Explicit Instruction
Elements Applied to Math
A Book Study

Explicit Instruction Academy
Webinar
March 17, 2020
St. Patrick’s Day ✤

Book Study

Title: How I Wish I’d Taught Maths:

Lessons learned from research, conversations with experts, and 12 years of mistakes

Author: Craig Barton
Craig Barton

- mrbartonmaths.com
- diagnosticquestions.com

A little background information

**Podcast:** Interviews
- Dylan Wiliam
- Robert & Elizabeth Bjork
- Daisy Christodoulou
- Doug Lemov

**Follow-up Research:**
- Read more than 200 books and articles
- Cognitive Science
- Research on Math/Math Instruction
- Research on Instruction
A little background information

Structure of the book

12 Key Themes
Each them broken down into ideas

Each idea consists of four sections
What I use to do
Sources of inspiration
My takeaways
What I do now

Topics

Theme
Idea
Barton’s take-aways
Archer’s take-aways
1. How students think and learn
1.2 Experts and Novices

Barton’s Take-Aways

“...experts and novices think differently.”

Two hallmarks of expertise (Didau, 2017)

1. Automaticity of foundational knowledge

Find 25% of 300

Automated Knowledge
% and meaning of percent
25% is ¼
½ of 300 = 150
½ of 150 = 75
25% of 300 = 75

“The fact you have automated much of the knowledge necessary to answer the math question frees up space in your working memory to attend to other things.”

1. Ability to see deep structure within domains of expertise

The average of teachers at a school is 36 years.
Mr. Smith’s age is 11/9 of the average.
How old is Mr. Smith?

Question is essentially asking you to find 11/9 of 36.

\[
\frac{11}{9} \times \frac{36}{1} = \frac{11}{9} \times 36 = 44 \text{ years old}
\]
1. How students think and learn
1.2 Experts and Novices

Barton’s Take-Aways

“I am now acutely aware of the fundamental importance of domain-specific knowledge. It is the distinguishing feature between expert and novice learner. Such knowledge helps our students think better acquire new knowledge, self-explain, solve problems, and become the independent learners we want them to be.”

Archer’s Take-Aways

Teach domain-specific knowledge and underlying structure.
1. How students think and learn
1.3 What are they thinking about?

Story of 6th grade fraction lesson using Swiss Rolls. Recall of 10th grader.

Barton’s Take-Aways

• Memory is the residue of thought.
• What you think about is what you learn.
• What you attend to is what you learn.

“Review each lesson plan in terms of what the student is likely to think about. This sentence may represent the most general and useful idea that cognitive psychology can offer teachers.” Willingham (2009)

Archer’s Take-Away

What you think about is what you learn.

2. Motivation
2.8 Achievement and Motivation

Barton’s Take-Aways

“The more success students have experienced, the more likely they are to be motivated to work harder. Rather than motivation resulting in improved performance, it seems that improved performance leads to increased motivation.” Didau & Rose (2016)

“Motivation is directly influenced by achievement. If students are successful and believe that can be successful, they will be motivated.”

“I can have a positive influence on this driver of motivation, not through tricks and gimmicks, but through good teaching.” Barton, 2018

Archer’s Take-Aways

Success breeds Success
Motivation may not predict Achievement BUT
Achievement does predict Motivation

How well I teach = How well they learn
3. Explicit Instruction

3.1 What makes great teaching?

Barton’s Take-Aways

“I strongly favor an explicit instructional model of teaching, especially in the early knowledge acquisition phase of learning. So, when I am introducing a topic for the first time, regardless of the age or prior achievement of the class, I will use an explicit instruction approach.”

Reviews of what makes great teaching:


*What makes great teaching*. Coe et al, 2014


Rosenshine’s *Principles of Instruction*

1. Begin a lesson with a short review of previous learning.
2. Present new material in small steps with student practice after each step.
3. Ask a large number of questions and check the responses of all students.
4. Provide models.
5. Guide students’ practice.
6. Check for student understanding.
7. Obtain a high success level.
8. Provide scaffolds for difficult tasks.
9. Require and monitor independent practice.
10. Engage students in weekly and monthly review.

