1. Introductions
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Introductions
Name
Where you’re From
Grades/Subjects you Teach/Your Role
An Experiment
How many key ideas can you recall?

What was that about?
The procedure is actually quite simple. First you arrange things into different groups... Of course, one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities that is the next step, otherwise you are pretty well set. It is important not to overdo any particular endeavour. That is, it is better to do too few things at once than too many. In the short run this may not seem important, but complications from doing too many can easily arise. A mistake can be expensive as well... At first the whole procedure will seem complicated. Soon, however, it will become just another facet of life. It is difficult to foresee any end to the necessity for this task in the immediate future, but then one never can tell. After the procedure is completed one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually they will be used once more and the whole cycle will have to be repeated. However, that is part of life.

(Bransford and Johnson 1972)
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(Bransford and Johnson 1972)
Bransford and Johnson (1972)

- Group One: Read the passage without context
- Group Two: Knew the passage was about doing laundry before reading
- Group Three: Read the passage without context, but was told after the context after reading
When should we Activate Prior Knowledge?

Bransford and Johnson (1972)

- **Having** prior knowledge does not guarantee that it’s useful

- Prior knowledge must be activated in a schematic context
What are Schemas?

As we learn new information, our brains work to categorize what we are learning into our memory structures (schemas).
Neurons that fire together, wire together – (Higgins & George, 2019)
What is Schema-Based Teaching and Lesson Design?

Teachers can exploit the connectivity of these neural networks.
Schema-based teaching and lesson design

- Understands students’ past experiences
- Gently reteaches incorrect or facile assumptions
- Emphasizes the context of new learning
What does Schema-Based Lesson Design look like in Practice?

- Consciously plan experiential learning tasks that provide students with background knowledge
- Engage context
- Use new knowledge and context to play to the congruency effect
Deeper Learning Technique: Critical Exploration
Critical exploration, then, as a research method, has two aspects:

1) developing a good project for the child to work on; and

2) succeeding in inviting the child to talk about her ideas: putting her at ease, being receptive to all answers; being neutral to the substance of the answer while being encouraging about the fact that the child is thinking and talking; getting the child to keep thinking about the problem, beyond the first thought that comes to her; getting her to take her thinking seriously. – Duckworth (2005)
Mirror Exploration
Focus Question: Where would you place a mirror on the wall so that you can see your partner in the mirror?
Mirror Exploration

- Get into groups of three
- There will be two lookers and one placer
- Lookers need one post it note per person
- The placer needs a post it note and a small mirror
The lookers will stand any distance from the wall, making a V shape.

Lookers will place a post it note on the floor exactly where their feet are.
Mirror Exploration

- Go to the middle and talk about where to place the mirror on the wall so that the lookers can see each other, without shifting position.

- The group will decide where to place the mirror on the wall, using the placer’s post it note as a visual.
Mirror Exploration

- Lookers return to their spots
- Placer positions the mirror directly over the post it note
- Can the two lookers see each other?
Focus Question: Where would you place a mirror on the wall so that you can see your partner in your mirror?

Remember:

- Talk about your ideas first then try them.

- The placer should **place** the mirror. If that placement didn’t work go back to the middle and try again.

- When an idea works, try to replicate your results under different conditions, or try a different idea.

- Work as a group to explain what worked, what didn’t work, and why.
Mirror Exploration

- Get into groups of three
- There will be two **lookers** and one **placer**
- **Lookers** need one post it note per person, the **placer** needs a post it note and a small mirror
- The Lookers will stand any distance from the wall, making a V shape
- Lookers will place a post it note on the floor exactly where their feet are
- Gather in the middle and talk about where to place the mirror on the wall so that the Lookers can see each other, without shifting position
- The group will decide where to place the mirror on the wall, using the placer’s post it note as a visual
- Lookers return to their spots
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Mirror Exploration Debrief
Mirror Exploration Debrief

