What? A Math Class That is Not All Lecture?

Dr. Heidi Hansen
Dr. Glen Richgels
Bemidji State University

Overview

- Common teaching practices
- Needs of students
- Change and standards recommendations
- Background/origins of the course
- Focus of the course
- Activity example
- Impact of the course on algebra understanding
- Student reactions to the class

Teaching practices

- Historically geared towards calculus as an entry level college course (Ganter & Barker, 2003)
- Primarily lecture (Dossey, Halvorson, McCrone, 2008)
- Separate courses for algebra, statistics, geometry, computer
- Primarily skill-focused with some applications included in each section

Today's College Students

- Blossoming growth in enrollment at 2 year colleges
- Nearly 1,000,000 students taking courses below Calculus in the U.S. (*Statistical Abstract Of Undergraduate Programs in the Mathematical Sciences in the U.S*. Lutzer, 2005)
- Up to 50% DWF rate in College Algebra at the college level (Baxter-Hastings, et. al, 2006)
- Only 6% of two-year college students enrolled in Calculus (Lutzer, 2005)

Today's students (cont.)

- Students who didn't succeed in high school math generally don't succeed in college math (Baxter Hastings, et al., 2006)
- 57% of two-year college students are enrolled in remedial courses. (Lutzer, et al., 2005)
- Needs of students have changed!

CRAFTY study by CUPM-MAA

Curriculum Renewal Across the First Two Years
Committee for the Undergraduate Program in Mathematics-MAA

- Looked at partner disciplines needs in 11 workshops across the country
  - physical sciences, the life sciences, computer science, engineering, economics, business, education, and some social sciences
- Math faculty just sat back and listened, answered questions
- Published *A Collective Vision: Voices of the Partner Disciplines* (Ganter & Barker, 2003)

Mathematical Needs of Other Disciplines

- Conceptual understanding
- Problem solving skills
- Modeling
- Communicating mathematically
- Balance between mathematical perspectives

Needs of other disciplines (cont.)

Content:

- Descriptive statistics
- Real world applications of mathematics
- 2 and 3-dimension and scale
- Use of technology especially spreadsheets

(Not more emphasis on algebraic manipulations)

Pedagogical recommendations

- Teaching methods for a variety of learning styles
- Active learning
- In-class problem solving
- Class and group discussions
- Collaborative group work
- Out of class projects

MAA's CUPM Curriculum Guide (2004) Recommendations for Teaching Students Taking Minimum Requirements

- Offer courses which
  - Engage students
  - Increase quantitative reasoning skills
  - Strengthen mathematical abilities applicable in other disciplines
  - Improve student communication of quantitative ideas
  - Encourage students to take more mathematics
- Examine the effectiveness of College Algebra for meeting the needs of students
- Examine whether students succeed in future coursework

AMATYC Standards

- Crossroads in Mathematics: Standards for Introductory College Mathematics (1995)
- Beyond Crossroads: Implementing College Mathematics in the First Two Years of College (2006)

Agreement in the documents
(Baxter Hastings, et al., 2006)

CONTENT:

- Lessen the traditional amount of time performing algebraic manipulations;
- Decrease time spent executing algorithms simply for the sake of calculation;
- Restrict the topics covered to the most essential;
- Decrease the amount of time spent lecturing;
- Deemphasize rote skills and memorization of formulas.

Agreement (cont.)

PEDAGOGY:

- Embed the mathematics in real life situations that are drawn from the other disciplines;
- Explore fewer topics in greater depth;
- Emphasize communication of mathematics through discussion and writing assignments;
- Utilize group assignments and projects to enhance communication in the language of mathematics;

Agreement (cont.)

PEDAGOGY (cont.)

- Use technology to enhance conceptual understanding of the mathematics;
- Give greater priority to data analysis;
- Emphasize verbal, symbolic, graphical, and written representations
- Focus much more attention on the process of constructing mathematical models before finding solutions to these models.

New: The Common Core Mathematical Practices

- 1. Make sense of problems and persevere in solving them.
- 2. Reason abstractly and quantitatively.
- 3. Construct viable arguments and critique the reasoning of others.
- 4. Model with mathematics.
- 5. Use appropriate tools strategically.
- 6. Attend to precision.
- 7. Look for and make use of structure.
- 8. Look for and express regularity in repeated reasoning.

