Notes on Effective Learning

Based on

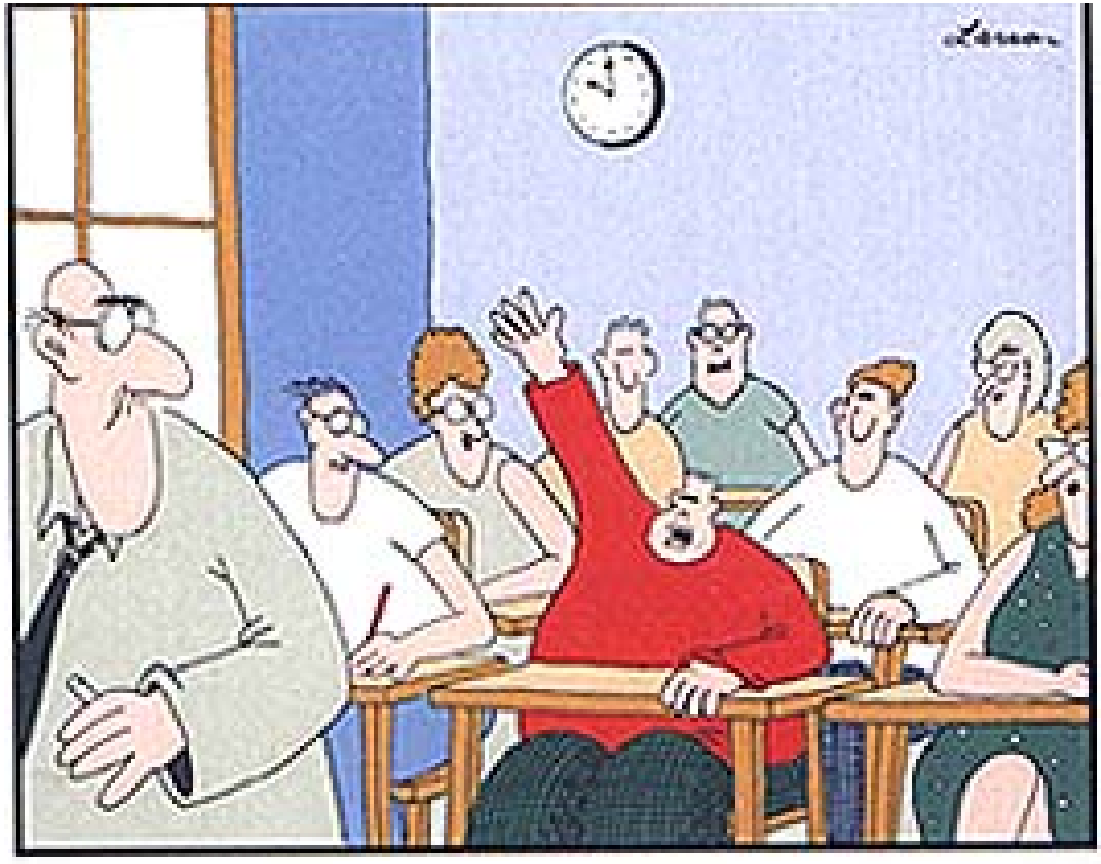
make it stick

The Science of Successful Learning

Brown, Roediger & McDaniel, 2014

January 8, 2018

There is no such thing as a full brain



"Mr. Osborne, may I be excused?
My brain is full."

There is no known limit to the capacity for learning

2010 Simon Reinhard memorized 300 random words in 15 minutes.

2008 Ben Pridmore memorized 884 shuffled playing cards in 30 minutes.

2010 Boris-Nikolai Konrad memorized 201 names and faces in 15 minutes.

Learning changes your brain

- Every time you learn something you **change your brain**.
  - Most learning involves reinforcing connections between neurons.
  - The hippocampus, important in long-term memory, actually creates new neurons throughout your life.
- But these things happen in your brain *only if they have to.*
- When learning is hard, you're improving your brain.

When you struggle with a problem, that's when you understand it. Anyone who struggled hard with a problem, never forgets it.

