Summative Assessment of Math 25 Finals   Fall 2003

Background: Last spring five members of the SP03 Elementary Algebra Teaching Community conducted a holistic assessment of final exams for the Problem-Solving Outcome and procedural skills using a different sampling design, similar exam questions, but a different rubric than this fall. Because of these changes, data gathered this semester (FA03) should be treated as a baseline, rather than used for comparative purposes. This is the first summative assessment of Math 25 finals relative to all five DE Program Outcomes. Twelve instructors (7 full time and 5 part time) participated in the assessment session this time.

Sampling design: From eight Math 25 sections taught by instructors participating in the Teaching Community, we chose a random sample of 23. 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: The Teaching Community wrote a common final exam. Then chose problems on the final to assess each of the five DE Program Outcomes. All outcomes except for the Effective Learner Outcome were assessed using at least four problems or parts of problems.

Technique: Each final exam was assessed holistically relative to each outcome using a rubric written by the Teaching Community earlier in the semester. For each outcome we conducted a benchmarking 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 ± 1, the scores were averaged. If the two scores differed by more than one level, that student's work was assessed by a third instructor. The closest two scores were then averaged. Eleven instructors participated in the grading and one facilitated.

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 # 8, 9b, 10a,b, 11
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 # 10, 11, 12, 14
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 # 7, 8, 9,10
"Skills" Outcome: Students will recognize and apply math concepts in a variety of relevant settings and demonstrate the math skills and knowledge necessary to succeed in subsequent courses.	Percent of procedural skills correct or with minor errors	Final exam # 1, 2, 3, 4, 5, 6
Effective Learner Outcome: Students will demonstrate the characteristics of an effective learner.	Complete and on-time Follows directions Use of resources Self-assessment	Final exam # 16

Summary: See rubric for description of scores

Communication Outcome : stemplot of rubric scores

```
0 |
1 | 5   5   5   5   5   5   8
2 | 0   3   5
3 | 0   0   0   0   5   5   5   5   5   5   8
4 | 8
5 | 0
```

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

Mean 2.8   Standard deviation 1.1   n = 23

Quartiles: 1.5   1.5   3   3.5   5

Problem-solving Outcome : stemplot of rubric scores

```
0 |
1 | 0   0   0   5   5   5   8   8
2 | 0   0   3   5   5   8
3 | 0   0   5   5   5   5
4 | 0   5
5 | 0
```

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

Mean 2.5   Standard deviation 1.1   n = 23

Quartiles: 1   1.5   2.5   3.5   5

Multiple Representations Outcome : stemplot of rubric scores

```
0 |
1 | 0   5   5   5
2 | 0   0   0   5   8
3 | 0   0   0   5   5   5   5   5   5
4 | 0   0   0   0   3
5 |
```

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

Mean 2.9   Standard deviation 1.0   n = 23

Quartiles: 1   2   3   3.5   4.3

"Skills" Outcome : stemplot of rubric scores

```
0 |
1 | 5
2 | 0   0   3   5   5
3 | 0   0   0   0   5   5   5   5   5
4 | 0   0   0   0   5   5   5   5
5 |
```

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

Mean 3.3   Standard deviation 0.9   n = 23

Quartiles: 1.5   2.5   3.5   4   4.5

Effective Learner Outcome : stemplot of rubric scores

```
0 |
1 | 5   5   5
2 | 0   0   0   5   5
3 | 0   0   0   5   5   5   5
4 | 0   0   0   5   5   5
5 |
```

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

Mean 3.1   Standard deviation 1.0   n = 21

Quartiles: 1.5   2   3   4   4.5

Observations:

1. Several instructors reported bimodal results on the final exam, with students either performing very well or very poorly.
2. The holistic assessment showed that students had strengths in finding and interpreting linear models when information was given verbally, numerically, or graphically.
3. Procedural skills do not seem to have improved relative to SP 03, despite the use of CAI. The mean score dropped 0.3 points, but some felt this reflected a difference in the rubrics.
4. For FA 03, students appeared to be stronger in skills taught toward the end of the course.
5. For three of the outcomes the mean performance was below 3 = proficient. Does this say something about the rubric? the difficulty of the exam? Our grading standards?

