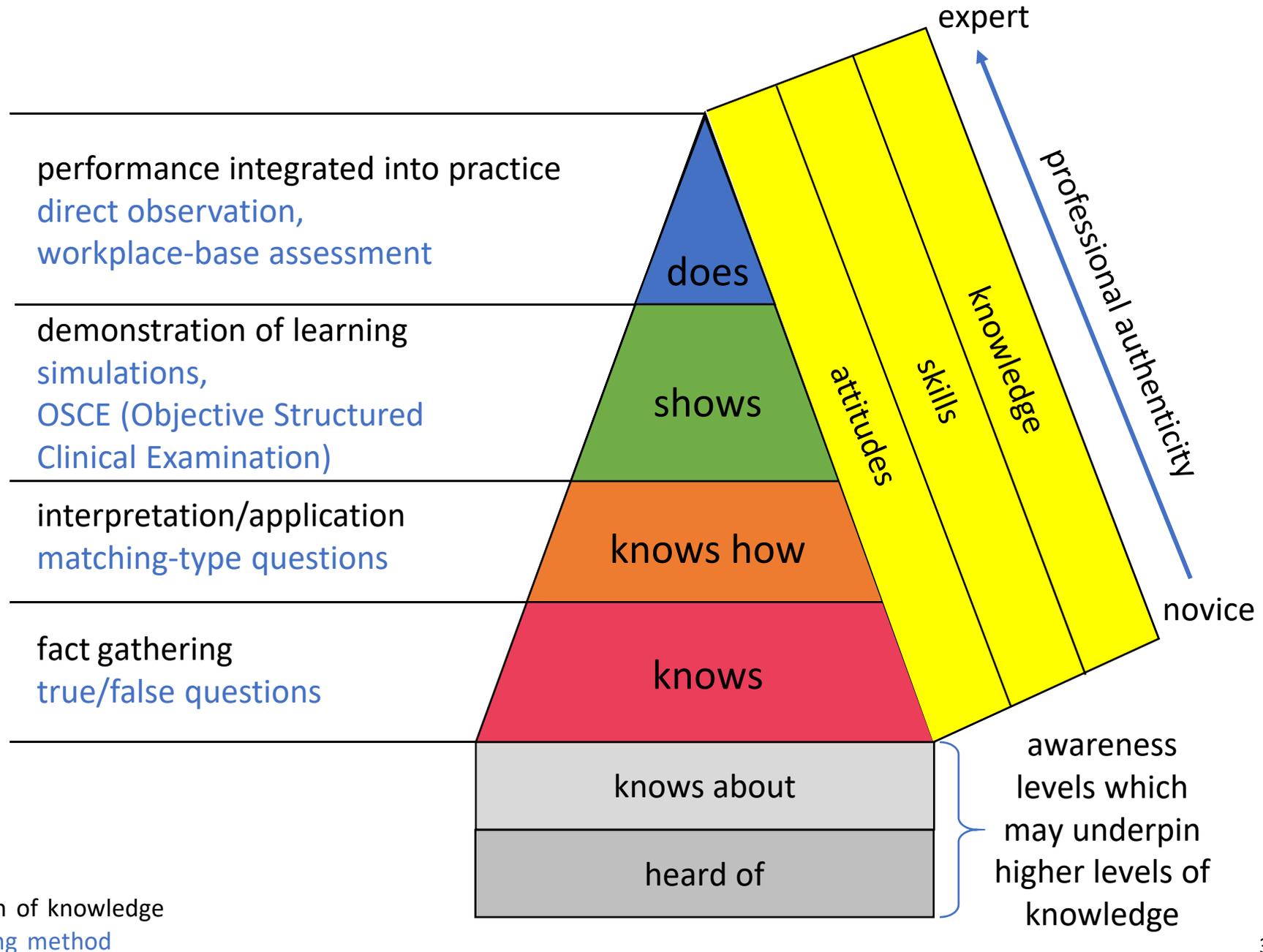
To prevent this

- Post the discussion questions visibly
- Request students to come to class with a question
- Arrange seats favoring discussions (semi-circle)
- Give sufficient time (up to a couple of minutes) for the students to think
- Vary questions (factual knowledge, opinion, non-linear thinking)
- Challenge student’s responses
- Reflect on student’s responses, clear up misconceptions without interfering too much
- Don’t allow the discussion to go off-topic
- Make sure everybody participates

