Assessment Grant Report from the Department of Mathematics
From: Joanne Snow
Date: January 7, 2010

1. What learning outcomes (if any) did you/your department have for the course before your grant?

   The course on which we focused our attention was Math 100 – Problem Solving Strategies in Mathematics. The course was a two-credit course that was approved as a three-credit course in Spring 2009. The content of the course now includes some work in algebra.

   Before the revision of the course and before the grant, we tended to use the phrase "learning objective" as opposed to "learning outcomes". Two sets of old learning objectives/outcomes are attached.

   - Learning objectives prior to course revision submitted to the curriculum committee. (A)
   - Learning outcomes submitted to the curriculum committee. (B)

2. What techniques for assessment (if any) were you/your department using before your grant?

   For Math 100, the instructors used participation, homework, in-class presentations, quizzes, tests, a portfolio of problems, and a final exam.

3. What learning outcomes did you/your department define for this course/your department as a result of your grant?

   The first half of our retreat (in fact, the entire morning) was spent examining these learning objectives and revising them as appropriate learning outcomes. We worked as a group to produce the final set of outcomes that are also attached. Jessica Ickes was very helpful in this process. She provided us with materials about writing learning outcomes that gave us models of learning outcomes and lists of the vocabulary to use in writing the outcomes. We began with a general discussion about learning outcomes, expressing our concerns about how to write them, how general/specific they should be, and even how many any one course should have. As we applied this knowledge to Math 100, Jessica critiqued our work as we went along. This narrowly focused effort was very beneficial, as we could see how to apply the process to other courses. The experience from the retreat is helping us this year as we revise our learning outcomes for the math major.

   The second half of the retreat was spent discussing tools that we could use to assess an incoming student's math skills and ability. Several members of the faculty made presentations on tools that are currently available. These included SNAP, Mathlab, the programs at the University of Michigan and Michigan State, Webworks, Compass, and Maplesoft, among others. We considered the particular purpose of each and asked the question if any of these would help us assess the skills/abilities of interest to us. Other

issues we examined included: the statistical validity of the test, the speed at which results are available, and the option to customize the test. Maplesoft has an excellent program, but it is expensive. We decided to try Webworks, as this is a free program. To use it, we need a virtual server. While we met with IT in May or June, due to the intense workload of the IT office, the server was not ready until well after the start of this academic year. As we are all extremely busy, I fear our work is stalled until the summer.

4. What techniques will you/your department use to assess each learning outcome?

   This information is found on the sheet entitled "Learning Objectives for Math 100". (B)

5. How will you tell whether the students achieved each learning outcome?

   Some of this is also addressed on the sheet entitled "Learning Objectives for Math 100". In general, successful completion (at least a C) on each of the means of assessment will tell us if a student has achieved the outcome.

6. Which resources did you consult in your work on assessment? Which would you recommend to others?

   The general resources that we used were those provided to us by Jessica Ickes.

   We used several that were specific to mathematics.
   - We obtained information about the assessment tests on line.
   - Jessica provided some examples of assessment plans for a variety of mathematics departments and she went over these with some faculty in the department. In this same meeting, the faculty had prepared learning outcomes for some of their courses, which Jessica critiqued.
   - We found other example plans on line.
   - We used the following:
     1. *Assessment of Student Learning in College Mathematics: Towards improved programs and courses* from the Association for Institutional Research. This book was very helpful to us. This group produces volumes for each discipline.
     2. *Supporting Assessment in Undergraduate Mathematics* from the Mathematical Association of America (MAA).
     3. *CUPM Discussion Papers about Mathematics and the Mathematical Sciences in 2010: What Should Students Know?* This was prepared by the Committee on the Undergraduate Program in Mathematics and published by the Mathematical Association of America.
     4. *Supporting Assessment in Undergraduate Mathematics.* This is web resource found on MAA Online.

7. Please reflect on your grant experience as a whole. What did you learn from this grant? What weren't you able to achieve but would have liked to? What do you see as your next

questions to explore or next steps in improving student learning and assessment in your course(s)/department?