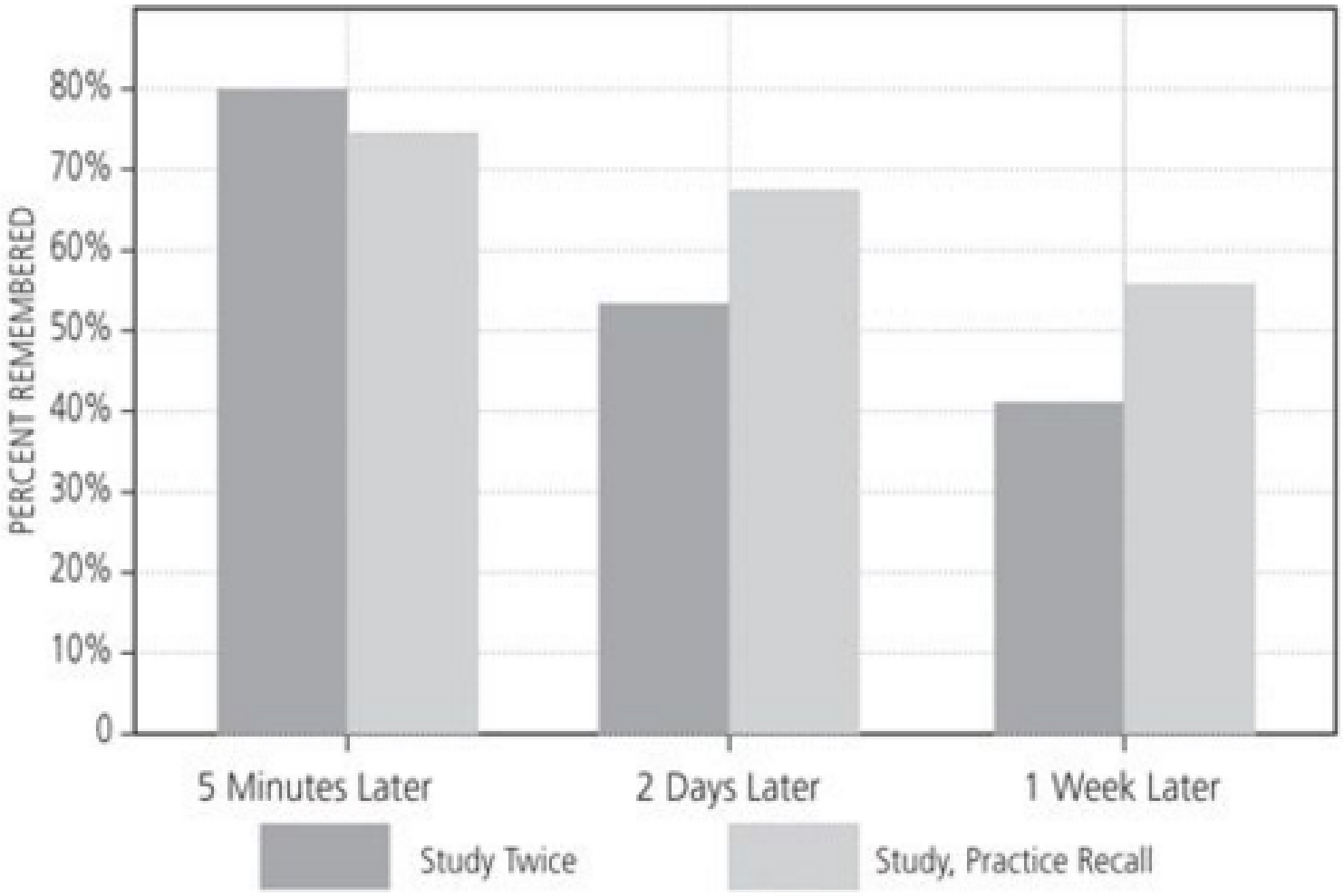
—Elon Musk
CEO, Tesla Motors, SpaceX

Learning: you're doing it wrong

- Learning is best when it's *effortful*.
- We are *poor judges* of when we are learning well.
- Bad learning habits:
  - *Rereading text* gives little benefit but leads to false sense of mastery.
  - *Massed practiced*, repeating something over and over until memorized, does not work.

