

## Analyzing Elementary Algebra Exams for Alignment with PSLOs SP 07

### Overview:

In the FA 06 assessment of Elementary Algebra final exams, student performance declined on communication, problem-solving, and use of multiple representations. The Developmental Math Committee hypothesized that the decline was due to instructors not teaching to these outcomes in a sustained and deep way. To test this hypothesis we analyzed instructors' unit exams, as well as their textbooks, for alignment with the Math DE SLOs.

This rubric was used by the LMC Developmental Math Committee to analyze a sample of unit exams submitted anonymously by instructors teaching Elementary Algebra in SP 07. The goal was to determine the extent to which the QUESTIONS on an exam address three of Developmental Math Program Student Learning Outcomes. This rubric has nothing to do with analyzing student work.

Outcome	Low	Medium	High
Communication	Questions on the exam do not explicitly address the Communication Outcome, except perhaps a generic "show work."	Some questions address communication outcome, such as prompts requiring students to define variables or explain the meaning of some math concepts. At least one question requires students to explain how they arrived at an answer.	Frequently asks for sophisticated interpretations such as implications of results or limits of models or documenting use of a general solution process.
Multiple representations	Questions focus mostly on one representation (for example, just symbolic)	Several problems give information in a different representation, e.g tables, graphs, words, symbols. Students are required to use and interpret multiple representations to solve problems.	Problems require students to make connections between different representations. Students have to create multiple representations to solve problems.
Problem solving	Problems require only standard symbolic manipulation.	At least one question prompts the use of some variation of Polya's process. At least one "word problem."	Problems are set in nonstandard contexts with perhaps extraneous information, and problems are not in template form. Very little scaffolding. Problems are open-ended in the sense that multiple solution methods are possible.

**Results:** We analyzed nine exams from nine instructors. One exam earned a high for all three outcomes; it was the exam written in FA 03 by the Elementary Algebra Teaching Community. Two exams rated a medium in all three categories, but both lacked tables and a problem that required use of Polya's method. Six exams were rated as lows because they focused solely on procedural skills and symbolic manipulation. It is important to note that we only analyzed one exam per instructor and therefore may have omitted other assessments used by instructors that were better aligned with these three learning outcomes.

## **Developmental Math Program SLOs referenced above:**

**Communication Outcome:** Students will read, write, listen to, and speak mathematics with understanding:

Students will read and listen to mathematical presentations and arguments with understanding.  
Students will communicate both in speaking and in writing their understanding of mathematical ideas and procedures using appropriate mathematical vocabulary and notation.  
Students will coherently communicate their own mathematical thinking to others.

**Problem Solving Outcome:** Students will use mathematical reasoning to solve problems and a generalized problem solving process to work word problems.

The student can apply standard problem-solving methods and use relevant concepts to solve problems.

The student uses a generalized problem-solving rubric if such a rubric is used in the class.

The student's written work demonstrates a conceptual understanding of course concepts.

The student's written work supports his/her solution. The student evaluates the reasonableness of his/her answer.

**Multiple Representations Outcome:** Students will demonstrate the ability to use verbal, graphical, numerical, and symbolic representations of mathematical ideas.

Students will use a variety of representations to demonstrate their understanding of mathematical concepts.

Students will use a multi-prong approach to problem solving.

Students will use appropriate technology to solve mathematical problems and judge the reasonableness of their results.