

Laney College Mini Conference on Faculty Inquiry 2007

Math Faculty Inquiry: Assessing Programmatic Outcomes in Developmental Math Los Medanos College Myra Snell

"It is not that teaching is so horrible, or that there are not many excellent teachers. The problem is that teaching as a profession -- and education in general-- has no systematic way of improving itself."

Lee Shulman, President, Carnegie Foundation for the Advancement of Teaching

Components of faculty inquiry that support a program's ability to improve student learning over time:

- Collaborative investigations into student learning
- An engaging question (often motivated by end-of-course assessment of student learning)
- Integration of research and effective practice into curriculum and pedagogy (common readings and assignments)
- Analysis of student work (including "think alouds")
- A "product" (individually or collectively produced)


Resource: <http://www.cfkeep.org/users/msnell/lmctillerypresentation2007>

LMC Tillery presentation website contains tips and examples of how to conduct inquiry, drawn from LMC's Developmental English and Developmental Math Teaching Communities, as well as strategies for documenting the impact of faculty inquiry on planning, teaching, and learning.

Tillery Institute UCB 2007

Intro | Maximizing Impact | Evidence of Impact | Do It | Document It | Share It | Build on It

The Impact of Professional Development on Programmatic Change at Los Medanos College



Our theory of change (from our SPECC grant proposal): Our work in developmental education is based on the belief that idiosyncratic efforts, while sometimes brilliant and inspiring, cannot effect the same kind of sustainable innovation and culture of teaching and learning that a community of practice can. While we respect each other enormously as individuals, it is as a community that we build understanding and advance our own skills as teachers, and ultimately, offer our students greater opportunity to learn.

Our view: The goal of faculty learning is to build, sustain, and advance an institution's ability to improve student learning over time. This depends upon

- a culture where learning at all levels is expected and respected
- broad-based and collaborative investigations into student learning
- content-based staff development
- an assessment cycle based on student learning outcomes
- integration of research and best practice into curriculum and pedagogy

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Program-level Assessment in Developmental Math at LMC

The process: A course committee writes a set of problems aligned with the Developmental Math Program Student Learning Outcomes. These problem must comprise at least 50% of the each instructor's final exam. A random sample of student work on final exams is collected across sections of the same course. Student work is assessed holistically using a rubric. After a norming session, each paper is independently read twice, with discrepancies in scores settled by a 3rd reader.

LMC Developmental Math Program Student Learning Outcomes Students completing the Developmental Math Program will demonstrate:

1. **Problem-solving abilities:** Students will use mathematical reasoning to solve problems and a generalized problem solving process to work word problems.
 - a. The student can apply standard problem-solving methods and use relevant concepts to solve problems.
 - b. The student uses a generalized problem-solving rubric if such a rubric is used in the class.
 - c. The student's written work demonstrates a conceptual understanding of course concepts.
 - d. The student's written work supports his/her solution.
 - e. The student evaluates the reasonableness of his/her answer.
2. **Mathematical versatility:** Students will use verbal, graphical, numerical, and symbolic representations of mathematical ideas to solve problems.
 - a. Students will use a variety of representations to demonstrate their understanding of mathematical concepts.
 - b. Students will use a multi-prong approach to problem solving.
 - c. Students will use appropriate technology to solve mathematical problems and judge the reasonableness of their results.
3. **Communication skills:** Students will read, write, listen to, and speak mathematics with understanding.
 - a. Students will read and listen to mathematical presentations and arguments with understanding.
 - b. Students will communicate both in speaking and in writing their understanding of mathematical ideas and procedures using appropriate mathematical vocabulary and notation.
 - c. Students will coherently communicate their own mathematical thinking to others.
4. **Preparation:** Students will recognize and apply math concepts in a variety of relevant settings and demonstrate the math skills and knowledge necessary to succeed in subsequent courses.
5. **Effective Learning Attributes:** Students will demonstrate the characteristics of an effective learner.
 - a. Student has the will to succeed and demonstrates the characteristics of a successful student: motivation, responsibility, focus, perseverance, the ability to cope with anxiety, a good attitude toward learning, and time management skills.
 - b. Student has the skills to succeed. (S)he uses appropriate resources to improve learning and reach goals.
 - c. Student self-monitors and self-regulates. (S)he assesses personal strengths and weaknesses in his/her learning process and then seeks and implements a strategy for improving learning.

