Building a Gateway for Non–STEM Students: Learning Assessment and the Developmental Student

Carol Weideman, Ph.D.
Sandy Cohen, M.S.
June 2014
Presentation Objectives:

- Background
- Course Design with Assessments
- Components of the Course
- Course Outcomes
- Student Feedback
- Lessons Learned
St. Petersburg College Quick Facts

- SPC – established in 1927
- 10 Campuses in Pinellas County
- First FCS college to offer baccalaureate degrees; 1,168 (2012–13)
- 2012–13 FTE: 21,546
- 2012–13 Graduates: 6,149
- Fall 2013 credit enrollment: 33,363 (unduplicated)
In 2013, The Florida Legislature passed a law that exempts students who received standard public high school diplomas after 2006 or those in the active military from taking placement tests.

Many non–STEM students enroll and perform poorly in MAT 1033, Intermediate Algebra which is currently the gateway course for all general education mathematics offerings.
Pass rates for MAT 1033 in Fall 2012, Spring 2013, Fall 2013 and Spring 2014 were 57%, 50%, 57% and 49% while withdrawal rates were 20%, 13%, 14%, and 11% respectively.

In light of the legislation and recognizing that 55% of students enroll in non-STEM general education math courses, such as Statistics and Liberal Arts Mathematics courses, a new gateway course was developed to meet their needs.
Which students need this new gateway course?

- Students who do not need MAC1105 for their course of study.
- Students who want and need a realistic approach to the study of mathematics.
- Students who want and need to improve their critical thinking and problem solving skills.
- Students who are active participants in their learning and who work well in groups.
- Students who want to learn how to communicate mathematically.
COURSE DESIGN

- This course builds the foundation for understanding selected concepts taken from algebra, set theory, logic, geometry, probability and statistics.
- Critical thinking skills, problem solving strategies, communicating mathematically and appropriate use of technology is incorporated throughout the course via activities and projects.
A committee of mathematics faculty used the major learning outcomes and objectives from the Statistics course STA2023 and the two Liberal Arts Math courses (MGF1106, MGF 1107) to develop a course outline for MAT1100.

The main goal of this new gateway course is for students to be successful in the subsequent courses that they take to fulfill their mathematics general education requirements.
Course Outline/Learning Outcomes

Course Description:

This course builds the foundation for understanding selected concepts taken from topics which include algebra, set theory, logic, geometry, probability, and statistics. Critical thinking skills, problem solving strategies, communicating mathematically, and appropriate use of technology will be incorporated throughout the course via activities and projects.

Learning Outcomes:

1. The student will apply fundamental mathematical properties.
2. The student will demonstrate an understanding of algebraic concepts.
3. The student will demonstrate an understanding of graphing
4. The student will apply basic concepts of set theory and mathematical logic
5. The student will apply basic concepts in geometry
6. The student will apply basic concepts in probability and statistics
The student will receive three college elective credits for a grade of D or higher.

A minimum grade of C is a prerequisite for MGF1106, MGF1107, STA2023

The class meets two days per week and serves as an alternative to Intermediate Algebra for non-STEM majors.

We are using the textbook Math Lit by Almy and Foes, published by Pearson.
Math Lit Textbook

- The book was designed to support pathways courses such as Mathematical Literacy for College Students (MLCS), which are one-semester courses for non-math and non-science majors.
- MLCS integrates numeracy, proportional reasoning, algebraic reasoning, and functions.
- These topics match the course outline developed by SPC faculty for MAT 1100.
Math Lit Textbook Features

- The book is divided into “cycles” which increase in depth as the course develops.
- Each cycle begins with a “Focus Problem.”
- Each cycle includes all four strands – numeracy, proportional reasoning, algebraic reasoning and functions.
- The “Focus Problem” is revisited several times during each cycle.
- MyMathLab homework and quizzes are designed to reinforce the four strands.
COURSE ASSESSMENTS

The course includes four assessment categories:

**Homework** (MyMathLab): It is assigned for each section discussed in class.

**Cycle Quizzes** (MyMathLab): Students must complete the associated homework with a score of 60% to gain access to the quiz. Three attempts are allowed for each cycle quiz. The highest grade for each quiz is used.
COURSE ASSESSMENTS

Projects: There are four team projects during the semester. A grading rubric is provided for each project.

