

1. Learners remember everything. They simply cannot retrieve some information at certain times.
2. Physical education improves learner performance in mathematics and literacy.
3. Offering learners the opportunity to struggle leads to better learning.
4. Completing a significant amount of reading, note-taking, and problems leads to better learning.

To better **understand** how my **students engage** in learning and the implications on my teaching.

## Success Criteria

- I can explain key principles of how my students learn.
- I can create learning opportunities for my students that integrate these principles into my school and classroom.


We remember what we **encode**.



|         |            |
|---------|------------|
| Tractor | Ocean      |
| Green   | Nicely     |
| Apple   | Countertop |
| Zero    | Airplane   |
| Weather | Jump       |
| Pastel  | Laugh      |
| Quickly | Tall       |

| #1   | #2   |
|--|--|
| <p>Complete the following:</p> $1 + 5 = ?$<br>$2 + 4 = ?$<br>$3 + 3 = ?$<br>$4 + 2 = ?$<br>$5 + 1 = ?$ | <ol style="list-style-type: none"> <li>Choose any number between 2 and 9.</li> <li>Add it to itself and record your answer.</li> <li>Then, increase your chosen number by one and decrease your chosen number by one.</li> <li>Add the two resulting numbers. What do you notice?</li> </ol> |

Hattie, Fisher, and Frey, 2017

| #1   | #2  |
|--|---|
| <p>Order the following fractions by first finding a common denominator.</p> $19/15$ $11/15$<br>$7/12$ $41/30$<br>$5/6$ $1/2$ | <ol style="list-style-type: none"> <li>Predict where you think <math>11/8</math> should be on the below number line.</li> <li>Explain why you placed <math>11/8</math> where you did.</li> <li>Draw and label a few other points to help you explain your reasoning.</li> </ol>  |



## Representation Patterns Emotion

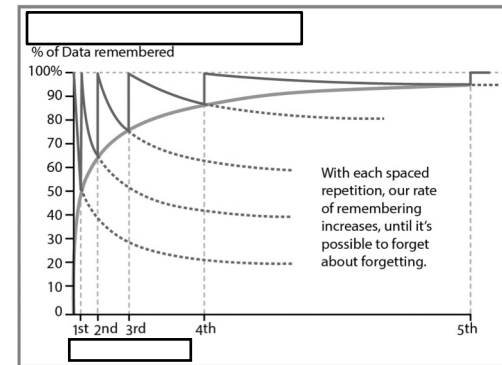
Median, 2008

### Retrieval Practice/Testing Effect

- Instead of repeated **restu**\_\_\_\_g, learners are far better off **tes**\_\_\_\_g themselves, both early and often (Roediger & Karpicke, 2006).
- The act of **retr**\_\_\_\_l is a memory **modi**\_\_\_\_r. Whatever **infor**\_\_\_\_n is **retr**\_\_\_\_d becomes strengthened (Bjork, 1975).
- With **fee**\_\_\_\_k, either by seeing the answers or **rev**\_\_\_\_g the information, the benefits of **tes**\_\_\_\_g become even more powerful (Hayes et al., 2010; Pashler et al., 2005).
- For **mult**\_\_\_\_e – **ch**\_\_\_\_e questions, have students justify why a particular answer is **cor**\_\_\_\_t and why other answers are **incor**\_\_\_\_t (Chan et al., 2006; Little et al., 2012).
- When material is studied over **sev**\_\_\_\_l **sess**\_\_\_\_s and tested in a new context, **var**\_\_\_\_g the contexts of study results in **be**\_\_\_\_r **perf**\_\_\_\_ce (Smith et al., 1978; Smith & Vela, 2001).