Examples of assessment-based inquiry by LMC Developmental Math Teaching Communities

Intermediate Algebra

Background: A Teaching Community met for a year to design backwards from PSLOs (SP 04 and FA 04). They identified gaps in their texts relative to the PSLOs, wrote exercises to address these gaps, and reviewed and critiqued each other's exercises. An appointed editor pulled these exercises into a coherent packet of 27 activities that was used by all instructors participating in the assessment in FA 04.

Assessment findings: 81% of students in the sample were proficient on communication, 69% on problem-solving, 59% on versatility.

Research question: The Teaching Community decided to focus on revising the activities to address problem-solving and versatility. Will revisions in the curricular activities, without additional professional development on pedagogy, improve student performance on problem-solving and versatility outcomes?

Teaching Community Activities: We revised the set of 27 class activities to address the assessment findings, by incorporating more problems in the class activity packet that warranted use of Polya's method, more prompts about paraphrasing the task and checking answers, and much more on interpreting, constructing, and using tables and graphs to solve problems. We did not share teaching strategies for making effective use of the activities.

Results: Improvements in learning were sustained over consecutive assessments with the only additional professional development occurring during the 5-hour assessment session.

Percent proficient or better				
	FA 04 N=32	SP 05 N=30	FA 05 N=32	SP 06 N=28
Communication	81%	77%	83%	82%
Problem-solving	69%	73%	90%	89%
Versatility	59%	80%	80%	82%

(Note: all instructors who submitted student work used the Teaching Communities' activities. The proportion of instructors submitting class sets of student work varied between 20% (2 of 10) to 56% (5 of 9) of those teaching the course.)

Next Steps: Production of an activities packet for sale in bookstore. Instructors encouraged to use these activities.

Elementary Algebra

Background: This was our first Teaching Community (SP 03 and FA 03). Individual instructors developed and shared activities that were keyed to content topics, such as the order of operations or the Pythagorean Theorem. We posted the activities on Blackboard; participants used what appealed to them.

Assessment findings: In FA 03, 57% of students in the sample were proficient on communication, 39% on problem-solving, 61% on versatility.

Research question: No research questions

Teaching Community Activities: We offered a series of monthly meetings that were well-attended. Instructors chose the focus each semester. For example, one semester a group collaboratively wrote mastery quizzes for key procedural skills. One group read excerpts from NRC's *How Students Learn Math in the Classroom* and discussed the five strands of mathematical proficiency. Aside from the mastery quizzes, no other product was produced during the four semesters.

Results: In the FA 06 assessment of final exams, student performance declined.

Percent proficient or better		
	FA 03 (N=23)	FA 06 (N=36)
Communication	57%	39%
Problem-solving	39%	39%
Versatility	61%	32%

(Note: 9 of 11 instructors submitted class sets of final exams. Instructors were using a wide variety of texts, only 33% used any of the Elementary Algebra Teaching Community's activities.)

Next Steps: To better understand this decline in performance we

- analyzed Elementary Algebra instructors unit exams, as well as their textbooks. We found weak alignment with these PSLOs;
- analyzed the Elementary Algebra Teaching Community's activities and discovered that 75% of activities focused on the Skills SLO, which was not the focus of the assessment;
- interviewed instructors and found that many instructors either did not like the activities or had difficulty using the activities for a variety of reasons.

In an attempt to improve learning, we implemented a three-step plan:

- SP 07: four retreats focused on pedagogy that promotes problem-solving; 16 instructors, 13 of whom were adjuncts, read and discussed case studies from *Improving Algebra Instruction: Using Cases to Transform Mathematics Teaching and Learning* and conducted a classroom-based project in which they experimented with a 'pedagogical move' and analyzed its impact on student learning;
- SU 07: overhaul of the classroom activities to more fully integrate communication, problem-solving, and multiple representations along with the development of our first instructors' manual;
- FA 07: weekly Japanese Lesson Study based on new classroom activities with 7 instructors (5 of whom are adjuncts) sharing set-up and implementation strategies used for each activity, analyzing student work on a previous activity, and preparing for the next activity by reviewing a draft of an instructors' manual.

Prealgebra:

Background: Instructors were using traditional texts with an emphasis on procedural skills.

Assessment finding (SP 05): On their final exams, students across sections performed poorly on the Communication Outcome and the Problem-solving Outcome.

Research question: Instructors said that their texts did not teach to these outcomes, and they did not have time to augment their instruction because the course covered too much content. This led to a suggestion that the group investigate the use of computer-aided instruction (CAI) for procedural skills, which could free up class time for activities focused on the DE Math Program SLOs. Specifically, this group investigated the question:

Does CAI (computer-aided instruction) and limited classroom instruction on procedural skills yield performance on standardized skill tests that is comparable to the performance of students in a traditional classroom where instruction is primarily focused on procedural skills?