I felt like the members of our department came to a better understanding of what a learning outcome is, what it means to measure an outcome, and what variety there is in tools to measure success. Before the retreat, for the most part, our knowledge was very general, very nebulous. Since the retreat, we have more confidence, experience, and knowledge to attack the issues.

Our department discussions this fall in looking at our learning outcomes for the major in mathematics have been very focused. We are using the right vocabulary. We are able to "nail" an issue. The concrete work that we did as a group--all focusing on one course—was of great help.

We were not able to prepare our assessment tool for incoming first year students. This was beyond our control.

I see a few issues of particular concern.

- Are there methods to measure achievement of a learning outcome that we are unaware of? We seem to rely upon the usual tests, papers, exams, and presentations.
- How will we measure achievement of learning outcomes for the major? Some institutions look only at student progress in 2 courses or only at one question on a final exam. Should we look at all courses? Should we focus on only one measure for a particular course, for example, look only at the final exam? Should we focus on only one or two learning outcomes per year?
- How will gather data and keep records? How will we use the data we gather? We have some experience and do keep assessment reports, but I think we need to focus more specifically on the learning outcomes. At our department retreat, we have discussed changes to make in courses based on our assessment conversations.
- How should students be involved in the assessment process? Should a student evaluate her own progress towards achieving the learning outcomes?

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Math 100: Problem Solving Strategies
Spring 2009

Instructor: Suzanne Cox
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Office Hours:	Monday	10:00 am – 2:00 pm
	Tuesday	9:30 am – 3:00 pm
	Wednesday	10:00 am – Noon, 1:00 pm – 2:00 pm, 3:00 pm – 4:00 pm
	Thursday	9:30 am – 3:00 pm
	Friday	10:00 am – 2:00 pm

This course is an intensive study of the problem solving process. It will examine Polya's four-step problem solving process. Students will learn to identify and implement problem solving strategies guess and check, finding a pattern, working backwards, making a simpler problem, making a table/chart, making a list, drawing a picture, and writing an equation. The course will emphasize oral and written explanations of both the problem solutions and the process involved in finding the solutions.

Course Requirements:

Participation and preparation for class: 20% of grade
Students are expected to be prepared to discuss assigned homework problems and to present problems worked in class. Five points will be deducted from the participation grade for each unexcused absence.

Quizzes: 10% of grade
Four OPEN note quizzes will be given on February 27, March 6, March 27, and April 8.

Tests: 30% of grade
Two tests (without notes) will be given on March 20 and April 17.

Portfolio of problems and presentation of selected problems to class: 20% of grade
Students will write an original problem illustrating each problem solving strategy, will correctly solve each problem and explain what strategies were used and why they were appropriate. The final portfolio is due April 27.

Final Exam: 20% of grade
The final exam (with calculator, without notes) is Thursday, May 7 at 4:15 pm.

Students earning at least a B- in the course will be exempt from taking the department proficiency exam in subsequent mathematics courses.

Honesty Policy: Students will be expected to work in groups during class sessions, but all written work, including homework, the portfolio, tests and quizzes, must be done individually. The college policy on academic honesty will be enforced.

This course does not fulfill the general education requirement in mathematics, but should prepare a student for further study of mathematics in a subsequent course which does satisfy the requirement.

COURSE SCHEDULE

Week 1:	Overview of Polya's Problem Solving Process and Strategies Strategy 1: Find a Pattern Strategy 2: Guess and Check
Week 2:	Strategy 3: Find a Simpler Problem Strategy 4: Make a List Strategy 5: Make a Table/Chart Quiz 1
Week 3:	Strategy 5: Make a Table/Chart (cont.) Strategy 6: Working Backward Quiz 2
Week 4:	Strategy 6: Working Backward (cont.) Review for Exam 1 Exam 1
Week 5:	Strategy 6: Working Backward (cont.) Strategy 7: Draw a Picture Strategy 8: Equations Quiz 3
Week 6:	Strategy 8: Equations (with multiple variable) Strategy 8: Equations (distance formula)
Week 7:	Strategy 8: Equations (cont.) Portfolio Draft Due Quiz 4 Student Presentation of Portfolio Problems Review for Exam 2
Week 8:	Student Presentation of Portfolio Problems Exam 2
Week 9:	Student Presentation of Portfolio Problems Strategy 8: Equations (percent) Portfolio Due
Week 10:	Strategy 8: Equations (mixed types) Review for Final Exam