## The Spacing Effect



Carpenter et al., 2012; Cepeda et al., 2006; Dempster, 1988; Rohrer and Pashler, 2010

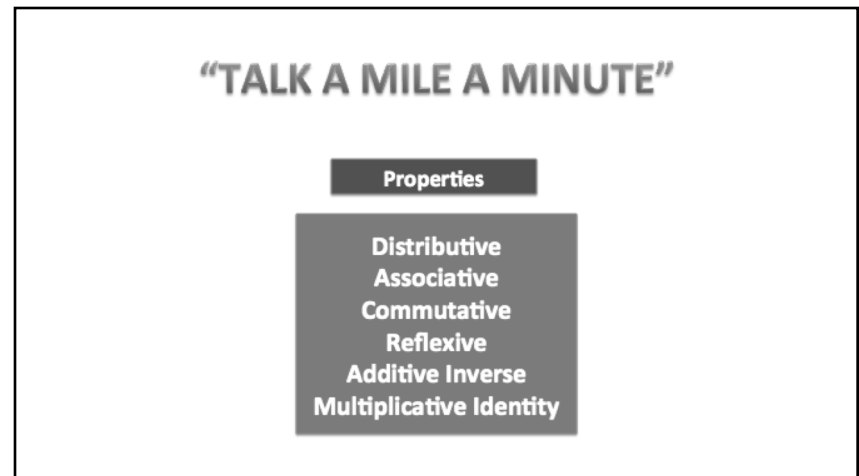
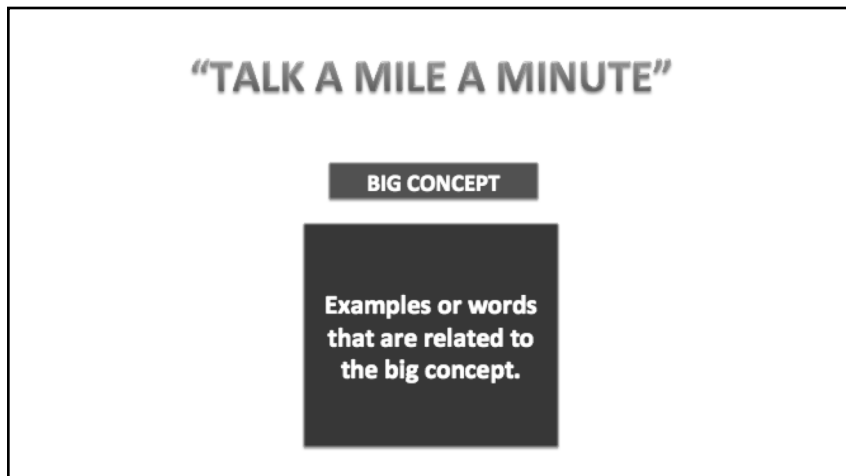
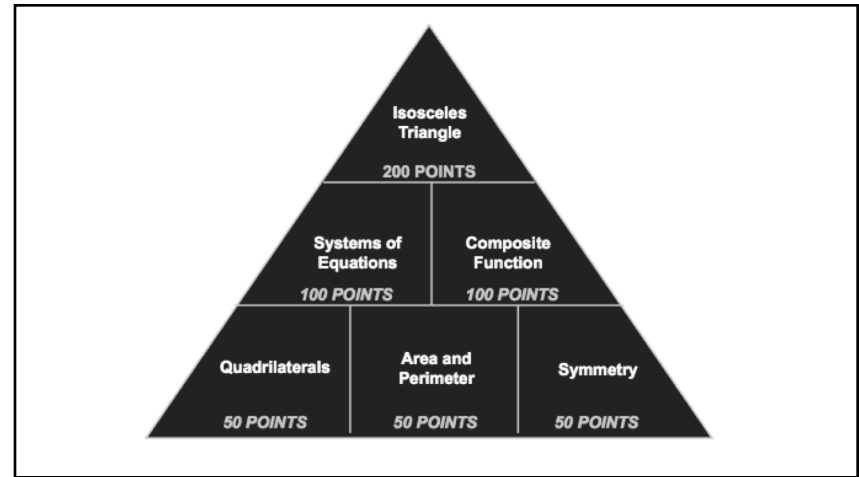
## Make Student Thinking Visible...

