Threshold concepts in teaching and learning

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What’s the probability that two people in the room have the same birthday?
Odds of finding a matching pair of birthdays

\[ P(\text{no match}) = \frac{365}{365} \times \frac{364}{365} \times \frac{363}{365} \times \ldots \times \frac{365 - (n - 1)}{365} \]

![Graph showing probability of a pair vs. number of people. The graph peaks at around 23 people.](image-url)
Why is this a threshold concept?

- The probability of 2 people having the same birthday is very low

**The Probability is non-linear!!!**

- This is useful in understanding non-linear systems
Every day applications

- **Odds two of you see an ad for the same company today**: 153 ads noted per day\(^1\), 46678 global companies\(^2\)

- **Odds that you have a mutual friend**: 1000 friends/person, 7.125B people

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2. topforeignstocks.com, 2015.

* does not account for sampling with replacement
Where is this useful?

- **Collision problem:**
  How often random numbers collide

- **Random identifiers/delays in protocols:**
  Cell networks “wait to talk”

- **Genomics and sequence alignment:**
  What are the odds of two genes having the same sequence of n-bases?
Self-reflection

Write down 3 threshold concepts that are encountered in your classes.

Threshold Concepts
Threshold Concepts

Transformative

Irreversible

Integrative

Bounded

Troublesome

Mayer and Land, 2003, Higher and Community Education, School of Education, University of Edinburgh, UK
Students move from more basic, compartmentalised understanding to one that is foundational, coherent and integrative, permeating the acquisition of new knowledge and ideas.

Image by Korey Brunetti, Amy R. Hofer, Silvia Lu & Lori Townsend.

Mayer and Land, 2003, Higher and Community Education, School of Education, University of Edinburgh, UK
Buzz-groups

- Discuss in groups whether your proposed concepts qualify as threshold concepts as described by the literature

- Identify which aspects of the 5 characteristics apply
  
  Bounded
  Integrative
  Transformative
  Irreversible
  Troublesome

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Our proposal

- Act to shorten the liminal stage
- Course design: Watch out for threshold concepts
- Avoid overloading course with other material
- Use active learning to overcome threshold concepts

Identifying threshold concepts
Identifying threshold concepts

1. Pre-course identification
   - Gathering opinions

2. In-course identification
   - Student observation
   - Formative assessment
   - Critical Incident Techniques

3. Post-hoc identification
   - Summative assessment
   - Class evaluation

Double loop
- Learn from past action
- Plan, revise, adjust

Single loop

Conceptualisation

Maturity

Take-home message
Take-home message

- Threshold concepts allow to form a coherent and integrative understanding and open the way to new learning

- In designing our courses, we can use the notion of threshold concepts to
  - Shorten the liminal stage
  - Avoid overloading course with less useful material
  - Use active learning impactfully
Examples

• Notion of self in young children
• The earth is round
• In economics, the notion of price