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A Map of Problem-Based Class Designs #TMC13
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My classroom is a game that my students play. I set the rules by how I allow them to succeed or fail in my class. If I've done it right, then the rules I set should motivate genuine learning and reflect that knowledge in the form of a "grade".
-Daniel Schneider, bit.ly/17o5J5v

6 Problem-Based Courses

1. Mr. Likis: Geometry. SBG, with binary grading on each standard. Each standard gets 1-2 weeks beginning with a few classwork/groupwork problems to figure out the basic ideas and give everyone a foothold. A collection of 8-20 example and extension problems is given out and students have several days in class to pick a few and write up papers and/or present, revising until the papers are acceptable per a rubric. The assessment is a single problem to write up, using the same rubric. Before reassessing, must write up two more problems first and a reflection. Role of homework TBD - there is not yet a strong homework culture at the school.

2. Mr. Quaden: Middle school math teacher. Using Exeter. Gives problems for HW then class time is discussion in groups. Expectations: everyone understands more than one way to solve, and can describe an equation "for an english teacher" (what the equation says, in complete correct sentence) and "for a science teacher" (what each element is, with correct units). Grading is HW completion (by scanning notebooks), test grade (tests are 3-4 Exeter-like problems in 1hr+, which students write up to a rubric), and occasional announces when HW handed out that "prob 3 is a turn-in" and that's graded like a test question, with a rubric. Note: After first test, students always say "I should have used my group better".

3. Mr. Goldner-2012: "Pre-calculus" but with huge range of readiness; some students have zero algebra skill. New problems given out as needed to make sure there are 7-15 open problems at any time. Two sets of problems: "Problems" (mostly pre-calc) and "Puzzles" (mostly brainteasers & recreational math). Students can chose any from either set. Presentations MWF at start of class, all other class time is

independent work time. Credit for solving and presenting a solution, if you convince the class you are correct. Further credit for writing and revising a paper until it is acceptable per a rubric. You can only present or write problems you solved. If you collaborate you split the credit. Grade is proportional to number of earned credits.

4. Mr. Goldner-2013: Pre-calculus. New problems given out as needed to keep 7-15 problems open. Presentations MWF at start of class, all other class time is independent work time. Earn two points for solving a problem and presenting it to the satisfaction of the class. You can't present a problem that's already been presented, but you can earn one point for an acceptable (per a rubric) write up of someone else's solution. If you collaborate, you split the credits. Grades proportional to credits earned. Note: some students earned high grades by writing up others' solutions and solving none on their own.

5. Ms. CPM: Students work in groups of 4 for a chapter; then groups are reshuffled. Each day students are given 3-5 classwork problems involving new content to work out on their own, in groups. The class ends with a debrief and discussion. Homework is 2-3 problems on that day's content plus 6-7 drawn from everything done so far that year. Grades are primarily on quizzes and tests, which are cumulative through the year.

6. Ms. Exeter: Students are given 7-8 new problems each night. Classes are 8-10 students; at class the next day, each student writes a problem on the board and discusses with the class how s/he solved it; other students ask questions and discuss other approaches. Grades are assigned by the teacher's evaluation of the students' contributions to the class discussions and from tests.

Interesting Reading

Coppin, Mahavier, May and Parker, *The Moore Method*, MAA (2009)
Kaplan and Kaplan, *Out of the Labyrinth*, Oxford (2008)
Lockhart, *A Mathematician's Lament*, Bellevue (2009)
Fawcett, *The Nature of Proof*, Teachers College (1938) or NCTM (1995)