Fall 2010/Spring 2011 Math Program Assessment Report
Exemplar Submission:

Introduction

The developmental mathematics program for CSU, Sacramento, housed in the Learning Skills Center is quite successful in remediating our underprepared students. The data collected and analyzed by the Office of Institutional Research (OIR) shows for a decade starting in 1998, a 93% average retention rate for first-time freshmen taking one or more Learning Skills classes.

As CSU-Sacramento begins implementing Liberal Education and America's Promise’s goals (LEAP), the Learning Skills mathematics (LSM) staff, realize that we must also adapt and modify our approach to the teaching of mathematics to coincide with these changes. But we understand that it will take some time. So for this past year, the LS math staff have investigated ways to improve problem solving skills in our classes. We held informal talks exploring ways to help our students as they leave our program and enter into their majors. We began looking at the LEAP goals and focused on problem solving as the one goal to try to implement into our classes.

The Association of American Colleges and Universities (AACU) define problem solving as “the process of designing, evaluating and implementing a strategy to answer an open-ended question or achieve a desired goal” (http://teachinginstitute.wikispaces.com/file/view/ProblemSolving.pdf). Problem solving is divided into six characteristics: (1) define problem; (2) identify strategies; (3) propose solutions/hypotheses; (4) evaluate potential solutions; (5) implement solution; and (6) evaluate outcomes (http://teachinginstitute.wikispaces.com/file/view/ProblemSolving.pdf).

In the Fall 2009, as the mathematics coordinator for Learning Skills, I began implementing tasks in my class to develop problem solving skills in my students. I spoke to the LS mathematics staff about what I was attempting to do and presented students’ work to the staff in order to encourage them to begin considering an alternative way to approach developmental mathematics instruction.

1. What question or issue were you addressing with this activity?

Is it possible to infuse problem solving into developmental mathematics classes? And what would problem solving look like in an assessment?

Changing a successful program is difficult. The LS mathematics classes utilize common assessments. In my LS 7A, I utilized the same assessments but added extra tasks to each assessment. This preserved the integrity of the mathematics objectives of the LS 7A, but allowed me to show the LS mathematics staff a way of infusing problem solving without diluting LS 7A.
To provide context, I presented some tasks taken from the Final Exam 2009 to illustrate what we have been doing in our classes. All of these tasks come from one student. The first task below is the stereotypical task found in algebra textbooks for the objective of solving variables on opposite sides of the equation:

Task 1: Solve: \( 4x + 3.1 = x - 3.2 \)

Here is a sample of work by one student (students were allowed to use calculators).

\[
3. \quad \text{Solve: } \quad 4x + 3.1 = x - 3.2
\]

\[
\begin{align*}
4x + 3.1 &= x - 3.2 \\
- x &\quad - x \\
3x &\quad = -6.3 \\
\frac{3x}{3} &\quad = \frac{-6.3}{3} \\
x &\quad = -2.1
\end{align*}
\]

This student, like most students, solved this task by subtracting \( x \) from both sides and then subtracting 3.1 from both sides. This mathematical task is typically used to build procedural rather than a conceptual understanding of the algebra. What does occur as result is that students come to believe that this is "doing" algebra. What is needed is a balance between the procedures and concepts.

As defined by AACU, a part of problem solving is the implementation of strategies to achieve a desired goal. In a mathematical context, a part of problem solving connects the different mathematical concepts or procedures to achieve a desired goal. This in turn fosters and builds a stronger mathematical foundation.

The task below was also given on the final assessment, but students were not allowed to use calculators. This task below differs from the task above in that the student must connect the different mathematical concepts such as writing, applying, and evaluating the algebraic representation. No mathematical task is given to the student; instead the student must generate the equations to be solved.

Task 2: Given the following linear pattern 2.4, 2.5, 2.6, 2.7, 2.8,… Find the following:
   a) The 120th term
   b) When the pattern is equal to -5.9
   c) The algebraic representation for this pattern

This is an example of the work of one student.
This student must identify a strategy and can choose to use either arithmetic or algebra to solve parts a) and b), but if using arithmetic, solving the problem becomes quite cumbersome. If a student chooses to use algebra to solve this task, then the student would need to do part c) first, which this student did. Once the student has determined the algebraic representation, the student still needs to utilize it correctly. In other words, there are two variables and the student must substitute correctly into the equation. There are elements of identifying strategies and implementing solutions, which are two characteristics for problem solving at least at the benchmark level for the AACU rubric.

On the final exam, I gave my students another task which contained similar algebra concepts to Task 2.

**Task 3:** Irma has $1260 in her bank account, and she will spend $35 per week at Sac State. Find the following:

- a) How much money will she have in 5 weeks?
- b) When will Irma run out of money? (Assuming that her parents never send her any money.)
- c) When will Irma have half her money?
- d) Find the algebraic representation for the number of weeks and amount of money in the bank.

Similar to Task 2, students must determine the best strategy to use, choose that strategy, and implement it. The work below comes from the same student work from Task 2.

Instead of using algebra, this student chose to use arithmetic to solve this task. From part d), the student was able to correctly write the algebraic representation; thus, she could have used algebra to do the whole task. This is the type of thinking we want to develop in our students as they leave our program, in other words, the ability to select the appropriate mathematical
tools for the situation. The students should also be confident that if they have forgotten a strategy, then they can generate another strategy to solve the task.

2. **What data did you collect to address this question or issue?**

   I collected students’ daily work and assessments. I used these artifacts as talking points for our conversations with the LSM staff.

3. **What did the data tell you?**

   These artifacts showed that it was possible to infuse problem solving skills throughout the semester for LS 7A students, who come with the lowest mathematics skills.

4. **As a result of faculty reflection on these results, are there any program changes anticipated?**
   a. If so, what are those changes?

      The LS Math faculty stated that this was a good direction for Learning Skills mathematics classes and understood that change was needed, but stressed that change in a successful program would need to take time. So before the start of the semester and during our initial meeting, we will discuss how to infuse more problem solving.

      During the semester, I will hold lunch seminars on what I am doing in my LS 7A class and will present lesson plans and/or assessments.

   b. How will you know if these changes achieved the desired results?

      One way to see change is to measure the participation of other LS 7A teachers. During these meetings, other teachers could share their assessments and lesson plans with the group. As the LS Math staff, we will proceed together in setting the pace and deciding how best to implement change in the program. As the mathematics coordinator, I will collect the LSM staff artifacts and look for change over time.

5. **What assessment activities are planned for the upcoming academic year?**

   I will teach LS 7A this fall. I will be providing those teachers who teach 7A with my lesson plans so that they can follow my progression through the curriculum. We will meet to discuss the successes and difficulties of infusing problem solving into our classrooms. I will initially provide LSM staff with my modifications to the assessment and hope that the LSM staff will contribute tasks for future assessments.