Incorporating Social Norms and "Leveling Up" to a Medium-Sized Calculus II Course

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MATHEMATICS

What is "doing" mathematics?

- According to Cuoco et al. (1996), mathematicians:
  - Think small and talk big (and vice versa)
  - Use functions
  - Use multiple points of view
  - Mix deduction and experiment
  - Push language
  - Have persistence when solving problems
    - (p. 384-388)
- This overview of mathematicians has been reiterated by the literature (e.g., Burton, 1999; Savic, 2012)

How can students become mathematicians?

- Cuoco et al. (1996) also had suggestions of what students should learn in a mathematics course. Students "should" be:
  - Pattern sniffers
  - Experimenters
  - Describers
  - Tinkerers
  - Inventors
  - Visualizers
  - Conjecturers/Guessers
- These are called *mathematical habits of mind*.

My analogy

- Mathematics content is like a playground:
  - Calculus is the swing set
  - Algebra is the slide
  - Topology is the sandbox, etc.
- What I want to teach students is how to play!
  - Mathematical habits of mind

How can we teach those mathematical habits of mind?

- My conjecture is to introduce mathematical habits of mind by inquiry-based learning. I claim that, no matter the content of the course, inquiry-based learning (along with the "right" tasks) will allow for situations that students can hone their mathematical habits of mind.
- For example, Smith (2006) wrote about an IBL transition-to-proof course and the successes in students' sense-making abilities

Why IBL?

- Other than my conjecture, Laursen et al. (2011) did a large national study about IBL, and concluded that:
  - "Learning gains and attitudinal changes were especially positive for groups that are often under-served by traditional lecture-based approaches, including women and lower-achieving students. First-year and less mathematically experienced students also benefited particularly. Yet there was no evidence of negative consequences of IBL for men, high-achieving students, older and more experienced students: these groups too made gains greater than their non-IBL peers." (p. XII)

Social Norms

- Yackel and Cobb (1996)
  - Social norms – "normative interactions in the classroom"
  - Sociomathematical Norms – Norms reflected in mathematics
- Examples
  - Social norm – raising your hand to answer a question
  - Sociomathematical norm – Round all answers to the nearest hundredth

Calculus II Course

- Spring 2014, Fall 2014
- Homework turned in every day, discuss that homework the next class period
- No group work to be turned in
- Two tests, one final, quizzes as needed

"Leveling Up"

- Level 1: 50 points, Reward of a bonus point
- Level 2: 125 points, Reward of two bonus points
- Level 3: 250 points, Reward of four bonus points
- Level 4: 425 points, Reward of a get-out-of a-question-on-the-test card
- Level D: 600 points
- Level C: 680 points
- Level B: 760 points
- Level A: 840 points

Point System

- 6 points for every homework completed, 2 points for correctness of a problem
- 1 point for every utterance in class, 3 points for a "good" mathematical question, maximum of 4 points
- Points on quizzes
- Test 1 – 100 points (with a 40% "buyback" program)
- Test 2 – 100 points x 1.5 magnifier (30 points take-home)
- Final – 150 points x 2 magnifier

Social Norms Established

- This course is not about punishment and encourages mathematical ideas and creativity (much like Cuoco (1996) encouraged)
- The first day we talk about "no judgment" and "freezing" people
- Two instances in the recent course
  - Student with unexpected answer
  - Student negating an answer

What do the students think?

- From evaluations:
  - "If he could answer questions more thoroughly sometimes would be much better"
  - "The point system kept me anxious throughout the semester"
  - "The participation points I understand that they act as motivation but I would prefer if it only acted as extra credit rather than points that directly count"

What do the students think?

- From email:
  - "Your class has been the hardest class I've had at OU and it's also the only class I've gotten a B in…In fact, calculus III last semester was easy because your class prepared me."
- From evaluations:
  - "It was successful in forcing me to think critically about problems and try different things"
  - "Learning opportunities not learning penalties"

What do the students think?

- From evaluations:
  - "I like how we are so involved in the class, in my opinion it encourages us to try harder… we aren't rush (sic) and we get to fully understand what is going on instead of just accepting it."

Questions?

- If you have any questions, please email me

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or you can visit my website

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