Teaching Community Activities:

Three instructors agreed to use CAI and restrict their procedural skill instruction to approximately 25% of class instruction time. One instructor agreed to be a control and did not use CAI and devoted approximately 80% of class instruction time to procedural skill instruction. The group developed quizzes that they all used. Other Teaching Community activities included:

- Discussions around effective use of computer-aided instruction and role of the calculator
- Writing, critiquing, and some class-testing of activities designed to promote communication and problem-solving skills
- Demonstrations using manipulatives
- Develop of a table of contents and preliminary chapters for a CAI manual

Results (FA 05): No significant differences between the CAI and control groups on the procedural skill quizzes. The instructor who served as the control did not submit student work on the common final exam problems. An analysis of the remaining final exams showed some improvement on the communication outcome, but a majority missed application problems involving proportional reasoning and percents.

..... the inquiry cycle begins again

Research question: Instructors participating in the FA 05 assessment shared the belief that poor performance on word problems stemmed from a lack conceptual understanding, which results from a curriculum that encourages mimicry and memorization instead of knowledge building. How do we build conceptual understanding? Will a conceptual understanding improve problem-solving ability?

Teaching Community Activities:

In SP 06 four of 8 prealgebra instructors met weekly to discuss excerpts from math education literature on building conceptual understanding. See the Resources below. We developed and class-tested a small set of class activities to apply what we learned. The more we read, the more we realized that arithmetic is conceptually rich. We began to understand that teaching students to think conceptually about proportions, and the underlying concepts of fraction, ratios, and percents, could not be done in a few classroom activities. We really need to overhaul and refocus

the course. This work is documented in a website that summarizes what we learned from the reading and its impact on planning, teaching, and learning
<http://www.cfkeep.org/users/msnell/lmcprealgebraproject2006>

Results (SP 06): Overall no significant improvements in use of percents and applications of proportions on final exam, with the exception of one instructor. We were not surprised. Our interventions were piecemeal and we have a lot more to learn.

Next Steps: A group of 8 instructors is meeting weekly to read Lamon's Teaching Fractions and Ratios for Understanding (SP 07, FA 07). We plan to write and class-test more activities with the goal of eventually reworking the whole course.

Resources:

National Research Council (2005). *How Students Learn: Mathematics in the Classroom*. Washington D.C.: National Academies Press

S. Lamon (2005). *Teaching Fractions and Ratios for Understanding: Essential Content Knowledge and Instructional Strategies for Teachers*. Mahwah: Lawrence Erlbaum Associates

L. Ma (1999). *Knowing and Teaching Elementary Mathematics*. Mahwah: Lawrence Erlbaum Associates

M. Stein, M. Smith, M. Henningsen, E. Silver (2000). *Implementing Standards-based Mathematics Instruction: A Casebook for Professional Development*. New York: Teachers College Press

Website on the work of the LMC Prealgebra Teaching Community:

<http://www.cfkeep.org/users/msnell/lmcprealgebraproject2006>

[Introduction](#) [Getting started](#) [Planning](#) [Teaching](#) [Learning](#) [Reflections](#)

Prealgebra Classroom Research: Working Together to Improve Student Learning

by Los Medanos College math faculty: Erich Holtmann, Kwado Poku, Myra Snell, and Pat Wagener.
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Introduction: Most of the students taking prealgebra in community college have been taught this math before, probably many times before. What can community college math instructors do to make learning stick?

The focus of our study ...


- Can the findings of math education research be applied to the community college prealgebra classroom?
- Will staff development combined with classroom-based research produce positive change in the planning, teaching, and learning of basic math skills?

What you will find in this site ...

- the application of math education research to a community college prealgebra course;
- evidence of the impact of staff development on curriculum, pedagogy, and learning;
- the results of classroom-based research conducted by prealgebra instructors at [Los Medanos College](#).

Whose perspective you will hear ...

- the facilitator of the Teaching Community (staff developer);
- instructors participating in the Teaching Community.



Click image to play. (1:51)

Instructor's Perspective

At Los Medanos College, a "Prealgebra Teaching Community" brings faculty together to investigate questions about their students' learning. Erich Holtmann and Pat Wagener, participants in the group, give an overview of its work and discuss their apprehensions about classroom-based research.

The definition of insanity is doing the same thing over and over and expecting different results. Benjamin Franklin