

Summative Assessment of Math 30 Finals

Fall 2005

Background: Math 30 is the capstone course for the DE Math Program; it is the prerequisite for all transfer level math courses. This is the third summative assessment of Math 30 finals; assessments have been completed for FA 04, SP 05, and now FA 05. A comparison of results from these three semesters is given below. During Fall 2004 and Spring 2005, an Intermediate Algebra Teaching Community met weekly with the goal of improving student achievement of the outcomes stated in the Math 30 Course Outline. During Fall 2005, a 5-hour flex activity for Math 30 instructors was held.

Sampling design: Five of nine instructors voluntarily submitted class sets of final exams for this assessment; four of the 5 were full-time, comprising 80% of full-time instructors teaching Math 30. Because some instructors taught two sections, the sample represents six of the eleven sections (55%). We chose a random sample of 24 exams, 4 exams per section. For two of the three outcomes assessed, one section of exams was omitted because the instructor did not include the requisite common problems that measured these two outcomes. Students who were failing the course prior to the final were excluded from the pool.

Method: The FA 04 Teaching Community wrote problems aligned with the DE Program Outcomes and Math 30 SLO's. These problems comprised at least 50% of each instructor's final exam. Three of the five DE Program Outcomes were holistically assessed using from two to four separate items on the final exam.

Technique: Each final exam was assessed holistically relative to each outcome using a rubric written by the FA 04 Teaching Community. 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 on a scale of 5, the scores were averaged. If the two scores differed by more than one level, that student's work was independently assessed by a third instructor. The closest two scores were then averaged. Four instructors participated in the grading.

Outcome	Criteria	Final Exam problems
Communication Outcome: Students will read, write, listen to, and speak mathematics with understanding.	Clear, organized, and logical work Clear explanations and reasoning Correct use of vocabulary or notation Defines variables and interprets the meaning of slopes, points, intercepts, and solutions in a context.	Health care, train, women's earnings parts a and e
Problem-Solving Outcome: Students will use mathematical reasoning to solve problems and a generalized problem solving process to work word problems.	Understanding of problem Estimation and checking answers Using an appropriate technique Generating and using a model Use of a general problem solving process	Train, waste management
Multiple Representation Outcome: Students will demonstrate the ability to use verbal, graphical, numerical, and symbolic representations of mathematical ideas.	Construction, use and interpretation of tables. Construction, use, and interpretation of coordinate graphs. Construction of EQ's from tables or graphs. Interpret models' accuracy/validity Use of technology	Health care, waste management, women's earnings, $4^x = 8x + 12$

Results: See rubric for description of scores

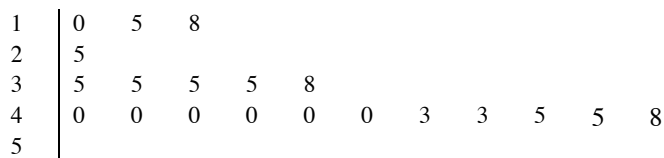
2| 5 represents an average score of 2.5 rounded to the tenths

Communication Outcome : stemplot of rubric scores



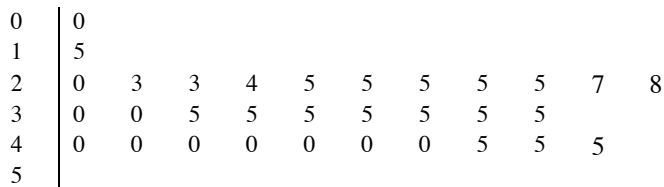
	FA 04	SP 05	FA 05
Mean	3.5	3.44	3.6
St. Dev.	1.0	0.9	0.7
Low	0.5	1.5	2
1 st quartile	3	3	3.25
2 nd quartile	3.5	3.5	3.75
3 rd quartile	4.4	4	4
High	5	5	5
proficient or better	81%	77%	83%

Problem-solving Outcome : stemplot of rubric scores



	FA 04	SP 05	FA 05
Mean	3.4	3.5	3.5
St. Dev.	1.1	0.8	1.0
Low	1	2	1
1 st quartile	2.4	2.75	3.5
2 nd quartile	3.6	3.75	4
3 rd quartile	4.2	4	4.125
High	5	4.75	4.75
proficient or better	69%	73%	90%

Multiple Representations Outcome : stemplot of rubric scores



	FA 04	SP 05	FA 05
Mean	3.1	3.6	3.5
St. Dev.	1.0	0.75	1.0
Low	0	1.75	2
1 st quartile	2.5	3	3
2 nd quartile	3.5	3.75	3.375
3 rd quartile	4	4.25	4.25
High	4.5	5	5
proficient or better	59%	80%	80%

Profile of the “average” Math 30 student based on rubric criteria and mean scores for each outcome:

Communication: Most of the work is neat and organized with answers supported by work shown. Explanations are usually given, but may at times be incomplete. If prompted, defines variables accurately and with appropriate specificity in most cases. Interprets slopes, intercepts, and solutions accurately, though some interpretations lack units.