What did you notice?
What worked? What didn’t work?
What surprised you? What puzzled you?
Where would you go from here?
**WHAT DOES THIS EXPLORATION SHOW?**

Light will take the shortest, most direct path -

Fermat’s Principle

The Angle of Incidence is Equal to the Angle of Reflection -

Snell’s Law

\[
\frac{n_1}{\sin \theta_i} = \frac{n_2}{\sin \theta_r}
\]

Snell’s law
Snell's Law in Practice

This is a worksheet for Snell's law

\[ n = \frac{c}{v} \]
\[ c = \text{speed of light in vacuum} = 3.00 \times 10^8 \text{ m/s} \]
\[ v = \text{speed of light in the material} \]

Snell's Law

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]

1) For the drawing to the right, find \( n_2 \).
What else could this teach?

How mirrors work
Perspective-taking
Introduction to angles
Rays
Reflections and symmetry
Deeper Learning Competencies

**CONTENT MASTERY**
Students apply knowledge to real world situations.

**COLLABORATION**
Students work with their peers, assume leadership roles, resolve conflicts, and manage projects.

**SELF DIRECTED LEARNING**
Students use teacher feedback to monitor and direct their own learning, both in and out of the classroom.

**CRITICAL THINKING & PROBLEM SOLVING**
Students consider a variety of approaches to produce innovative solutions.

**EFFECTIVE COMMUNICATION**
Students demonstrate skills in active listening, clear writing, and persuasive presentation.

**ACADEMIC MINDSET**
Students feel a sense of belonging and motivation to persist through their school work.
What about the CCSS?
Balancing Schema-Based Teaching with CCSS

“The Common Core...stresses critical-thinking, problem-solving, and analytical skills that are required for success in college, career, and life.”
Critical Exploration and the CCSS

Critical Exploration allows learners to engage in projects and activities which help them to construct meaning for high-level learning concepts.
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An Example - The Distributive Property

Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find $8 \times 7$ as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$.

(Distributive property.)
The Distributive Property - A Critical Exploration

Make a 4x6 array with tiles

Take a pipe cleaner and lay it across one of the seams in your array
Record the multiplication fact pairs for the two smaller arrays

How do they compare to the larger array?

\[(1 \times 6) + (3 \times 6) = 6 + 18 = 24\]
The Distributive Property - A Critical Exploration

Record the multiplication fact pairs for the two smaller arrays:

How do they compare to the larger array?

\[(4 \times 2) + (4 \times 4) = 8 + 16 = 24\]
Repeat this process until you run out of places to put your pipe cleaner.

What do you notice? Does placing the pipe cleaner on top of your array change its value?

How do the recorded multiplication fact pairs relate to the larger array?
Once students have explored the concept and constructed a knowledge base, the teacher can move the students toward an abstract, algorithmic understanding.
Three Things to keep in mind When Designing a Schema-Based Critical Exploration

1. Students bring their prior expectations, knowledge, and misconceptions to the learning experience

2. Students need something complex that challenges them to explore

3. The teacher is a facilitator with a research mindset
Questioning Techniques to Facilitate Deeper Learning
What’s Wrong With Yes or No Questions?
What's Wrong With Yes or No Questions?

Yes or no answers don’t inform the teacher about where a student is in their process

Yes or no answers don’t encourage problem solving

Yes or no answers don’t encourage discussion

Yes or no answers provide a stopping point, rather than encouraging further exploration

Yes or no answers don’t encourage revision – If it’s not yes, it must be no!
What else can we ask?

Try:

“How do you know...?”

“How can you prove...?”

“What happens when...?”

“Tell me why...”

“How is this similar to...?”

“In what different ways can you...”
Your turn

Think of a lesson or concept that is difficult to teach

Develop a few guiding questions and begin brainstorming ideas for a Critical Exploration
Share and Take Aways
Thank you!

Feedback Form:
http://tinyurl.com/yxalz6yp

Caroline Hammel
carolinemhammel@gmail.com