Archer’s Take-aways

16 Elements of Explicit Instruction
5. Self-Explanations

5.1 The Self-Explanation Effect

Barton’s Take-Aways (Read these statements and underline three critical ideas.)

- Self-explaining is NOT explaining concepts to others ... It is the simple act of pausing and reflecting on a simple step in a solution, a concept, or an explanation. It is asking yourself, ‘what does this mean?’, ‘why am I writing this?’, and ‘how does this step follow on from the last?’

...the impact on learning of such self-explanations can be profound. Indeed, the Self-Explanation Effect – where learners who attempt to establish a rationale for the solution steps by pausing to explain the examples to themselves appear to learn more than those who did not – has been observed and replicated across multiple domains and ages of students.

Archer’s Take-Aways
6. Making the most of Worked Examples

6.1 Worked Example Effect

Barton’s Take-Away

The “Worked Example Effect” is the name given to the widely replicated finding that novice learners who try to learn by solving problems perform worse on subsequent test problems, including transfer problems different from the ones seen previously, than comparable learners who learn by studying equivalent worked examples. Sweller et al, 1998; Atkinson et al, 2000

6.2 Example Problem Pairs

Barton’s Take-Away

1. Diagnostic multiple-choice questions to assess baseline knowledge (e.g., adding fractions with like denominators, fractions equal to one whole).

2. During introduction of the new concept and the subsequent worked example, students are silent and focused.

3. I model the solution in silence first.

<table>
<thead>
<tr>
<th>Worked Example</th>
<th>Your Turn</th>
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<tbody>
<tr>
<td>( \frac{3}{5} + \frac{1}{4} = )</td>
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Worked Example

Your Turn

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\( \frac{3 \times 4}{5 \times 4} + \frac{1 \times 5}{4 \times 5} = \)

\( \frac{12}{20} + \frac{5}{20} = \)
6. Making the most of Worked Examples

6.2 Example Problem Pairs

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\frac{12}{20} + \frac{5}{20} = \frac{17}{20}
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2. During introduction of the new concept and the subsequent worked example, students are silent and focused.

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4. Once I have finished my silent solution, I pause. I then narrate and/or annotate over the top.
### 6. Making the most of Worked Examples

#### 6.2 Example Problem Pairs

**Barton’s Take-Away**

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7. Students try the paired problem in absolute silence, writing on white boards.

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Archer’s Take-Away

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6. I ask students to try the paired problem.
7. Students try the paired problem in absolute silence, writing on white boards.
8. If I see an example of a student’s work that is set out really well, I will use show-call, displaying the completed problem using a document camera.
7. Choice of Examples and Practice Questions
7.1 Examples v Definitions

Barton’s Take-Away

“Instead of starting with the definition and explanation of a concept, I start with examples. Once students have seen a reasonable number of carefully chosen examples and non-examples, they form their own interpretation of the concept, and hence are in a much better place to understand and appreciate the subsequent definition.”

Archer’s Take-Away

Vocabulary Instructional Routine

Step 1: Introduce the word’s pronunciation.

Step 2: Introduce the word’s meaning.

Step 3: Illustrate the word with examples.
(and non-examples when helpful)

Step 4: Check students’ understanding.
Examples and Non-Examples First
Vocabulary Instructional Routine

**Step 1:** Introduce the word’s pronunciation.

**Step 2:** Illustrate the word using examples and non-examples.

**Step 3:** Have students determine the critical attributes.

**Step 4:** Introduce the word’s meaning using a formal definition.

**Step 5:** Check understanding using examples and non-examples.

---

**Step 1.** Introduce the word’s pronunciation.

a) Show the word on the screen.

b) Read the word and have the students repeat the word.

If the word is difficult to pronounce or unfamiliar, have the students repeat the word a number of times or say the parts of the word as they tap.

Next, have students orally spell the word.

*Introduce the word with me.*

This word is **polygon**. What word? *polygon*

Tap and say the parts of the word. *pol y gon*

Spell polygon with me. *polygon*

What word? *polygon* *poly* means *many*
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 2. Illustrate the word using examples and non-examples.

“I am going to show you some examples and non-examples of a polygon.”

“Your job is to think: What are the critical attributes of a polygon?”

Instructional Routine

Step 2. Illustrate the word using examples and non-examples.