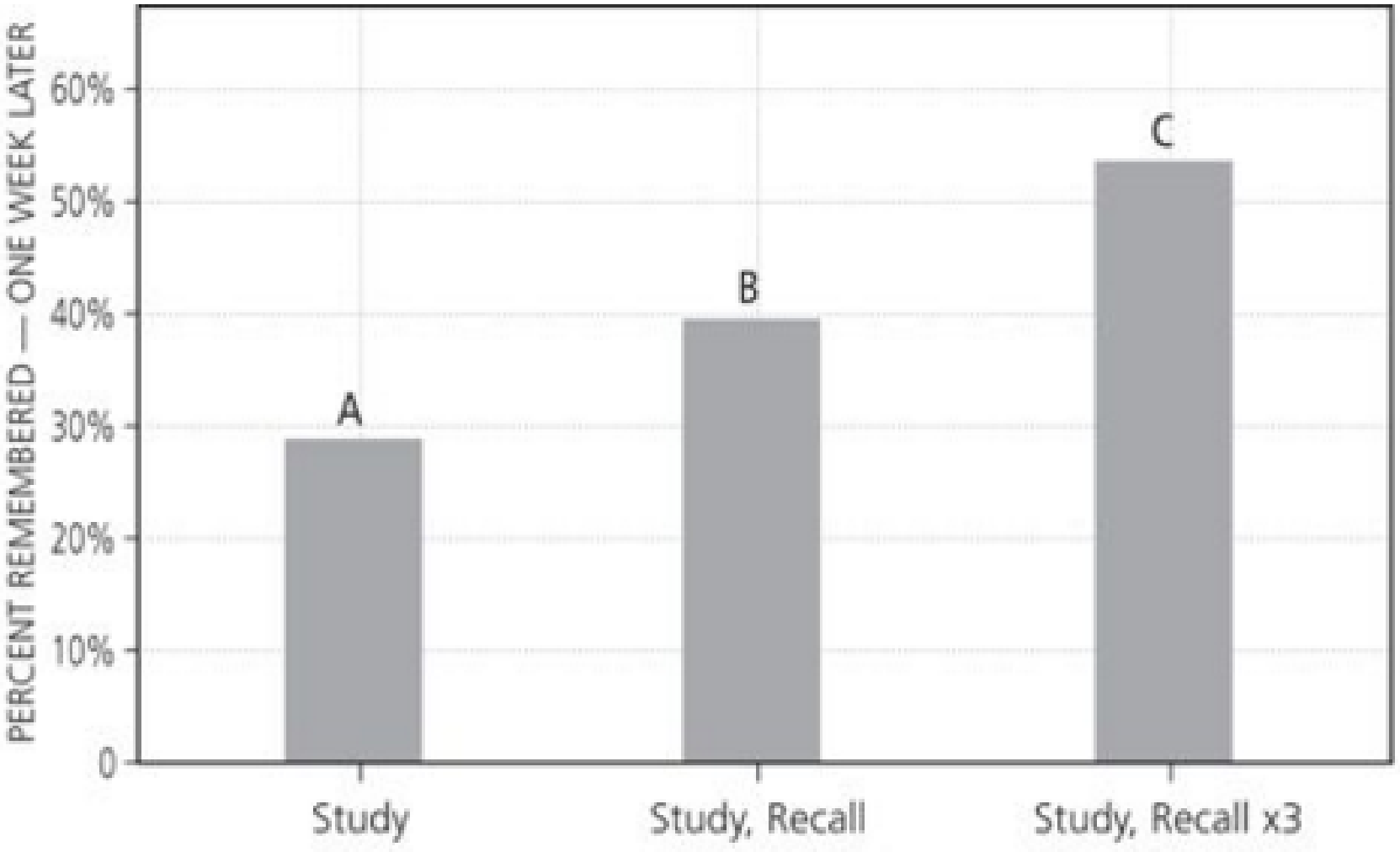
Which penny is real?

