# Mathematical metaphors for writing

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### writing

#### The fundamental theorem of calculus

Part one

If f is continuous on [a, b], then the function g defined by

$$g(x) = \int_{a}^{x} f(t) dt$$
  $a \le x \le b$ 

is continuous on [a, b] and differentiable on (a, b), and g'(x) = f(x).

#### Part two

If f is continuous on [a, b], then

$$\int_{a}^{b} f(x) \, dx = F(b) - F(a)$$

where F is any antiderivative of f, that is, a function such that F' = f.

Stewart, 2008

### writing



# writing

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A metaphor is "an ontological mapping across conceptual domains, from the source domain... to the target domain"







# writing

The drafting process

Aim for a bad first draft

# writing

Perfection is irrelevant

#### Modelling

A bad 1<sup>st</sup> draft is a productive way in





$$\begin{split} \frac{dS_j^{\text{pm}}}{dt} = & b_j(R_{i=27}) - \beta_d^{\text{pm}} I_{d_j} S_j^{\text{pm}} - \beta_{\text{ind}}^{\text{pm}} I_{\text{ind}_j} S_j^{\text{pm}} - \mu^{\text{p}} S_j^{\text{pm}} \\ \\ \frac{dE_j^{\text{pm}}}{dt} = & \beta_d^{\text{pm}} I_{d_j} S_j^{\text{pm}} + \beta_{\text{ind}}^{\text{pm}} I_{\text{ind}_j} S_j^{\text{pm}} - (\mu^{\text{p}} + \sigma) E_j^{\text{pm}} \\ \\ \\ \frac{dI_j^{\text{pm}}}{dt} = & \sigma E_j^{\text{pm}} - (\mu^{\text{p}} + \gamma) I_j^{\text{pm}} \end{split}$$

 $\frac{dR_{j}^{\rm pm}}{dt} = \gamma I_{j}^{\rm pm} - \mu^{\rm p} R_{j}^{\rm pm}$ 

Aim for a bad first draft

# writing



Use writing as an analytic tool

# writing

#### Being stuck is natural

#### **Problem solving**

Get unstuck by seeing things differently



The crafting process

#### Use writing as an analytic tool

# writing

#### Addressing an audience

Seek readerly experiences of your writing



# writing

Standard paragraph structure

Main idea

Evidence for idea

Explanation of idea

Significance of idea









#### The Negative Perception of Errors in Traditional Mathematics Instruction

Most mathematics students, as well as teachers, have negative feelings about errors and approach them as unfortunate events that need to be eliminated and possibly avoided at all times. Implicit evidence of these beliefs can be found in many common practices, such as the fact that making errors automatically lowers a student's test grade, that most often incorrect answers to a question posed by the teacher in class are rejected or ignored until the correct one is produced, and that teachers try to assign tasks that "good" students should be able to complete without making errors.

These beliefs and attitudes should come as no surprise because they have been given theoretical justification within the behaviorist view of learning informing a transmission paradigm (as discussed earlier in Chapter 2). Behaviorist research, in fact, suggests that learning is enhanced when correct responses are rewarded (positive reinforcement) and incorrect ones are either punished (negative reinforcement) or extinguished through lack of attention (withholding of positive reinforcement; Miller, 1983). Within this framework, students and teachers are obviously not invited to see errors in a positive light and, furthermore, paying explicit attention to errors in class may even be considered "dangerous," because it could interfere with "fixing" the correct result in the student's mind.

#### One thing we should stop doing: Spending too much time on curneccessary stuff (e.g. how to read a book / how to change play around with an error (say 70+ too min on such content is way too much.



#### Principles for using discipline-based metaphors to teach academic writing

- 1. Contextualisation principle
- Establish students' disciplinary familiarity, especially at undergraduate level
- Anticipate metaphors may not be one-way: they may enhance students' familiarity with source domain
- 2. Necessity principle
- Provide early, significant experiences of struggle to create the need for the desired writing outcome
- Restructure assessment to provide extrinsic motivation for working on writing
- 3. Consolidation principle
- Provide immediate, clear ways for students to practice the desired writing outcome



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