Examples of a Polygon | Non-Examples of a Polygon
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 3: Have students determine the critical attributes.

- Ask students to write down the critical attributes.

- Have students compare the critical attributes with those of their partners or team members.

Examples and Non-Examples First
Vocabulary Instructional Routine

- Step 4: Introduce the word’s meaning using a formal definition.

**polygon**

- closed figure
- 2 dimensional shape
- straight sides
- number of angles = number of sides
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5:  Check understanding using examples and non-examples.

“Look carefully at the shape. Decide if it is a polygon or not. When I say show me, put you hand in the air and form the American sign for YES (it’s a polygon) or NO (it is not a polygon). Show me YES. (Students show YES sign.) Show me NO. (Students show a NO sign.) Be ready to tell your partner WHY.”

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Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5:  Check understanding using examples and non-examples.
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5: Check understanding using examples and non-examples.

![Example Image]

WHY?
Examples and Non-Examples First
Vocabulary Instructional Routine

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Examples and Non-Examples First
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Examples and Non-Examples First
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**Step 1. Introduce the word’s pronunciation.**

a) Show the word on the screen.

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   If the word is difficult to pronounce or unfamiliar, have the students repeat the word a number of times or say the parts of the word as they tap. Next, have students orally spell the word.

*Introduce the word with me.*

This word is **equation**. What word? **equation**

Tap and say the parts of the word. **e qu a tion**

Spell equation with me. **Equation**

What word? **equation**
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 2. Illustrate the word using examples and non-examples.

“I am going to show you some examples and non-examples of an equation.”

“Your job is to think: What are the critical attributes of an equation?”

<table>
<thead>
<tr>
<th>Example</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>4x</td>
<td>x</td>
</tr>
<tr>
<td>4x + x</td>
<td>x</td>
</tr>
<tr>
<td>4x + 1</td>
<td>x</td>
</tr>
<tr>
<td>4x + 1 = x</td>
<td>x</td>
</tr>
<tr>
<td>4x + 1 = 7</td>
<td>yes</td>
</tr>
<tr>
<td>4 x + 1 = x</td>
<td>yes</td>
</tr>
<tr>
<td>4 x + 1 = y</td>
<td>yes</td>
</tr>
<tr>
<td>4x + 1 = x²</td>
<td>yes</td>
</tr>
<tr>
<td>4 + 1 = 5</td>
<td>yes</td>
</tr>
<tr>
<td>4 + 1 = 5 = x</td>
<td>x</td>
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Examples and Non-Examples First
Vocabulary Instructional Routine

Step 3: Have students determine the critical attributes

- Ask students to write down the critical attributes.
- Have students compare the critical attributes with those of their partners or team members.

Note: This vocabulary example is based on the work of Craig Barton in his book *How I Wish I’d Taught Maths* (2018).

Examples and Non-Examples First
Vocabulary Instructional Routine

• Step 4: Introduce the word’s meaning using a formal definition.

equation
  • a mathematical statement
  • that 2 things are equal
  • indicated by an equal sign =

equation
equal
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5: Check understanding using examples and non-examples.

“Look carefully. Decide if it is an equation or not. When I say show me, put your hand in the air and form the American sign for YES (it’s an equation) or NO (it is not an equation). Show me YES. (Students show YES sign.) Show me NO. (Students show a NO sign.) Be ready to tell your partner WHY.”

15 + x = 40
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5: Check understanding using examples and non-examples.

15 = x

Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5: Check understanding using examples and non-examples.

15 + x + y
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5: Check understanding using examples and non-examples.

$X = 15 - y$
Examples and Non-Examples First
Vocabulary Instructional Routine

Step 5: Check understanding using examples and non-examples.

\[ Y = 75 + x = 4x \]
New Book – February 28, 2020

Our Next Webinar

Date:  April 21, 2020

Topic:  Homework

If you have specific homework questions, please send them to archerteach@aol.com
My prayers for you and your students.

May you be well.
May your family members and friends be well.
May you be safe.
May your family members and friends be safe.

May your students be well.
May their family members be well.
May your students be safe.
May their family members be safe.

May we be kind to ourselves.
May we be kind to ALL.

A little kindness music
Kindness ---- Scott Perry.mp3