Summative Assessment of Math 30 Finals Spring 2006

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 fourth summative assessment of Math 30 finals. The first assessment was completed in Fall 2004. A comparison of results from previous 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.

Sampling design: Two of the ten instructors voluntarily submitted class sets of final exams which comprised 25% (3 out of 12) of the number of sections taught. Both were full-time instructors teaching on the main campus who used extensively the supplementary curriculum developed, class tested, and edited by the Teaching Community in the previous semesters. This is a decrease in participation relative to previous semesters (e.g., FA 04 when 50% (6/12) of the Math 30 instructors submitted student work, one of whom was part-time, SP 05 when 37.5% (3/8) submitted their students' exams). Students who were failing the course prior to the final were excluded from the pool. From three of the twelve sections of Math 30, we chose a random sample of 28 exams, 9 or 10 exams per section.

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. Six 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, waste management parts b and c, women's earnings part 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 part e, waste management part b, women's earnings parts a, b, c and d, $4^x = 8x + 12$

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

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

	FA 04	SP 05	FA 05	SP 06
Mean	3.5	3.44	3.6	3.82
St. Dev.	1.0	0.85	0.7	0.95
Low	0.5	1.5	2	2
1st quartile	3	3	3.25	3
2nd quartile	3.5	3.5	3.75	4
3rd quartile	4.4	4	4	4.5
High	5	5	5	5
% proficient or better	81%	77%	83%	82%

Problem-solving Outcome : stemplot of rubric scores

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

	FA 04	SP 05	FA 05	SP 06
Mean	3.4	3.5	3.5	3.88
St. Dev.	1.1	0.82	1.0	0.68
Low	1	2	1	2.5
1st quartile	2.4	2.75	3.5	3.38
2nd quartile	3.6	3.75	4	4
3rd quartile	4.2	4	4.125	4.25
High	5	4.75	4.75	5
% proficient or better	69%	73%	90%	89%

Multiple Representations Outcome : stemplot of rubric scores

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

	FA 04	SP 05	FA 05	SP 06
Mean	3.1	3.63	3.5	3.61
St. Dev.	1.0	0.75	1.0	0.89
Low	0	1.75	2	1.5
1st quartile	2.5	3	3	3.25
2nd quartile	3.5	3.75	3.375	3.5
3rd quartile	4	4.25	4.25	4.38
High	4.5	5	5	5
% proficient or better	59%	80%	80%	82%

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.

Action plans from Fall 2005 focused on improving instructor access to the classroom activities by making class sets available for students to purchase in the bookstore (by instructor request) and ensuring that all Math 30 instructors have access to the activities on-line through the use of a Blackboard classroom.

Summary of Previous Action Plans	Progress on previous action plan
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 continued to increase in SP 05, FA05, and SP 06. Likewise, 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%. The gains were maintained in SP 06 with 89% proficient on this outcome. Noteworthy increases in the 1st quartile have been maintained and indicate that students in the bottom 25% of the sample show the most improvement in problem-solving relative to FA 04.
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, FA 05, and SP 06. The percent rated as proficient or better rose from 59% (FA 04) to 80% (SP 05 and FA 05) to 82% (SP 06) on this outcome. Gains made in SP 05 by the students in the bottom 25% of the sample were maintained in FA 05 and SP 06.
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. In SP 06 we can only verify that 2 of the 11 instructors used the activities.
FA 05 action plans suggested we strive to increase access to the classroom activities by encouraging instructors to make them required materials for students to purchase in the bookstore and ensuring that all instructors had access to the activities on-line through a Blackboard classroom.	We posted the classroom activities on Blackboard Board, created accounts for all DE instructors, and discussed the use of activities in pre-semester flex activities. However, use of these activities remains low.
SP 06 instructors called for revising some components of the assessment process: including more table creation and use on the exam questions, and greater detail about use of the problem solving process in the grading rubric. Additionally, instructors need to better emphasize student communication when using technology (e.g., using graphical techniques to solve an equation) and also finding and interpreting multiple solutions, especially ones that occur outside Quadrant I. Activities could be edited to reflect these needs.	

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 generally pleased 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 suggested improving the wording in the exam problems and grading rubric to emphasize clear communication standards and give students more opportunities to create tables, estimate, and check answers.

2. Instructors participating in the assessment had a variety of recommendations for improving the exam questions and for assessing student performance using multiple measures. See *Instructor Feedback on Assessment Activity SP06* for a summary.

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%
SP 06	2/10 = 20%	5/10 = 50%

Despite the repeated reminders from the DE Lead, the majority of instructors did not respond to the request for student work. However, participation in the actual assessment session was much better, with 50% (5/10) of the FA 06 Math 30 instructors attending. Looking at student work from the end of the course fostered a good conversation between Math 30 instructors who had just finished teaching the course last spring and instructors preparing to teach it this fall. Since the purpose of assessment is to improve student learning, we want to keep the "forward focus" of the assessment session fostered by scheduling it during flex. 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.