Study *vs.* Testing



TWO DIFFERENT STUDY SCHEMES (STUDY TWICE VS. STUDY + TEST)
RECALL RESULTS AFTER FIVE MINUTES, TWO DAYS, OR ONE WEEK

Testing *vs.* More Testing



THREE DIFFERENT STUDY STRATEGIES

RECALL RESULTS, ONE WEEK LATER

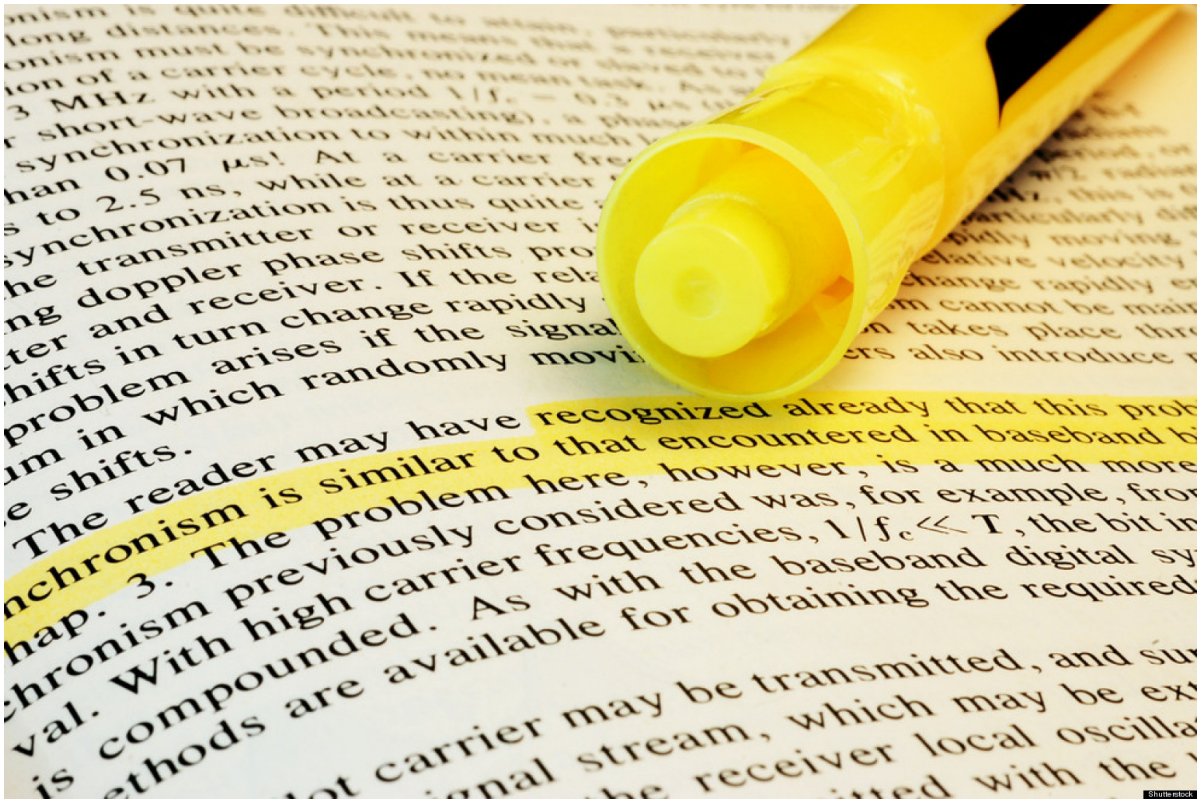
Learning: doing it right

- *Retrieval practice* is far more effective.
- Flash cards are the simplest example.

- Trying to solve a problem yourself leads to better learning,
- ... even if you try before you know how
- ... even if errors are made

We are all susceptible to **illusions** of learning

- Reading and rereading the text gives the **illusion** of fluency.
- Highlighting the text gives the **illusion** of mastery.



Testing dispells illusions

- **Testing** helps calibrate our judgements.
- Only shooting an azimuth gives us the truth.

Tests: assessment *vs.* learning tool

We are what we repeatedly do. Excellence, then, is not an act, but a habit.

—*Aristotle*

Exercise in repeatedly recalling a thing strengthens the memory.