Objectives and depths of learning in the cognitive domain: Bloom's taxonomy

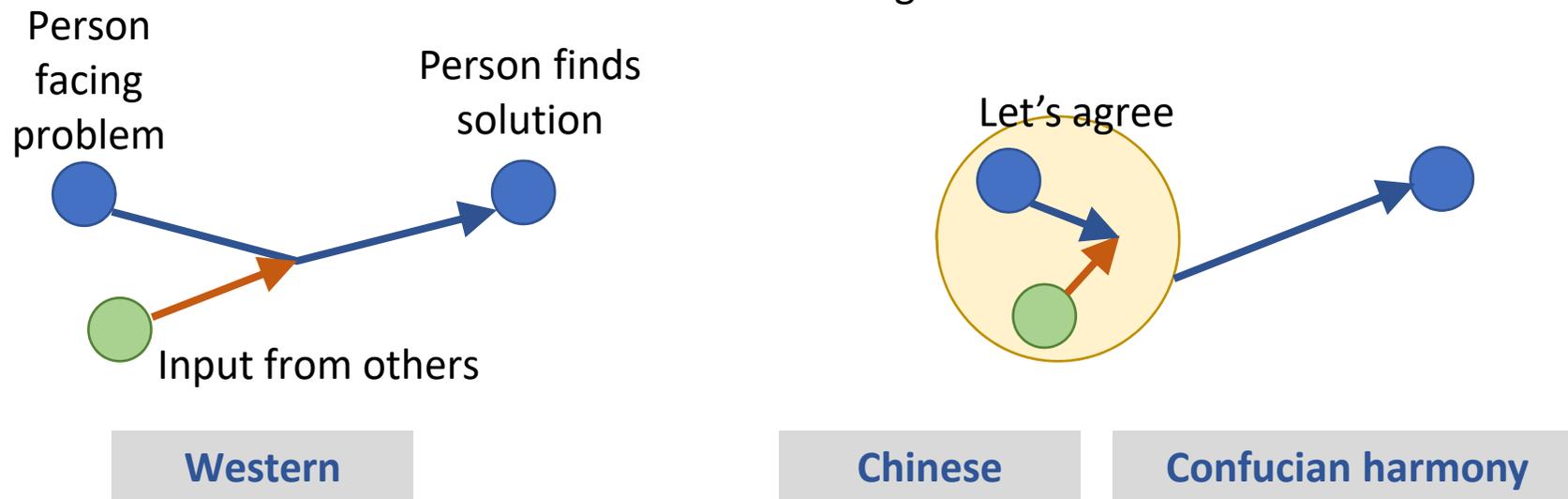


Levels of learning: Miller's pyramid



Help students succeed

- Create a safe and supportive learning environment
 - students are worried about the teacher
 - first impression at the very beginning of class
 - chat with students
 - team work
 - mutual respect (student → teacher, teacher → student, student → student)
 - be aware of national differences in attitude
 - Some Islamic male students don't respect women
 - Chinese – Western misunderstanding



Help students succeed

- Cultivate a growth mindset



- Emphasize that learning is not achieved without efforts
- “Your answer is not yet good, how could you proceed if you consider that ...”
- “Everybody can pass biophysics with a good grade”

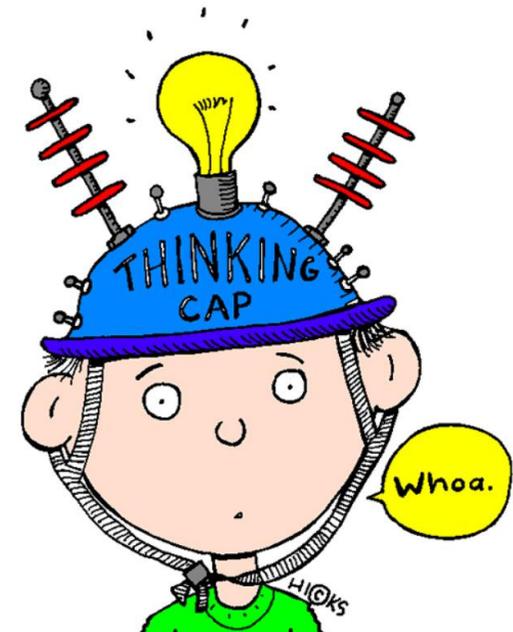
Help students succeed

- Address problems early
 - Students talking, Facebook-ing, being late
 - misbehavior must have consequences