Learning Objectives for Math 100

1. To take personal responsibility for their work and success in this and future math courses.
   (a) Students must attend class on a consistent basis, participate in discussions, ask questions during class and see the instructor during office hours.
   (b) Students should take complete and accurate notes during class.
   (c) Students should be aware of positive and negative experiences from their math background and identify their own fears when confronted with math problems.

   Assessment: Attendance and participation is a calculated part of the grade in this course. Open note quizzes are given on a regular basis. The students must write a short paper as part of their first assignment which addresses their best and worst experiences in math, and their reaction when confronted with a particularly difficult problem.

2. To become comfortable with the language of mathematics and the precision of mathematical notation.
   (a) Students learn to take everyday language within a story problem and to interpret that in a mathematical way.
   (b) Students learn to identify key words and phrases within a problem.
   (c) Students learn to identify information which is not pertinent to the solution of a problem.
   (d) Students learn to use appropriate mathematical language and notation in the context of writing problems and solutions, finding a solution, and explaining a solution.

   Assessment: A variety of problems are presented in class and assigned as homework. Students are asked to solve problems on quizzes and exams, and make up a portfolio of problems they have written as a final class project. The portfolio problems must use complete, accurate, and understandable wording, much as a math textbook might present. Every student must present some of their portfolio problems to the entire class.

3. To learn a variety of problem-solving techniques which will give them the tools with which to work when confronted with math problems in the future.
   (a) Students learn that there is often more than one appropriate approach to solving a particular problem.
   (b) Students gain confidence in their ability to independently problem-solve.
   (c) Students learn to review their successful work and generalize their approaches for future problem solving.
   (d) Students learn to appreciate the process through which a problem is solved, not just as a solution that must be found.

Developmental and Learning Outcomes for Math 100

from retreat

Developmental Outcomes

1. Students will demonstrate personal responsibility for their education
   a. Play an active role in the class learning community including
      - Attending class on a consistent basis
      - Participate in discussions
      - Ask questions during class
      - See instructor during office hours
      - Take complete and accurate notes during class
   b. Reflect on past and current experience in math
   c. Gain confidence in ability to be successful in mathematical classes

Learning Outcomes

2. Students will interpret and use the language and notation of mathematics correctly, in particular
   a. read everyday problems with precision
   b. distinguish information relevant and irrelevant to the problem using key words and phrases
   c. translate everyday problems into mathematical models
   d. articulate the solution to posed problems and explain the answer in context
   e. formulate original problems with complete, accurate and understandable wording

3. Students will indentify and apply a variety of problem solving techniques, in particular
   a. choose, justify and employ an appropriate problem solving strategy to posed problems and identify other possible techniques.
   b. Adapt problem solving techniques to more general context

4. Students will demonstrate proficiency in basic algebra skills and concepts including the following
   a. perform arithmetic computations involving fractions, decimals and percents correctly
   b. perform order of operations in standard order
   c. solve liner and quadratic equations in one variable
   d. solve systems of linear equations
   e. graph linear inequalities in 2 variables

Assessment: Quiz and exam problems ask students to identify which problem-solving technique they used for a particular problem and why it was helpful. Their portfolio must include one problem for each problem-solving technique learned in class and an explanation of why that particular technique was useful for that problem. Each problem must also be accurately solved by the student.

4. To strengthen and solidify basic algebra skills and concepts necessary for future success in mathematics.
   (a) Students will learn and review algebra rules involving fractions, decimals and percentages.
   (b) Students will learn and review techniques for solving equations.
   (c) Students will see and practice a substantial number of problems involving basic algebra skills and concepts.

   Assessment: A third quiz and exam specifically involving algebra techniques will be given. The portfolio project will be expanded to include the algebra concepts covered in class.