Problem-Solving: Usually interprets problems correctly with occasional difficulty in understanding. At least 70% of the problems are worked correctly. Strategies are effective, but may not be efficient. Usually able to generate a model, but model may have minor errors. Usually able to use a model to answer a question, though some errors may affect accuracy. Limited and incomplete use of a general problem-solving process; for example, at times estimates are unreasonable, reasoning may be illogical, and does not consistently check answers.

Multiple Representations: Correctly interprets and uses information from tables and graphs in an attempt to answer a question, find an equation, etc. Constructs tables and graphs but organization, scale, or some other difficulty may impede finding a solution. Tables are labeled accurately. Graphs are accurately scaled and labeled. Interprets validity and limitations of tables and graphs though some interpretations lack precision or complete reasoning. Able to use technology to answer questions, though answers may be incomplete.

Analysis:

1. Did previous action plans impact learning?

Action plans from Fall 2004 focused on improving student performance in problem-solving and use of multiple representations. Performance in problem-solving improved slightly in SP 05, followed by impressive gains in FA 05. In the use of multiple representations, performance improved significantly in SP 05 and was maintained in FA 05.

Action plans from Spring 2005 focused on increasing the use of the classroom activities written by the Math 30 Teaching Community since use of these activities correlated with improvements in student performance.

Summary of Previous Action Plans	Summary of Relevant Assessment Results
Based on action plans developed after the FA 04 assessment, Math 30 activities, originally written by the Teaching Community, were edited to emphasize the steps in the general problem-solving process (e.g. identifying given and extraneous info, paraphrasing the task, estimating, checking, etc.). Instructors submitting student work for the assessment both in SP 05 and FA 05 used these revised activities.	Relative to FA 04, the mean score on problem-solving has shown small but statistically insignificant gains in in SP 05 and FA 05. However, the percent rated as proficient or better rose from 69% in FA 04 to 73% in SP 05 with impressive gains in FA 05 to 90%. Noteworthy is the increase in the 1 st quartile indicating that students in the bottom 25% of the sample showed the most improvement in problem-solving.
Math 30 activities, originally written by the Teaching Community, were edited to foster the use of tables and graphs in problem-solving and to improve the critical thinking involved in generating useful tables and graphs. Instructors submitting student work for the assessment both in SP 05 and FA 05 used these revised activities.	Relative to FA 04, there were statistically significant gains in the use of multiple representations in the sample assessed in SP 05 and FA 05. The percent rated as proficient or better rose from 59% (FA 04) to 80% (SP 05 and FA 05) on this outcome. Gains made in SP 05 by the students in the bottom 25% of the sample were maintained in FA 05. This is particularly noteworthy since the FA 05 sample included papers from two instructors not included in the SP 05 sample.
SP 05 actions plans called for an increase in the use of the classroom activities written by the Math 30 Teaching Community. These activities were posted in the DE Math Blackboard classroom and accounts were created for all Math 30 instructors. In a pre-semester flex activity Math 30 instructors participated in the assessment of FA 05 student papers and were introduced to the TC activities as a way of helping students meet DE Program SLOs.	There was a modest increase in the number of instructors using the Math 30 TC activities, from 3 out of 8 in SP 05 to 5 out of 9 in FA 05. These 5 instructors used at least 90% of the activities.

2. **Did student performance on the three outcomes appear to differ by section?** Both instructor and student anonymity are protected in the assessment process. Instructors who submitted student work can request to see the assessment results for their students.

Closing the assessment loop: improving learning

1. Instructors participating in the assessment of Math 30 final exams were satisfied with the overall student performance on the three Math DE Program Outcomes assessed. Since instructors who submitted student work used the activities written by the FA 04 Math 30 Teaching Community, use of these activities appears to foster proficient performance relative

to communication, problem-solving, and use of multiple representations. We plan to continue to provide easy access to these activities via the Blackboard classroom for instructors.

2. Instructors participating in the assessment had a variety of recommendations for improving the exam questions. In particular, the majority of instructors wanted to incorporate problems that were more “open-ended” with less scaffolding.

Other observations:

How can we get more instructors to submit student work?

	# instructors submitting student work	# instructors participating in the assessment session
FA 04	$6/12 = 50\%$	$7/9 = 78\%$
SP 05	$3/8 = 38\%$	$6/8 = 75\%$
FA 05	$5/9 = 56\%$	$4/9 = 44\%$

Despite the repeated reminders from the DE Lead, the majority of instructors did not respond to the request for student work. The Math DE Committee needs to devise strategies for increasing the number of instructors who submit student work. Perhaps support from the Department Chair, the Academic Dean, and the Teaching and Learning Project would help instructors see the benefit to students that assessment can bring.