Portfolios: The portfolios are due at the end of each cycle in the textbook. It consists of two self assessments, a vocabulary check, a concept and application review and a self-evaluation. Each student submits their own portfolio for each cycle.
Course grades are calculated from the four assessment categories as follows:

- Homework: 30%
- Quizzes: 20%
- Projects: 20%
- Portfolio: 30%
Cycle 1 Focus Problem: Medication Errors

A 6-year-old patient underwent an outpatient tonsillectomy and adenoidectomy. The surgeon ordered 1,000 cc D5W, dispensed at a rate of 600 cc every 8 hours, to maintain hydration levels. A pharmacist calculated the infusion rate for the IV drip to be administered. He used a calculator and checked his calculations twice. He then listed the infusion rate on the electronic medical chart as 200 mL/hr.

The nurse who started the infusion obtained a bag of D5W, which contains 1,000 cc of fluid, and administered the IV solution to the child. Like other nurses in her unit, she relied on the accuracy of the pharmacist since he had a reputation for correctness. Therefore, she did not check his calculations even though her job duties include verifying dosages.

Once the first 1,000 cc bag of D5W was empty, she hung a second bag to infuse.

The child began vomiting frequently, which is not unusual in the recovery for this surgery. The child was given medicine to ease the vomiting. Forty minutes later the child exhibited seizure-like activity which is unusual in the recovery from this type of surgery. This behavior increased over the course of the day, during which a third 1,000 cc bag of D5W was hung to dispense.

The pediatrician on call noticed the patient was experiencing hyponatremia and water intoxication due to the high IV infusion rate and lack of sodium chloride in the infused medicine. In fact, the child’s sodium level was 107 mEq/L, whereas the normal range is 136–145 mEq/L. Despite treatment, the child did not survive.

Assuming all three bags were completely administered, how much D5W did the child actually receive compared to the amount ordered? Assuming the surgeon’s orders were correct, what should the IV rate have been in cc/hour? How long should the IV have continued to administer the 1,000 cc ordered by the surgeon? By what percent was the child’s sodium level beneath the normal range?

Where did this child’s medical treatment go wrong? What can the hospital do to avoid a recurrence of these events? In other words …

What Can Be Learned????
1. In golf, the average number of strokes a good player should need in order to complete a course is called *par*. Par for a whole course is calculated by adding up the par scores for each hole. Scores in golf are often expressed as some number either greater than or less than par. Assume a particular golfer has golfed 2 under par on 3 holes, 3 over par on 3 holes, and 1 under par on 3 holes. If par for the 9-hole course is 32, how many strokes did it take the golfer to complete the course?
Sample Class Activity: Order of Operations

Students will work in groups. Using the roundtable rules below, complete the origami activity using the blank paper provided.

Roundtable rules:

a. There is only one sheet of paper on which to complete the activity per group.
b. There is no talking once work begins.
c. Only one member at a time can work. The group member with the earliest birthday in the year goes first.
d. Each group member completes one step (from the origami instructions) during his or her turn.
e. At the end of a turn, the member passes the activity paper to the right.
f. Undoing (not fixing) the previous person’s mistake is allowed, but it counts as a turn.

Time allowed: 10 minutes!
Origami Hat Instructions

1. Fold the paper in half lengthwise, then unfold.
2. Fold the paper in half again from top to the bottom.
3. From the fold, fold the left and right corners to the center to form a triangle.
4. Fold up the bottom flap along the base of the triangle.
5. Turn the paper over.
6. Like Step 4, fold up the bottom flap.
7. Put the hat on and you're done!
Reflection on the Activity

Show your team’s work to the class

What makes this type of activity challenging?

How do order and accuracy affect the final product?

How do small errors in early steps get magnified as the process continues?
Group Project Example
You will graduate from SPC in May 2015 and suppose you have three job offers.

JOB A: Water Treatment Position:
Pays $ 50,000 per year
$ 5000 bonus for an additional degree
2 weeks vacation
Need to relocate to a small city
Great benefits, but no gym membership
No casual attire permitted

JOB B: Manufacturing Position:
Pays $ 45,000 per year with 6% bonus at the end of the first year, 5% bonus at the end of the second year, 4% bonus at the end of the third year, etc.
2 weeks vacation with an additional day added at the end of five years and each year afterwards.
No need to move
Great benefits with gym membership
Pays $ 3000 for college coursework
Casual dress.
You will graduate from SPC in May 2015 and suppose you have three job offers.