An experiment

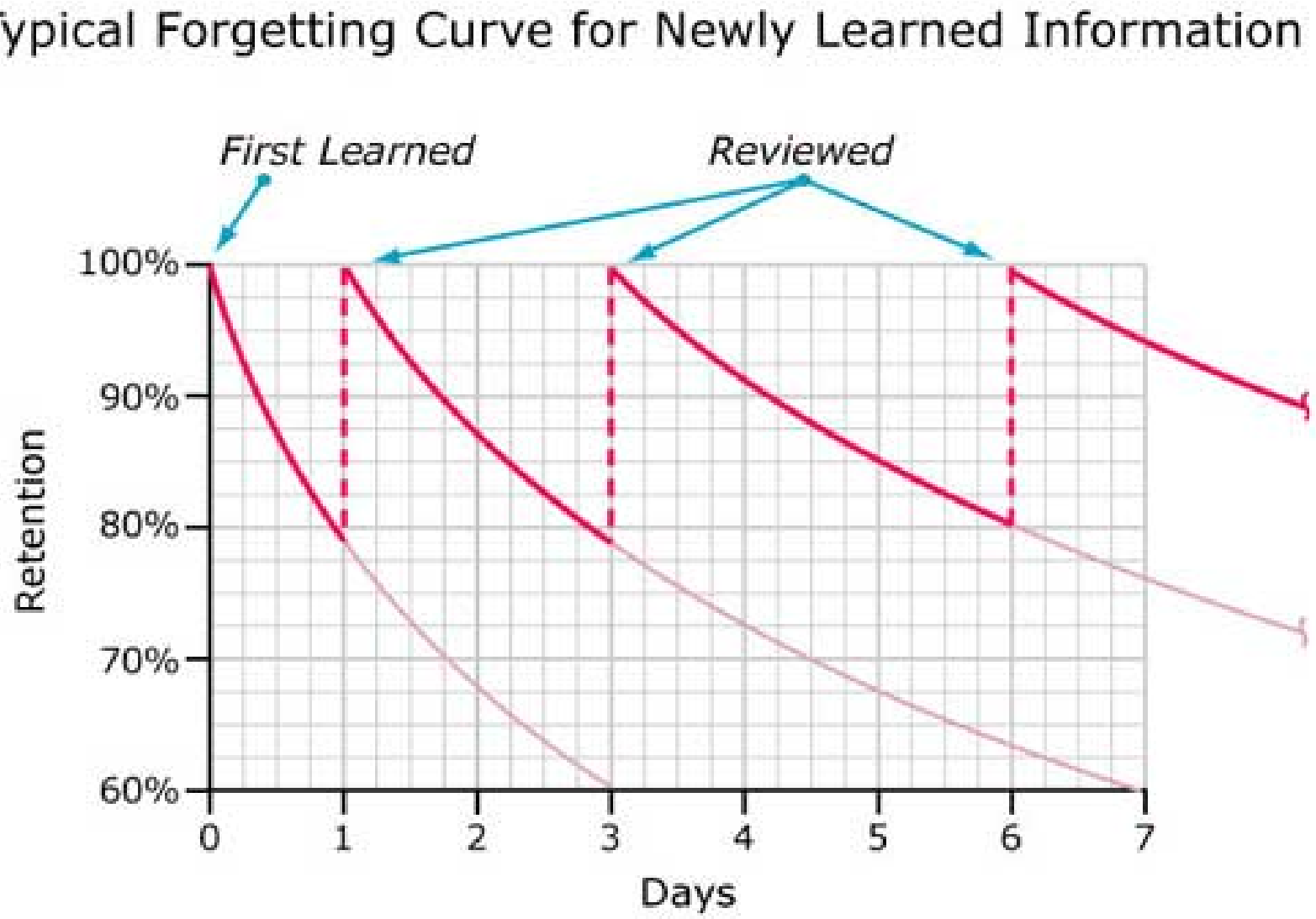
- Subjects were given passages to read.
- Some passages were immediately tested on.
- Other passages were reread.
- **Tested passages were remembered better.**

Another experiment

- Some subjects asked to memorize pairs like *foot-shoe*
- Others asked to memorize pairs like *foot-s__e*
- **Second group did substantially better.**

Quizzing is a learning tool!

Spaced repetition is the most effective



How to practice retrieving from memory

- Quiz, quiz, quiz!
- Use flash cards: `www.ankisrs.net`
- Use Cornell note taking system
  `http://lsc.cornell.edu/LSC_Resources/cornellsystem.pdf`
- Look up from the book and summarize
- Invent quiz questions as you read

- Don't listen to your intuition! Shoot an azimuth!
- Space out retrieval practice, no cramming.