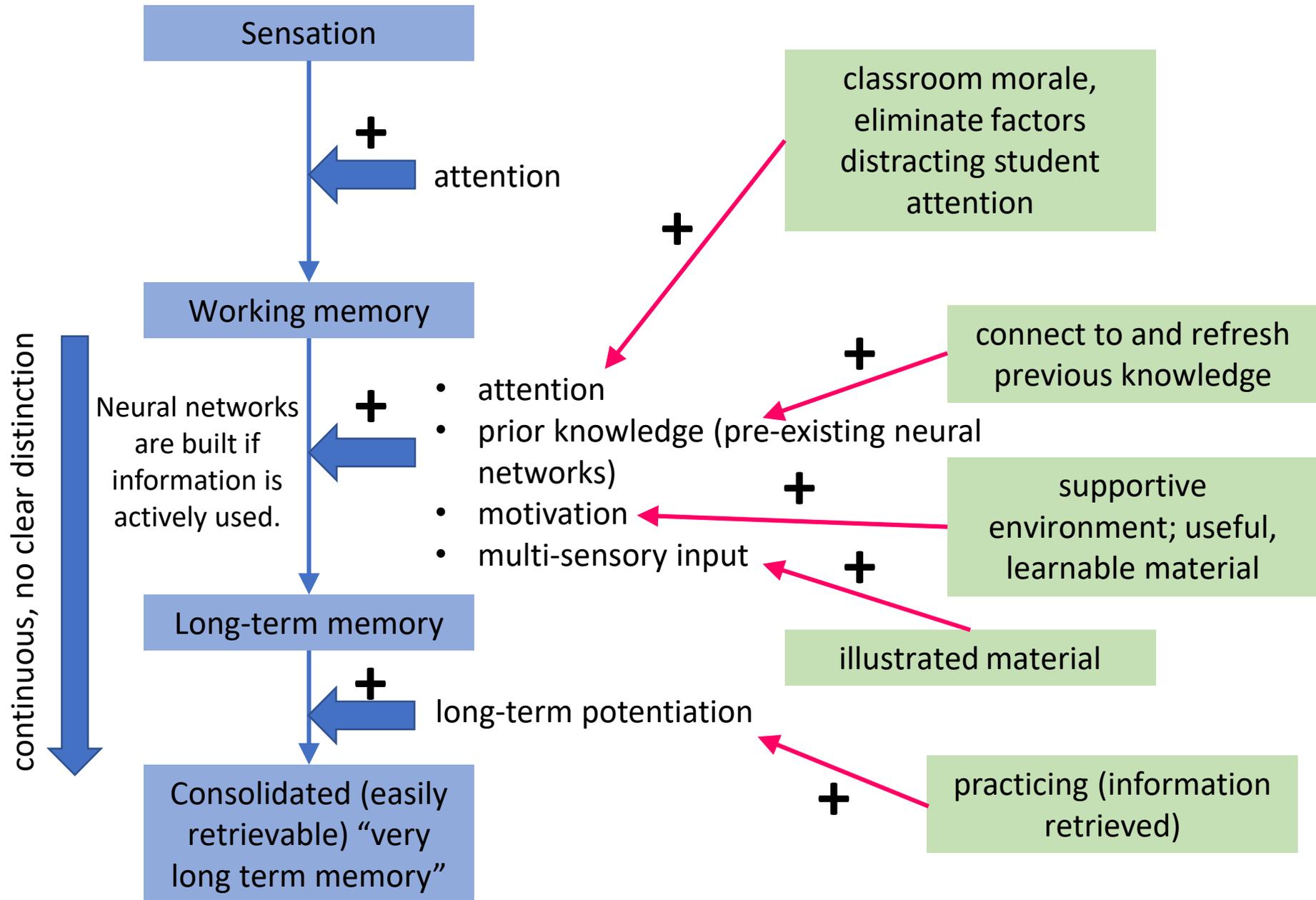
Carnegie Mellon University

<https://www.cmu.edu/teaching/solveproblem/step1-problem/index.html>

- Articulate your expectations
- Provide feedback (e.g. after presentations) regarding strengths and weaknesses
- **Activate / check prior knowledge (quiz, questions, discussion, preaching)**
 - to facilitate relating new info to old
 - to build on previous knowledge
 - so that you know what to expect



Physiological / psychological background of how to help students learn



My suggestion

1. Lecture

- “I, We, You” approach achieving only step 1 (“I”)
 - The teacher preaches and explains the notable, most (but not all) of the material
 - because we (will) have slide descriptions
(Let’s liberate the lectures.)

2. Seminar

- mixture of “I, We, You” and “You, You all, We” approaches
- engage students
- make them work at home
 - essay
 - presentation (provide exemplars for good and bad presentations)

1. establish a different lecturing / teaching culture (?)

- not focused on teaching facts
- rather on principles, deliberations...

2. always connect with the students

- fewer classes to ease the burden on teachers and students?
- same teacher for the group for the whole semester?