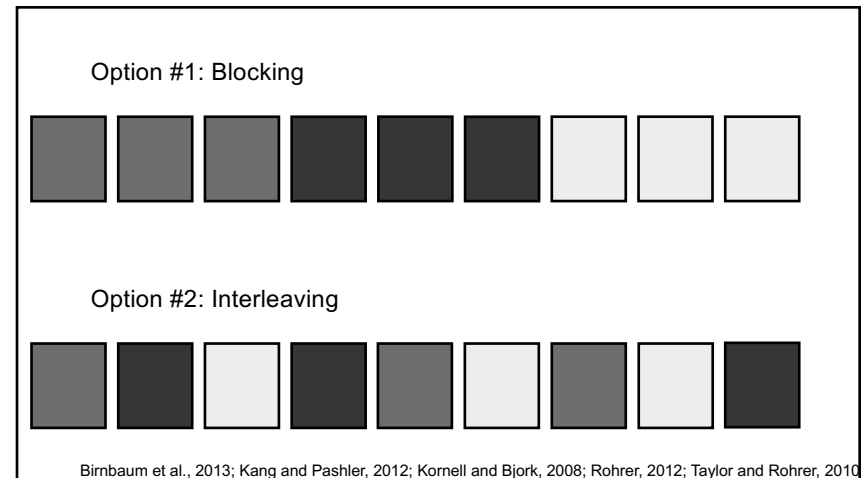
1. Ask students to ob\_\_\_\_\_ and de\_\_\_\_\_ what they "see".
2. Build ex\_\_\_\_\_ and int\_\_\_\_\_.
3. Re\_\_\_\_\_ with ev\_\_\_\_\_.
4. Make co\_\_\_\_\_.
5. Consider different v\_\_\_\_\_ and pe\_\_\_\_\_.
6. Capture the big i\_\_\_\_\_ and form co\_\_\_\_\_.
7. Promote inquiry or the a\_\_\_\_\_ of more q\_\_\_\_\_.
8. Uncover the co\_\_\_\_\_ by going below the s\_\_\_\_\_.

