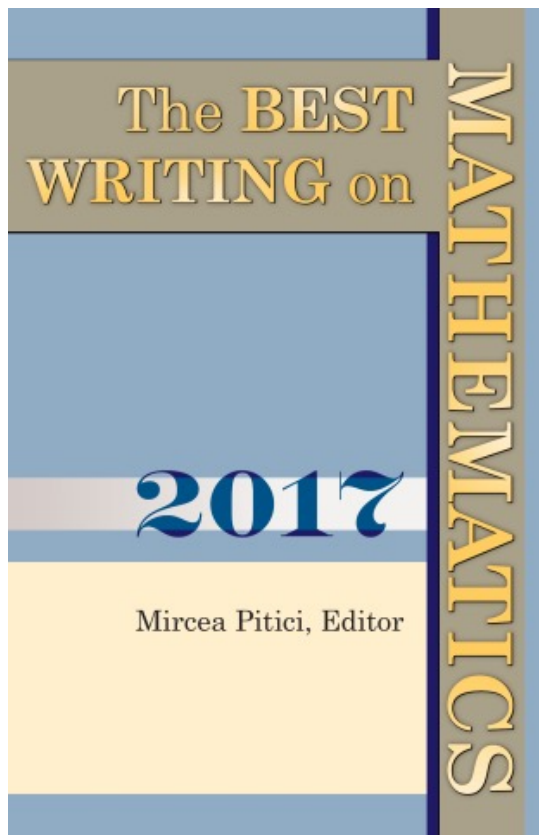


Rapidly Reaching Threshold Concepts in Short-term Biomedical Data Science Training

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Threshold Concepts & Undergraduate Mathematics Teaching

Article (PDF Available) in [PRIMUS: problems, resources, and issues in mathematics undergraduate studies](#) 26(9):837-847 · July 2016 with 19 Reads

DOI: 10.1080/10511970.2016.1191573

[↓ Cite this publication](#)



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Abstract

Traditionally, many undergraduate mathematics courses have been defined in terms of mathematical content and the techniques in which students should become proficient or theorems they should be able to prove. This can result in a reliance on shallow or rote learning by students, despite the fact that the main goal of a mathematics lecturer is usually to foster mathematical understanding in their students. In contrast, it is suggested that placing an emphasis on the threshold concepts involved in a course can enable teachers and students to focus on what is fundamental to the study and mastery of their subject.

Questions to Myself:

- “There are a lot of high-quality online—many of them free!—resources from which someone can learn data science. What can I provide the students that they can’t just get online?”
- “Since I’m only given a small amount of time with students, what should I focus on?”
- “What should I be responsible for and what should I ‘outsource’ to Coursera, DataCamp, etc.?”

Individual Context: Academic Surgeon



- Clear clinical research question in mind
- Deep medical understanding
- Limited mathematical understanding
- No computational understanding
- Needs a small set of skills
- No impact on his economic value

1/3 of short term trainees doctorates

Individual Context: MS Level Biologist in Industry



- Broad biological understanding
- Some computational context
- Little mathematical understanding
- Comes with a specific work-driven problem
- Has opportunity for greatly increasing her economic value if think more broadly

Individual Context: Bachelor Level...

Philosophy, Linguistics, English, Art History, Musician, Spanish Language,...



- Complete career pivot
 - No medical, computational, or mathematical understanding
- Intelligent
- Broad potential endpoints
- Opportunity for large economic gains

- **Big, Important Market**

Threshold Concepts

Concepts that lead to “seeing things in a new way.”

- Transformative
- Irreversible
- Integrative
- Bounded
- Troublesome

Threshold concepts are subset of competencies

“Enhancing Teaching-Learning Environments in Undergraduate Courses, 2001-2005”

Value of thinking in thresholds

- Aware of what I'm going to have difficulty teaching

“It can be difficult for lecturers or experienced practitioners to appreciate the difficulties of their students, as this requires them to look back over thresholds they have long since crossed.” (Breen and O'Shea)

- They are the topics that personal teaching support is most important

“Lecturers should empathize with learners who are grappling with troublesome concepts, make sure that they are aware that others are experiencing similar difficulties, and encourage them to **tolerate uncertainty** in the short term.” (Breen and O'Shea)


- Prioritize

- What I should teach
- What they can learn on their own


Proposed Threshold Concepts from Related Fields

- Medicine
 - Uncertainty (Academic Medicine: [April 2017 - Volume 92 - Issue 4 - p 426](#))
 - Inverse problems and diagnosis (Rob El-Kareh)
- Mathematics
 - Limits
 - Functions
 - Cosets and Quotient Groups
 - Don't really understand what these are!
- Computer Science
 - Object Oriented Programming
 - Pointers

Threshold Concepts in BMDS?

- Subset of threshold concepts from medicine/biology, computer science, mathematics/statistics
- Probably NOT Threshold Concepts
 - Pointers
 - Cosets and Quotient Groups

Not part of our world

 - Regular expressions
 - Lots of difficult things I teach

Troublesome but not transformative
- Probably Threshold Concepts
 - Uncertainty
 - ???
 - Great topic for discussion

In Summary: The Problem

- “Three” Students
- “Three” Contexts
- “Three” sets of threshold concepts
- One class/course of study

The Solution:

“Reimagining the EHR” -> “Reimagining Higher Education”

EDUCATION

Here's How Higher Education Dies

A futurist says the industry may have nowhere to go but down. What does the slide look like?

ADAM HARRIS JUN 5, 2018

Failure to reimagine “would be a humanitarian disaster” Bryan Alexander