Relate it to your own experience

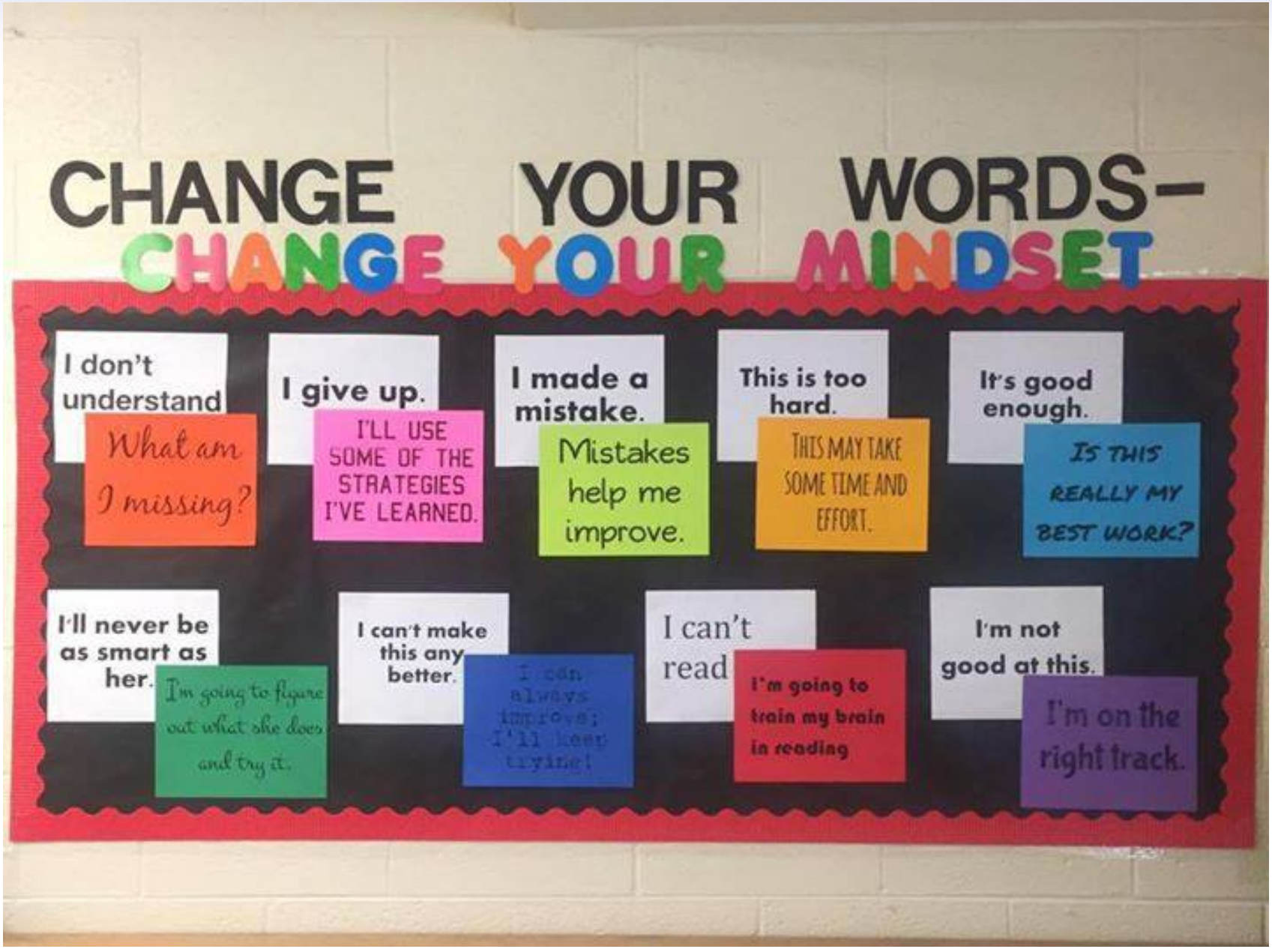
Generation: Try to answer a problem before being shown the solution.

Elaboration: Explain it in your own words and relate it to your own experience.

Reflection: Write out essays on your learning.

The Pomodoro Technique

1. Decide on a task to be done.
2. Set the pomodoro to 25 minutes.
3. Work on the task.
4. End work when the timer rings and put a checkmark on a piece of paper.
5. Take a short break (3-5 minutes).
6. After four pomodoros, take a longer break (15-30 minutes).


CHANGE YOUR WORDS–
CHANGE YOUR MINDSET
I don't understand
What am I missing?
I give up.
I'LL USE SOME OF THE STRATEGIES I'VE LEARNED.
I made a mistake.
Mistakes help me improve.
This is too hard.
THIS MAY TAKE SOME TIME AND EFFORT.
It's good enough.
IS THIS REALLY MY BEST WORK?
I'll never be as smart as her.
I'm going to figure out what she does and try it.
I can't make this any better.
I can always improve; I'll keep trying!
I can't read
I'm going to train my brain in reading
I'm not good at this.
I'm on the right track.

Wish for the new year

I hope that in this year to come, you make mistakes.

Because if you are making mistakes, then you are making new things, trying new things, learning, living, pushing yourself, changing yourself, changing your world. You're doing things you've never done before, and more importantly, you're doing something.

So that's my wish for you, and all of us, and my wish for myself. Make new mistakes. Make glorious, amazing mistakes. Make mistakes nobody's ever made before. Don't freeze, don't stop, don't worry that it isn't good enough, or it isn't perfect, whatever it is: art, or love, or work, or family, or life.

Whatever it is you're scared of doing, Do it!

Make your mistakes, next year and forever.

—Neil Gaiman
creator, The Sandman