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A Scaffolding Spectrum for IBL

<https://tinyurl.com/2p86w6j5>

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Goals

- What is the right amount of scaffolding for an IBL activity?
- See examples of IBL activities with different amounts of scaffolding



A Definition of IBL

- From the Academy of Inquiry Based Learning:

*“IBL is a form of active learning in which students are given a carefully **scaffolded** sequence of mathematical tasks and are asked to solve and make sense of them, working individually or in groups.”*

<http://www.inquirybasedlearning.org/what-is-ibl>



Excerpt from Calculus IBL Activity

Horizontal Distance (in miles)	Elevation (in feet)
3.1	1732
3.3	1827
3.4	1925
3.45	1954
3.5	1995
3.55	2036
5.1	3056

Find the slope between the starting point and the ending point of the Dismal Trail.

Added Scaffolding

- 1 What units are used to measure the horizontal distance? What units are used to measure elevation?
- 2 What is the elevation at the beginning of the Dismal Trail? What is the elevation at the end of the Dismal Trail? What is the total elevation gain over the Dismal Trail?
- 3 Find the slope between the starting point and the ending point of the Dismal Trail.
- 4 **Check:** Were the units of all quantities in the last question consistent? If not, go back and fix your answer.



Functional “Definitions” of Scaffolding

- Breaking a complex problem/question into more manageable bits
- Asking questions to focus and direct student attention



**Very Little
Scaffolding**

**Lots of
Scaffolding**





Related Rates Scaffolding

- 1 Read the problem carefully.
- 2 Draw a diagram if possible.
- 3 Assign symbols to all quantities that are functions of time.
- 4 Express the given information and the required rate in terms of derivatives.
- 5 Write an equation that relates the various quantities of the problem.
- 6 Use the Chain Rule to differentiate both sides of the equation with respect to t .
- 7 Substitute the given information into the resulting equation and solve for the unknown rate.





POGIL stands for . . .

- Process
- Oriented
- Guided
- Inquiry
- Learning

Process Oriented

- Students work in self managed teams
- Each student has a role, which helps them develop teamwork skills and forces (or encourages) them to work together
- Roles could include: manager, reader, spokesperson, recorder, consensus builder, encourager, strategy analyst
 - Roles are designed to be interdependent
 - Reader prevents one person rushing ahead



From Concrete to Abstract

Both available in google drive <https://tinyurl.com/2p86w6j5>

- Meta-POGIL
- Average Velocity

Check <https://pogil.org/> for lots more on POGIL, including upcoming workshops.





- Inquiry Oriented Linear Algebra
(<https://iola.math.vt.edu/>)
- Inquiry Oriented Differential Equations
(<https://iode.sdsu.edu/>)

- Consists of activities to guide students toward learning key concepts
- Activities provide most of a course in Linear Algebra
- Instructor needs to supplement row reduction, determinants, . . .

First ioLA Task in google drive

<https://tinyurl.com/2p86w6j5>

(This paraphrases the first activity.)

You have a hover board that in one hour travels from the origin to

$\begin{bmatrix} 3 \\ 1 \end{bmatrix}$. You also have a magic carpet that in one hour travels from the

origin to $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$. Can you get to the location $\begin{bmatrix} 107 \\ 64 \end{bmatrix}$? Justify your answer.





Few Guard Rails

- Method was invented by Robert Moore
- People have called this method the “Moore Method” or the “Modified Moore Method”
- Moore was racist (and other “-ist”s)
- Because of that racist legacy, there is a call to have a different name for this method



Few Guard Rails Description

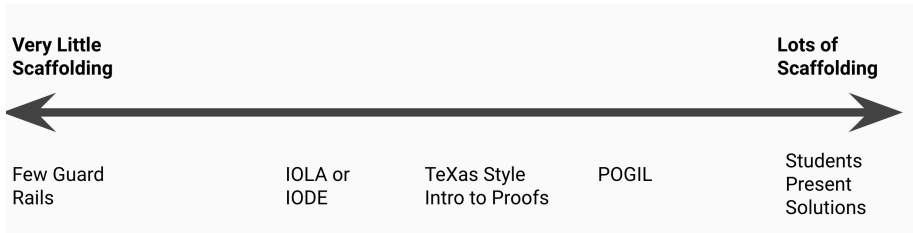
- Provide set of “notes” consisting of definitions and theorems to prove
- Students work outside class to prove the theorems.
- Class time is devoted to student presentations.
- Students come to consensus on whether a presentation is correct.
- I found grading to be a bear.



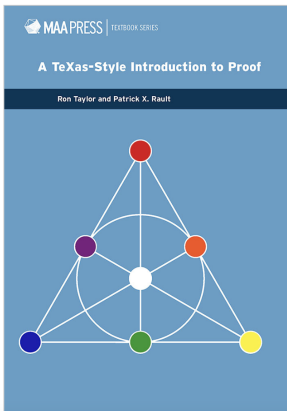
Few Guard Rails Example

Available in google drive <https://tinyurl.com/2p86w6j5> .





Intro to Proofs Textbook



Click above image for expanded view

A TeXas Style Introduction to Proof

Ron Taylor

Patrick X. Rault



MAA Press: An Imprint of the American Mathematical Society

eBook

eBook ISBN: 978-1-61444-625-5

Product Code: TEXT/35.E

List Price: \$59.00

MAA Member Price: \$44.25

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available here <https://bookstore.ams.org/text-35/>.



Pros of Heavy Scaffolding



Cons of Heavy Scaffolding



Pros and Cons of Heavy Scaffolding

Pros

- Sol Methods are more uniform
- Students get stuck less
- Scaffolding provides good study aids

Cons

- Sol Methods are more uniform
- Less practice in problem solving and stretching
- Inspires less creativity



Closing Thoughts

- I started at the right (more scaffolding) and have moved to the left over the years
- Lower-level classes tend to need more scaffolding
- Think about the amount of scaffolding that aligns with the goals of your class
- Mix and Match
- Use a method that makes sense for you



Thank you!

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