**JOB C: Sales Position:**
- Pays $3000 per month plus 40% commission on all sales you produce
- 2 weeks vacation plus 3 personal days per year
- You will be traveling 60% of the time
- Great benefits with gym membership for you and your immediate family
- Pays $5000 for college coursework
- Casual dress one day per week.

1. Which job offer would you take?
2. List three things that are most important to you in looking for a job.
3. List three things that are nice, but are not necessary for you to select a particular job.
4. List three things that would make you turn down a job offer.
Self-assessment includes:

- What did you like about the project?
- What didn’t you like about the project?
- Did everyone contribute equally?
- What grade do you think you will earn?
### Portfolio Components

- **Self-Assessment:** from textbook
  - beginning of cycle, end of cycle

#### Self-Assessment: Looking Forward

Below is a preview of the key procedures that will be developed in this cycle. For each procedure listed, indicate your level of expertise by using an arrow or shading.

<table>
<thead>
<tr>
<th>Skill or Concept</th>
<th>Progress Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I'm not sure</td>
</tr>
<tr>
<td>1. Create and use Venn diagrams.</td>
<td></td>
</tr>
<tr>
<td>2. Plot and read ordered pairs.</td>
<td></td>
</tr>
<tr>
<td>3. Interpret rates that are commonly used in daily life.</td>
<td></td>
</tr>
<tr>
<td>4. Simplify, add, subtract, multiply, and divide fractions.</td>
<td></td>
</tr>
<tr>
<td>5. Solve applied problems involving fractions.</td>
<td></td>
</tr>
<tr>
<td>6. Create and interpret pie and bar graphs.</td>
<td></td>
</tr>
<tr>
<td>7. Create and interpret scatterplots.</td>
<td></td>
</tr>
</tbody>
</table>
Portfolio Components

- Vocabulary Check: from textbook

Vocabulary Check

<table>
<thead>
<tr>
<th>Cycle 1 Word Bank</th>
<th>cycle 1 word bank</th>
<th>cycle 1 word bank</th>
<th>cycle 1 word bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>ratio</td>
<td>deductive reasoning</td>
<td>percent change</td>
<td></td>
</tr>
<tr>
<td>rate</td>
<td>conjecture</td>
<td>independent variable</td>
<td></td>
</tr>
<tr>
<td>proportion</td>
<td>counterexample</td>
<td>dependent variable</td>
<td></td>
</tr>
<tr>
<td>proportional</td>
<td>variable</td>
<td>scatterplot</td>
<td></td>
</tr>
<tr>
<td>scale</td>
<td>algebra</td>
<td>pie graph</td>
<td></td>
</tr>
<tr>
<td>Cartesian coordinate system</td>
<td>constant</td>
<td>bar graph</td>
<td></td>
</tr>
<tr>
<td>axes</td>
<td>expression</td>
<td>Venn diagram</td>
<td></td>
</tr>
<tr>
<td>origin</td>
<td>equation</td>
<td>function</td>
<td></td>
</tr>
<tr>
<td>ordered pair</td>
<td>term</td>
<td>area</td>
<td></td>
</tr>
<tr>
<td>quadrants</td>
<td>linear relationship</td>
<td>perimeter</td>
<td></td>
</tr>
<tr>
<td>inductive reasoning</td>
<td>exponential relationship</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Choose a word from the word bank to complete each statement.

1. A ________________ is a picture that can be used to compare and contrast sets.

2. The ________________ is comprised of two number lines that intersect at a right angle. The two number lines, called ________________, intersect at the _________________. The number lines divide the plane into four areas called ________________.