Action Plans: The following suggestions were provided by verbal or written feedback given by instructors who participated in the assessment activity (12/16/03) and by Elementary Algebra instructors analyzing the assessment results during a flex activity (1/13/04).

Suggestions for improving student performance:

1. Because student performance was weaker on skills taught earlier in the course (e.g. unit analysis), we need to "recycle" or spiral material more. Activities need to be revised to incorporate more review and homework and class assessments should include review material in a systematic way.
2. Instructors need to work on how to use the activities in class to promote student achievement --- the coaching principle.
3. Use more CAT's to assess student understanding after an activity and as an opportunity to incorporate review.
4. Weak performance on the Communication Outcome suggests that the classroom activities written by the Teaching Community need to do a better job of teaching to this outcome.

Suggestions for revising the final exam:

1. Final exam should include more than one problem requiring students to graph. Assessment of student ability to graph in problem (#7) was confounded because it was in the context of solving a system of equations.
2. In general, directions should be clarified by use of bold type or capitalization for key instructions, e.g. #9b Find the slope **AND** the intercept or #7 Solve the system by **GRAPHING.**
3. Final should include a problem that requires students to label and scale graphs.
4. #8c should include "and state the solution".
5. Reformat #7. Many students were confused because the system of equations was written horizontally.

Suggestions for revising the rubric:

1. The rubric and the criteria for the Multiple Representation Outcome focus on two prongs (numerical and graphical). Rewrite these to include the symbolic and verbal prongs.
2. The *proficient* and *excellent* levels for the Multiple Representation Outcome part of the rubric are too close. Revise these levels.
3. Include "% correct" in levels for the Multiple Representation Outcome.
4. Levels for the Problem Solving Outcome are too high.

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)?
2. Discuss the validity of using the final exam as the sole source of assessment conclusions. Final are timed situations during a week when students are overwhelmed with academic obligations. In this setting do we get an accurate snapshot of what they know and can do?

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Instructor feedback on Assessment Session: n = 11 (6 full time, 5 part time instructors)

	mean	Not		Somewhat		Very
1. How experienced are you with criteria-based grading?	2.9	1	2	3	4	5
		1	2	5	3	0
		9%	18%	45%	27%	
2. Are you interested in future staff development on designing and using criteria-based grading in the classroom?	4.3	1	2	3	4	5
		0	0	2	4	5
				18%	36%	45%
3. To what extent is the rubric consistent with your definition of proficiency in the five DE outcomes for the Math 25 student?	3.9	1	2	3	4	5
		0	0	2	8	1
				18%	73%	9%

Comments:
Levels in PS rubric are too high.
Levels 3 and 5 in MR not differentiated enough and missing 2 prongs.
My EL rubric is nonexistent.

	mean	Not		Somewhat		Very
4. Assuming algebra instructors read the results from today's activities, how useful do you think the information gathered today will be in improving teaching and learning in Elementary Algebra?	3.8	1	2	3	4	5
				4	5	2
				36%	45%	18%

Comments:
I think instructors need to experience staff development to see the benefits.
Extrapolate?

	mean	Not		Somewhat		Very
5. Rate the future importance of these types of assessment activities to the Math DE Program.	4.5	1	2	3	4	5
				1	4	6
				9%	36%	55%

Other comments and feedback:

This type of exercise should be mandatory for all staff because of the insights I made from my colleagues and how this affected my grading. This should be done in all course committees with the final exam questions. This kind of activity will be very useful when we do program and course assessment.

Thank you for the invite and all the prep work to make the day very informative and a learning experience.

The holistic grading method is new to me but very useful. I learned a lot about how other people are doing things. I intend to use some of these methods in future courses.

You are on the right path to improving student learning.

Good job Myra. Several questions on the test need to be re-written/edited.

You did a phenomenal job, again, Myra. I might suggest we keep looking at the same four exams so that we become familiar with the tests, since we look at the same questions for different criteria.