Summative Assessment of Math 30 Finals Spring 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 second summative assessment of Math 30 finals. The first assessment was completed in Fall 2004. A comparison of results from these two 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: Three of 8 instructors voluntarily submitted class sets of final exams; all 3 were full-time instructors teaching on the main campus who participated in the Teaching Community both semesters. This is a decrease in participation relative to FA 04 when 50% (6/12) of the Math 30 instructors submitted student work, one of whom was part-time. Students who were failing the course prior to the final were excluded from the pool. From three of the nine sections of Math 30, we chose a random sample of 30 exams, 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 and one facilitated.

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

0	
1	5 8
2	0 3 8 8 8
3	0 0 3 3 3 3 4 5 5 7 8
4	0 0 0 0 0 3 3 5 5 5
5	0

	FA 04	SP 05
Mean	3.5	3.44
St. Dev.	1.0	0.85
Low	0.5	1.5
1st quartile	3	3
2nd quartile	3.5	3.5
3rd quartile	4.4	4
High	5	5
% proficient or better	81%	77%

Problem-solving Outcome : stemplot of rubric scores

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

	FA 04	SP 05
Mean	3.4	3.5
St. Dev.	1.1	0.82
Low	1	2
1st quartile	2.4	2.75
2nd quartile	3.6	3.75
3rd quartile	4.2	4
High	5	4.75
% proficient or better	69%	73%

Multiple Representations Outcome : stemplot of rubric scores

0	0
1	5
2	0 3 3 4 5 5 5 5 5 7 8
3	0 0 5 5 5 5 5 5 5
4	0 0 0 0 0 0 0 5 5 5
5	

	FA 04	SP 05
Mean	3.1	3.63
St. Dev.	1.0	0.75
Low	0	1.75
1st quartile	2.5	3
2nd quartile	3.5	3.75
3rd quartile	4	4.25
High	4.5	5
% proficient or better	59%	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. For both outcomes, we see more consistent performance, with the most improvement in the lowest performing students. In the use of multiple representations, performance improved significantly.

Summary of FA 04 Action Plan	Summary of Relevant Assessment Results
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 used these revised activities.	Relative to FA 04, there were small but statistically insignificant gains in problem-solving in the sample assessed in SP 05. The percent rated as proficient or better rose from 69% to 73% on this outcome. The mean performance increased slightly from 3.4 to 3.5. Noteworthy is the decrease in standard deviation from 1.1 to 0.82, suggesting more consistent student performance on this outcome. In particular, the 1st quartile increased the most, so 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 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. The percent rated as proficient or better rose from 59% to 80% on this outcome. Here again we see a noteworthy decrease in standard deviation from 1.0 to 0.75, suggesting not only improved student performance but more consistent student performance on this outcome. In particular, the 1st quartile increased the most, so students in the bottom 25% of the sample showed the most improvement in use of multiple representations.

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 provide easy access to these activities by setting up a Blackboard classroom for instructors and to encourage others to experiment with these activities.

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 SP05* for a summary.

Other observations:

How can we get more instructors to submit student work?

The number of instructors submitting student work for the Math 30 assessment drastically decreased, from 50% (6/12) in Fall 2004 to 37.5% (3/8) in Spring 2005, with student work from members of the Teaching Community down from 100% (5/5) in Fall 2004 to 60% (3/5) in Spring 2005.

One contributing factor might be that the assessment session was moved from final exam week to the week before fall flex. 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 good, with 78% (7/9) of the FA 05 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.