3. In the ________________ (5, 4), the first number tells how far to move to the right and the second number tells how far to move up.
Portfolio Components

- **Concepts and Applications**
  - Multi-step questions requiring problem solving and critical thinking skills

- **Self-Evaluation**: Students write a one page evaluation discussing the following:
  - What new concepts did you learn?
  - What new vocabulary and applications did you learn?
  - Discuss progress from the first self-assessment to the second self-assessment.
Pilot Classes

Spring 2014: 2 sections offered at two SPC campuses: St. Petersburg Gibbs & Tarpon Springs

Enrollment for each section fixed at 30 students

Initially one section per campus was offered but these sections filled within a week

An additional section was added at each campus
### Student Demographics

<table>
<thead>
<tr>
<th>Gender</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>62%</td>
</tr>
<tr>
<td>Males</td>
<td>38%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 22 years</td>
<td>39%</td>
</tr>
<tr>
<td>22–30 years</td>
<td>15%</td>
</tr>
<tr>
<td>31–40 years</td>
<td>14%</td>
</tr>
<tr>
<td>41–50 years</td>
<td>14%</td>
</tr>
<tr>
<td>51–60 years</td>
<td>15%</td>
</tr>
<tr>
<td>&gt; 60 years</td>
<td>4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prior Math Experience</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students who had taken MAT0024/MAT0028</td>
<td>78</td>
</tr>
<tr>
<td>Students who were successful in MAT0024/MAT0028</td>
<td>70</td>
</tr>
<tr>
<td>Students who had taken MAT1033</td>
<td>44</td>
</tr>
</tbody>
</table>
Course Outcomes

- MAT1990: Pass rate: 80.7% for four sections (119 students)
  F and WF: 15.2%
  Withdrawals: 1.7%
  Course Completions: 94% of students completed the course

- MAT1033: Pass rate: 48.8% (1,888 students)
  F and WF: 28%
  Withdrawals: 11.1%
Pilot Class Students: Gen Ed Math Enrollments

- **Summer 2014**
  - MGF1106: 12 students enrolled
  - MGF1107: 6 students enrolled
  - STA2023: 1 student enrolled

- **Fall 2014**
  - MGF1106: 18 students enrolled
  - MGF1107: 13 students enrolled
  - STA2023: 8 student enrolled
Summer:
- 4 sections offered; one at each of the four main SPC campuses (Clearwater, Seminole, Gibbs, Tarpon)
- Enrollment for each section is fixed at 30 students
- 104 total students enrolled

Fall
- 8 sections offered at five SPC campuses (Clearwater, Downtown, Seminole, Gibbs, Tarpon)
- Enrollment for each section is fixed at 30 students
- 128 students enrolled so far
Student Feedback

- We asked students to provide feedback mid-semester (March) through a short anonymous survey.
- The survey was administered in class for two sections and electronically for two sections.
- Response rate: 73%
How Did You Learn about this Course?

- Advisor: 67%
- Academic Chair: 9%
- Professor I had in a previous course: 11%
- Professor I have in this course: 10%
- Other: 3%
The text, *Math Lit*, is easy to read.
I like the applications in the text, Math Lit.
Compared to prior math courses, what is your current level of math anxiety in this class?

- Low: 51%
- High: 8%
- Medium: 16%
- Virtually non-existent: 25%
What grade do you think you’ll earn in this course?

- **A**: 71%
- **B**: 23%
- **C**: 6%
Which math course do you plan to take next?

- MGF1106/Liberal Arts I: 46%
- MGF1107/Liberal Arts II: 8%
- STA2023/Statistics: 46%
Student comments

- I’m loving this course. It is math that is necessary for everyday life.
- Less anxiety about big tests and finals
- This course has brought a new confidence, that was previously non-existent.
- I feel less anxiety here than usual in math.
- I find the critical thinking in this course to be rewarding because I use this math in everyday of my life.
- I've never felt this comfortable in a math course such as this one
- This course was extremely helpful, without all the anxiety, the pace was just right
Lessons Learned

- Use a traditional classroom, rather than computer lab
- Visit Learning Support Center periodically so students can work on MML homework
- Keep class size fixed at 30 students
- Incorporate in-class group work to reflect graded projects
- Have homework due every week to keep students on task
- Allow re-do of homework until one week before end of semester
- Have in-class assessments
Moving the Needle 2014

Save the Date – November 6-7 – Clearwater, FL

Institutions will be sharing their transformational data strategies and best practices
Questions?

Contact Information:
Sandy Cohen: cohen.sandy@spcollege.edu
Carol Weideman: weideman.carol@spcollege.edu