

## Summative Assessment of Math 25 Finals

Fall 2006

**Background:** Three years ago, 12 Math instructors assessed the performance of Math 25 students on their final exam relative to all five DE program SLO's. Several suggestions were made and we now wish to look three years later to see if performance has improved.

**Sampling design:** In Fall 2006, 9 of 11 instructors turned in their final exams to be assessed, after the teachers had already graded their students work. Seven of those 9 were written in a usable format for assessment. We randomly chose 4 students from each section. Students who took the final but either failed the course (or had no hope of passing before finals were graded) were excluded from the pool.

**Method:** Half of the material on all the final exams is made up of common questions. Seven faculty members examined the common questions to see which ones were direct measures of specific learning outcomes. The communications, problem solving and multiple representations were assessed using at least four problems or parts of problems. For example, the multiple representation outcome could be assessed on common questions #4ad, 5, 6bcd, and 11a.

**Technique:** Each final exam was assessed holistically relative to each outcome using a rubric. For each outcome we conducted a norming exercise in which each instructor graded the same paper. We then discussed the scores and reached consensus. Next, for each outcome each final was assessed independently by two instructors. If the two scores differed by no more than  $\pm 1$ , the scores were averaged. If the two rubric scores differed by more than one level, that student's work was assessed by a third instructor. The closest two scores were then averaged.

Outcome	Criteria	Final Exam problems
Communication Outcome: Students will read, write, listen to, and speak mathematics with understanding.	Work shown Explanations Use of vocabulary or notation Definitions of variables Interpretations: m, intercepts, solutions in context	Final exam #3abc,4ab,6b,11b
Problem-Solving Outcome: Students will use mathematical reasoning to solve problems and a generalized problem solving process to work word problems.	Understanding of problem Right answers with standard methods Use of general problem-solving process Estimation and checking	Final exam # 2,3a,4ad,11d
Multiple Representation Outcome: Students will demonstrate the ability to use verbal, graphical, numerical, and symbolic representations of mathematical ideas.	Interpretation and use of tables Construction of tables Labeling of tables Interpretation and use of graphs Construction of graphs Labeling of graphs	Final exam # 4ad,5,6bcd,11a

### Summary: See rubric for description of scores

2|5 represents an average score of 2.5 rounded to the tenths

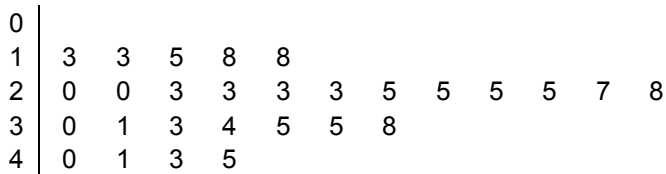
### Communication Outcome : stemplot of rubric scores

0											
1		3	3	5	8						
2		0	3	3	4	5	5	5	5	8	8
3		0	3	5	5	8	8	8			
4		2	3	3	6						

Mean 2.8    Standard deviation = .9    n = 28

Quartiles: 1.3   2.3   2.5   3.6   4.6

**Problem-solving Outcome** : stemplot of rubric scores



Mean 2.7      Standard deviation = .9      n = 28

Quartiles: 1.3   2.1   2.5   3.4   4.5

**Multiple Representations Outcome** : stemplot of rubric scores



Mean 2.5      Standard deviation 1.0      n = 28

Quartiles: 1.3   2.1   2.5   3.1   4.8

**Observations from each of the outcome assessments**

From Communication:

1. Leaving enough space between problems on the actual test paper for student responses impacts scores, especially with the communications outcome.
2. More guided questions or prompts (eg. Parts a, b, and c instead of a long narrative question) had an effect on performance. Particularly communication problems need prompts.
3. Varying context and representation changed individual achievement. Students showed inconsistent ability across single tests.
4. When context becomes less familiar, communication suffers.
5. Using graphs to find or check a solution needs improvement.
6. There is a lot of reluctance to estimation.

From Problem Solving:

1. Same spacing issue as above.
2. Some students are not showing work but getting correct answer.
3. Many are not checking for the reasonableness of the answer.
4. On the “Marshalls” problem, students had better problem solving skills than communication--they could get a good strategy but not always follow it logically or communicate results.
5. Some students skipped word problems all together—many tests had common exam questions saved until the end when students’ time and energy had lapsed.
6. Students were not organizing work well

From Multiple-Representation:

1. Bimodal results—either they really got it or not at all.
2. Great use of tables and graphs did not match with a student’s ability to work with equations.
3. Interpolation and extrapolation was particularly hard for students.

## Action Plans:

### Suggestions for improving student performance:

1. Continually ask students questions like “why?” or “what about this?” Ask them to explain how you would talk about this.
2. Change contexts and representations.
3. Insist on students showing all their work. Organize the work on the page more clearly.
4. Get students to try even the difficult problems and work on test-taking skills.

### Suggestions for revising the final exam:

1. Consistent generous spacing on the final exam in terms of format.
2. Do not have work done on separate sheets as this is impossible to use in the assessment process.

### Suggestions for improving the holistic assessment session:

1. Decide what to do if a problem is left blank or no work is shown to support an answer. Should this lower the score for the outcome or should we disregard these problems in some outcomes (e.g. N/A)? This comment came up three years ago and we decided this time to still assess the problems as a 1.0, assuming that lack of an answer meant lack of ability to start the problem.

## Comparison to previous assessment results

Percent proficient or better		
	FA 03 N=23	FA 06 N=36
Communication	57%	39%
Problem-solving	39%	39%
Multiple-Reps	61%	32%

(Note: 9 of 11 instructors submitted class sets of final exams. Instructors were using a wide variety of texts, only 33% used any of the Elementary Algebra Teaching Community’s activities.)

*Next Steps:* To better understand this decline in performance we

- analyzed Elementary Algebra instructors unit exams, as well as their textbooks. We found weak alignment with these PSLOs;
- analyzed the Elementary Algebra Teaching Community’s activities and discovered that 75% of activities focused on the Skills SLO, which was not the focus of the assessment;
- interviewed instructors and found that many instructors either did not like the activities or had difficulty using the activities for a variety of reasons.

In an attempt to improve learning, we implemented a three-step plan:

- SP 07: four retreats focused on pedagogy that promotes problem-solving; 16 instructors, 13 of whom were adjuncts, read and discussed case studies from *Improving Algebra Instruction: Using Cases to Transform Mathematics Teaching and Learning* and conducted a classroom-based project in which they experimented with a ‘pedagogical move’ and analyzed its impact on student learning;
- SU 07: overhaul of the classroom activities to more fully integrate communication, problem-solving, and multiple representations along with the development of our first instructors’ manual;
- FA 07: weekly Japanese Lesson Study based on new classroom activities with 7 instructors (5 of whom are adjuncts) sharing set-up and implementation strategies used for each activity, analyzing student work on a previous activity, and preparing for the next activity by reviewing a draft of an instructors’ manual.