Assessing Student Learning
Alternative Approaches - I

Joint Mathematics Meetings – Baltimore
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Room 340 BCC

Active Assessment and Group/
Individual Final Exams

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Abstract
We present and discuss an approach we have used in a mathematical modeling course in which in-class assessment through overlooking small group work, presentations, routine “board" work in which students offer up their ideas simultaneously for teacher and peer feedback.

The culmination is in a final exam in which students are assigned “randomly" to teams of three, given their own classroom, and work on a common modeling scenario coupled with individual additional accountability question(s), and individual write-ups.

Students show their stuff, always. Making it easy to assess and a good experience for students and faculty. We have used similar techniques in an “at risk" entry level course and we point out the richness possible with these approaches with such students.
We present an approach we have used for years in our assessment of student learning in a mathematical modeling course taught at the United States Military Academy.

**Course**
Mathematical Modeling - a course for sophomores on up.

**Prerequisite**
3 semesters of mathematics core courses including modeling with discrete dynamical systems and of calculus with modest differential equations coverage.

**Process**
During the course we teach just in time notions from differential equations, linear algebra, optimization, statistics, etc.
Setting
Class size is no larger than 18 – usually less, possibly one or two sections.

Classroom has movable desks and chairs and holds no more than 19 students and faculty large desk and chair with computer and overhead projector capabilities for images and sound.

All four walls have blackboards with the exception of front wall which has whiteboard projection area between blackboards on either side.

Small group work, individual work, and class discussion used.

Students work at desks, moved and grouped desks, and blackboard.
Method
Since this is a mathematical modeling class much of the activity is just that, modeling!

Modeling needs time and trial and error as well as moving ahead and stepping back.

Classroom is VERY active with individuals contributing to "lecture" and small group work.

Students work on extended individual write-ups of classroom modeling activities.

Students select one half-semester modeling project of their own.
Immediate Assessment

Small class affords opportunity for assessing individual progress, knowledge, application, and contributions during class time.

Board presentations, spot checking with questions, and student questions and answers enable teacher to witness learning and competency.

Classroom interactions

Put students in role of individual consultant for client (professor or guest) with write-ups for client (nitty-gritty) and senior consultant (analysis).

No in-class exams, but in-class group/individual final exam!
Final Exam (required) Assessment

Idea based on Designated Student Grading as a Learning Device

in which papers are collected, student selected and given homeworks, papers are graded with student key generated, and graded homeworks are returned in two days. . . . never fails!

Why not do something like student grading of presentations from group work during final exam?

In 3 hour exam period devote first hour and a half to groups developing model and presentation. Then during last hour and a half have groups present “solutions” with modeling rationale.

All groups issue evaluation and grade on all other groups.
Disaster
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All groups issue evaluation and grade on all other groups.

Familiarity breeds complacency, not contempt.

Yet another same model presentation bored the students.

Nothing outstanding in solution or presentation, just same old, same old, yawn!

Not enough time for honest critiques so student evaluations all inflated, cautious, and overly generous.
Disaster of group assessment during final exams led to . .

No student assessment during final exam, but refined modeling activity structure.

Groups of three (possibly 2 or 4) assigned to separate classrooms in which the group can work together on a modeling scenario, generate ideas, fill the boards, share paper results, to work on a modeling scenario for first hour and half.

At 1.5 hour mark individual questions related to modeling scenario and other modeling issues (few) assigned and for remaining 1.5 hours individual students work on write-up of modeling scenario based on group ideas and address individual questions.
Write-ups and individual question responses collected from individual student at end of 3 hour exam period and graded by professor.

These are then included in final course grade per contract grading percentages offered on day one of the course.

Rich group ideas were written up in various ways, some well organized and presented nicely, others not so.

Final grades corresponded to overall student abilities and performances as demonstrated on class write-ups.

Several students rose to the occasion and performed exceptionally well, while no student performed poorly.
Because, “Several students rose to the occasion and performed exceptionally well, while no student performed poorly.” (quoting from previous slide) students left the course with a good last experience.

This was important, for a modeling course is one in which student self-confidence and self-efficacy are important change variables.

The fact that students did well spoke to their abilities to apply general modeling notions developed in the course, e.g., state assumptions clearly, offer rationale and defense, identify variables, relate variables, perform correct analysis, do a reality check, and reflect.
What preparation did we give students for this experience?

We gave practice exam in which we spent one hour of class time about two weeks before final exam on a modeling activity related to the topic at hand or just totally different.

In practice session we hoped to reduce anxiety, for students had now learned that modeling takes time and they were concerned that during a final exam they would not have enough individual energy to generate ideas.

After practice exam they realized the collective idea generation power of a small group was enough to get them kick-started to generate even more ideas of their own.

Sometimes the final exam question was the same as practice!
How did we assign groups for final exam experience?

We told students we randomized the class roster and then randomly selected groups. They were anxious about this before, but jumped right in during the exam without any apparent concern for the groupings.

We lied!

We ranked students on grades thus far – top to bottom and picked off groups of three, the best with the best and the “worst” with the “worst.”

Students sensed this at group posting at final exam!

This strategy proves to be best for such a final exam.
Consider . . .

Putting strong and weak students into the same group often permits strong students to dominate, indeed, do the work. Moreover, in such groups weak students shut down as they believe they are weak and have not much to contribute.

However, when three weak students are in a group they look around and say, “We better dig deep for it’s just us.” They perform at a higher level for they know they want/need to succeed. Moreover, on such a broad modeling situation exam they CAN make strong contributions as they consider the material at hand and recall the good approaches seen in class.

ALWAYS weaker groups stayed until end of exam and many times they wrote the best exams, for they were energized.
More Considers . . .

Good students like working with good students. . . a run of the thoroughbreds.

However, in the course of such a final exam period a group can only say and do so much, thus the weaker students by steady group effort and then stimulated individual write-ups could really produce excellent work as well.

Finally, weaker students actually see material coming together by working with other students who struggle at times. Their collective efforts from similar perspective helps them focus and produce.
A special happening for me.

There was a student who seemed to really struggle in the course, submitting incomplete work, turning in material late, and sometimes dozing in class. I had spoken to him during the course about this and he gave the usual promise to improve.

He was the last one to leave – stayed until last minute – during this exam.

When I graded the exams his was the best, head and shoulders above all others, in terms of exposition, mathematics, modeling, results, etc. No one else was even in his league.

Exam was late afternoon so I invited him out to dinner. Students like that, especially West Point cadets who like to get off Post.
In our conversation over dinner I found out his mother was battling cancer and he was given special Leave privileges to go home and look after her on many weekends. This explained his inability to devote time to quality write-ups, say on weekend time.

He never told me anything about this during previous discussions and I could understand this, as he wanted no sympathy during the course. He was dealing with his own emotions in a way that suited him.

Because his final exam was an exemplar I based more of his grade on that submission for he put it all together and he did quite well in the course.

It was all there in him, but he had great difficulty doing his work because of his concerns for his mother.
References