Preparing students for college

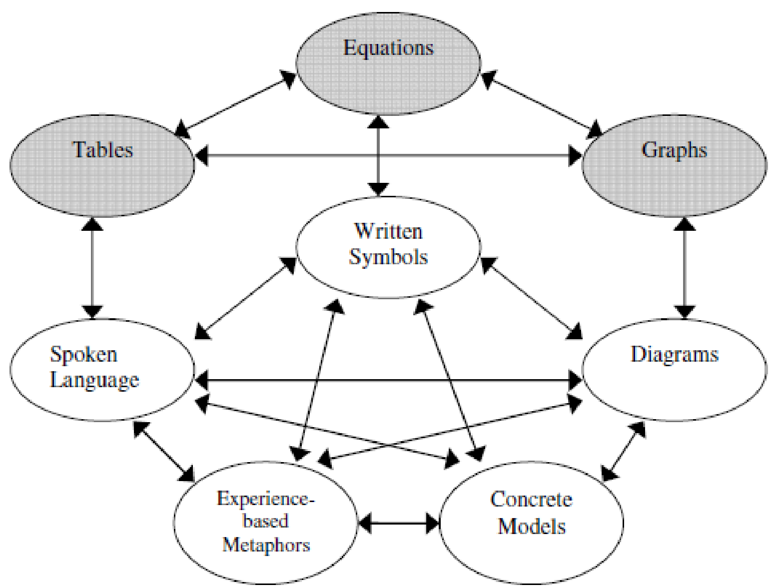
- Students are often not prepared for the mathematical needs of the college disciplines
- High school needs should tie in to college needs
- As noted before, students who do not succeed in high school math do not succeed in college math
- What kind of a course do students need?

Introduction to the Mathematics Sciences

- Background of the course (Glen)
- Focus of the course
- Activity example

Research on the Course

- Study of how well students were able to move between representations algebraic ideas of slope
- Lesh Translation Model



Source: http://www.cehd.umn.edu/rationalnumberproject/03_1.html

Questions

- Do students show that they understand the algebra better through ability to move between representations?
- Is the course implemented according to the vision of the course designers?
- Does the course reflect the standards of the MAA, AMATYC and NCTM?

Results–Student Understanding

- Students could **make meaning** of the algebra by using different representations
  - Explain in writing
  - Discuss in class
- Students could use spreadsheet program technology to generate representations
- Students had the greatest difficulty in writing equations, although they could interpret equations into scenarios.

Results–Implementation

- Pedagogy
  - Aligned with course designers vision
  - Included group work, **discussion**, use of multiple representations and was student-centered
  - Taught in lab, computer based
  - Multiple solution paths
  - Deviated some in terms of time in class
- Subject matter
  - Integrated stats, computer science and algebra
  - Optimization not covered as desired

Results–Alignment with Standards

- Aligned with NCTM, MAA, AMATYC as summarized by Baxter Hastings et al., 2006
  - Active learning
  - Less skill work
  - Essential topics
  - Multiple representations
  - Discussion
  - Technology

Other Incidental Findings

- Student Attitude Change
  - "I feel like I've learned some algebra but I didn't realize I was learning it, which is a really a good thing. Because too many times we walk into a situation like this, like I was just deathly afraid of algebra, and didn't think that I was capable of doing it. And the way that Mr. X has explained it and walked us through it hasn't even seemed like a problem at all…and there's more people that feel the same way that I do." –Student 2

Other Findings (cont.)

- Students' reflection on their work
  - Reasoning and sense making
  - Talked about what they did right and wrong
- Students found the math applicable
  - "You deal with figuring out things in everyday life versus just an algebra problem or just something you have out of a textbook, with just x and y and they don't mean anything." -Student 2
- Students perceived the course as student-centered
  - "It's more of an everyone-included class rather than the teacher up front, preaching to the class. It works really well." -Student 3

Questions?

GLEN RICHGELS
grichgels@bemidjistate.edu
HEIDI HANSEN
hhansen@bemidjistate.edu