

MATHEMATICS ACROSS THE COMMUNITY COLLEGE CURRICULUM - MAC³

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<u>Complete the following statement:</u> (think. pair. share...)

• A quantitatively literate student should be able to. . .

MATHEMATICAL LITERACY IS DEFINED AS:

An individual's capacity to identify and understand the role that mathematics plays in the world, to make wellfounded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.

- Programme for International Student Assessment (PISA, 2000)

WHAT IS QUANTITATIVE LITERACY (QL)?

- "Numeracy is not the same as mathematics, nor is it an alternative to mathematics."
- "Quantitative Literacy is more a habit of mind, an approach to problems that employs both statistics and mathematics."



WHAT IS QUANTITATIVE LITERACY (QL)?

• "...quantitative literacy involves mathematics acting in the world. Typical numeracy challenges involve real data and uncertain procedures but requires primarily elementary mathematics."



WHAT IS QUANTITATIVE LITERACY (QL)?

• "Quantitative literacy empowers people by giving them tools to think for themselves... These are the skills required to thrive in the modern world."



A NOTE ON WORDING...

 "The capacity to deal effectively with quantitative aspects of life is referred to by many different names, among them quantitative literacy, numeracy, mathematical literacy, quantitative reasoning, or sometimes just plain 'mathematics'."



WHO SAYS WE NEED QL?

• NCTM Standards:

- Connections Standard
 - Recognize and apply mathematics in contexts outside of mathematics.
- AMATYC Crossroads & Beyond Crossroads:
 - Implementation recommendation: Faculty will integrate quantitative literacy outcomes into all mathematics courses and collaborate with faculty in other disciplines to integrate quantitative literacy into coursework across all disciplines.

• CPCC:

 Core competency: Information Technology & Quantitative Literacy

WHOSE RESPONSIBILITY?

Bernard Madison:

 "Quantitative Literacy, the ability to use numbers and data analysis in everyday life, is everybody's orphan. Despite every person's need for QL, in the discipline-dominated K-16 education system in the United States, there is neither an academic home nor an administrative promoter for this critical competency."



Quantitative Literacy

AMATYC BEYOND CROSSROADS CURRICULUM AND PROGRAM DEVELOPMENT:

- "Quantitative literacy outcomes should be woven into every mathematics course and as many other college courses as possible."
- "Quantitative literacy is more about habits of mind than specific mathematical content. Therefore, the responsibility for developing quantitative literacy, like writing across the curriculum, is shared by the entire college faculty. However, mathematics faculty should lead the quantitative literacy movement by helping to establish a set of outcomes expected of students in each program."



THE MATHEMATICAL ASSOCIATION OF AMERICA

A quantitatively literate college graduate should be able to:

- Interpret mathematical models...
- Represent mathematical information symbolically, visually, numerically, and verbally...
- Estimate and check answers ...

1998 – Quantitative Reasoning for College Graduates

THE MATHEMATICAL ASSOCIATION OF AMERICA

Too big an order for a one- or two-term mathematics course? Unquestionably. Just as writing is not the sole province of English departments, neither does the responsibility for students' mathematical development rest only with mathematicians. Of course, the impetus to promote quantitative literacy, the leadership to define its elements effectively, and the energy to sustain its objectives will have to reside in the mathematical community. But mathematics must permeate the undergraduate experience the same way it permeates modern society: MATHEMATICS ACROSS THE CURRICULUM!"

1998 -Quantitative Reasoning for College Graduates

A LITTLE HISTORY



Mathematics Across The Curriculum

at Dartmouth College



• 1996-2000 MATC

• 2000-2004 MAC

• 2005-2009 MAC³













© MAC³ MATHEMATICS ACROSS THE COMMUNITY COLLEGE CURRICULUM

- AMATYC is the lead institution.
 - Edmonds CC
 - Seattle Central CC
 - Miami Dade College
- DE supported our first year.
- NSF will support all four years.









MAC³ supports faculty of all disciplines in creating curriculum that enhances the mathematical or quantitative literacy dimensions in their courses.



As a result, students will be offered opportunities to deepen and reinforce the mathematics they have learned in their math classes, apply it in context, and understand its greater importance and application in their lives.

EXAMPLES OF MAC³ PROJECTS

DISCIPLINES

Accounting Anthropology Art Art History **Biology Business Career & Technical Campus-Wide** Initiatives **Chemistry Computer Information Systems Computer Science Economics Education English Environmental Science Ethnic Studies Ethnomathematics** Geology

Health Health & Human Services **History Humanities** Labor Studies **Mathematics** Nursing **Physics Policy Studies Political Science Psychology** Reading Sociology **Spanish** Speech **Special Education Statistics and Data Analysis Study Skills Urban Planning**

WHAT CAN MAC LOOK LIKE?

Modes of Integration:

- Projects within a Course
- Linked Assignments
- New Courses
- Learning Communities
- Service Learning Projects
- Department Wide Projects
- Institution Wide Projects

WHAT CAN MAC LOOK LIKE?