Ritchhart, Church, and Morrison, 2011



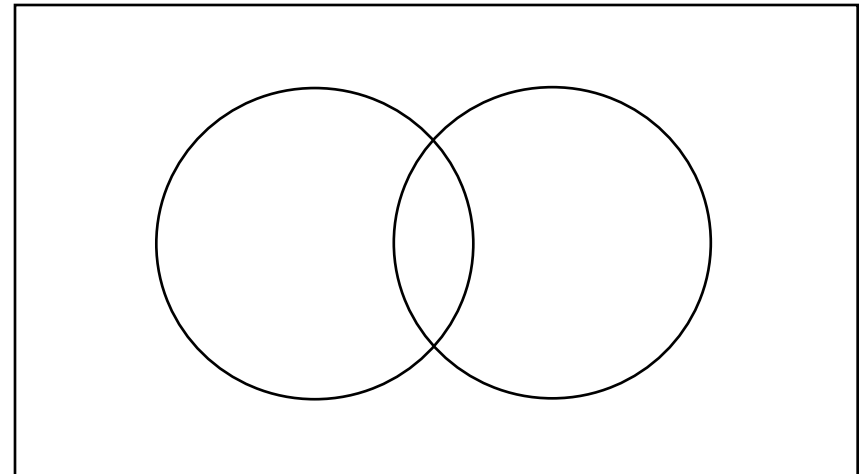


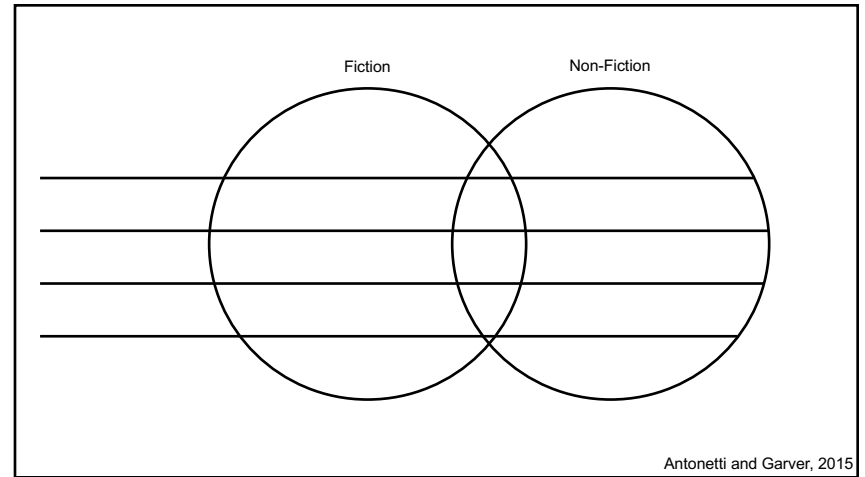
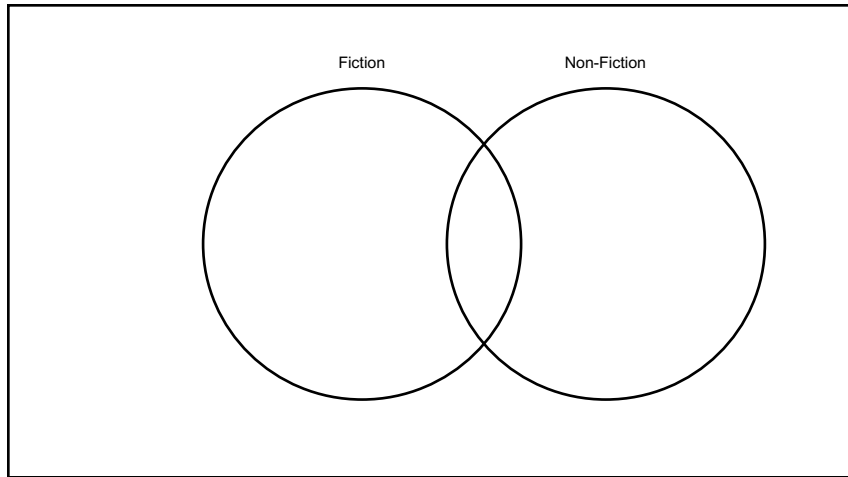





## Desirable Difficulties

1. A study **st**\_\_\_\_\_y which makes it appear that you are **le**\_\_\_\_\_g quickly now will likely not support your **ab**\_\_\_\_\_y to **rem**\_\_\_\_\_r the information later (Yan, Clark, & Bjork, 2017).
2. The most robust techniques for **l**\_\_\_\_\_g – **t**\_\_\_\_\_m **le**\_\_\_\_\_g are referred to as **de**\_\_\_\_\_e **dif**\_\_\_\_\_s (Bjork, 1994).
3. For the very same reason that these **str**\_\_\_\_\_s are effective, learners and educators alike judge them to be **ine**\_\_\_\_\_e and **inef**\_\_\_\_\_t (Yan, Clark, and Bjork, 2017).
4. There is a difference between **perf**\_\_\_\_\_e and **le**\_\_\_\_\_g.
5. However, it is not the **st**\_\_\_\_\_y that leads to **l**\_\_\_\_\_g – **t**\_\_\_\_\_m **le**\_\_\_\_\_g, but rather the **cog**\_\_\_\_\_e **pro**\_\_\_\_\_s which are engaged by these strategies (Bjork & Bjork, 2014).






## Success Criteria





- I can explain key principles of how my students learn mathematics.
- I can create learning opportunities for my students that integrate these principles into my mathematics teaching.

### NEXT STEPS



| Measure Your Baseline   | Establish a Foundation  | Join the Community   |
|---|---|--|
| Focus on the practices that have the highest impact on student learning in your context | Translate the research into action and plan and implement your first impact cycle | Connect with others around the world who are implementing Visible Learning <sup>plus</sup> |





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