• Examples of projects:

- Art Design
- Art Ceramics
- Biology
- English Composition
- Health
- Spanish

HEALTH

Lessons on Survey Design, Graphing, and Statistics

- Learn to effectively assess the statistics in current media by developing critical thinking skills with the data.
- Learn how to perform simple statistical analyses. The data used will be on drugs, alcohol and sexual health for potential adolescent behavior modification.
- Improve survey designs and graphs.

SPANISH

- Doing math (arithmetic or algebra) in Spanish
 - Learn words for numbers without sequence
- Completing quantitative projects in Spanish class (with directions given in Spanish)
 - Converting units (metric)
 - Geographically-appropriate business project
- Comparing math structure with language structure
 - Similarities in rules
- Quipu project

ART (DESIGN) COURSE

- Project in *Two-Dimensional Design* course
- 5 CR Art course
- Math instructor guest lectured on Regular Polygons & Tessellations

EXAMPLES OF STUDENT WORK

ART DESIGN COURSE





EXAMPLES OF STUDENT WORK

ART DESIGN COURSE

 Incorporation of geometric figures gave students form and structure



BIOLOGY WITH MATH-AID

- Combined Biology 201 (5-credits) with Topics in Math (2-credits).
 - Biology 201 is the first-quarter of the 3-quarter biology majors series
 - Class met 1 extra hour a day for 5 weeks
 - Knowledge of math content used in assignments and labs

BIOLOGY WITH MATH-AID

Math topic	Biology examples
Graphing	Photosynthesis Enzymatic reactions
Units & Scientific	liter, ml, 🕅
Notation	meter, mm, 🖬
Logarithms &	pH, electrophoresis,
exponential	bacterial growth
functions	
Probability &	Mendelian genetics
Genetics	
"DNA math"	restriction maps,
	electrophoresis

BIOLOGY WITH MATH-AID

Instructor feedback

- The math instructor better understood which mathematical skills are used in biology courses and how they are used.
- The math instructor can now incorporate more appropriate examples into the mathematical courses that are prerequisites for biology.

ART: CERAMICS

- Started as a non-credit integration when they developed ceramics projects in Geometry course for future teachers
 - Ceramic vase project
 - Tiles









ART: CERAMICS

- Combined Ceramics & 1
 CR Math Fall 2006
 - <u>Measurement</u> <u>activities</u>
 - Ratio/proportion
 - Scavenger hunt
 - Symmetry patterns
 - Ethnomathematics
 - Unique surfaces



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Economics

"Why Work?" Learning Community Course



ECONOMICS: "WHY WORK?" COURSE

- The coordinated studies course centers around the household as a decision-maker and choices between market work and non-market work.
- Economic data are discrete and require students look for trends, in sharp contrast to "college algebra" which often begins with symbolic models that then generate data.

ALGEBRA THE WRITE WAY

- Coordinated studies course integrated course
- 5 CR Elementary Algebra course & 5 CR Intro to Essay Writing course
- Common ground/focus areas:
- Writing to explain the mathematical algorithms and deepen understanding of concepts
- Readings related to mathematics / Quantitative Reasoning
- Key Integrated Parts of the Course
- Math Homework writing questions
- Journal (writing & math prompts, reading responses)
- Essays

ALGEBRA THE WRITE WAY ESSAY ASSIGNMENTS

- Math autobiography (in-class)
- Essav #1: Argument for or against more emphasis on quantitative literacy in schools
- Essav #2: Argument for or against Walmart (using quantitative support)
- Essay #3: Explanatory Thesis on the topic of Ethnomath

ANTHROPOLOGY – MAC³ AND SERVICE LEARNING



ANTHROPOLOGY – MAC³ AND SERVICE LEARNING

- Learn-n-serve
 Environmental
 Anthropology Field
 (LEAF) School
 - AmeriCorps scholarship, 15 credits in Human Ecology



ANTHROPOLOGY – MAC³ AND SERVICE LEARNING



MAC³ EVALUATION

MAC³ Evaluator: Dr. Jane Korey Dartmouth College (Retired)

MAC³ Evaluation Process offers 3 measurement points:

Institute experience Faculty implementation Student results

STUDENT SURVEY

- Pre & Post Attitudes (21 question survey)
 - Math Awareness /Role of math in society
 - Concept of math
 - Interdisciplinary learning
 - Interest & confidence in doing math
- Student Learning Self Assessment
 - Learning of course-specific math outcomes
 developed by each team of instructors
- Gains in math skills (7 questions)

STUDENT SURVEY RESULTS

• Excellent participation by faculty:

 32 MAC³ courses have completed pre- and postsurveys

• 521 matched pre-post student surveys

Solid student results

- Significant gains in 3 of 4 main areas
- Solid learning and skills improvement

CHANGE IN STUDENTS' MATH ATTITUDES



Based on 521 matched pre-post surveys from 32 MAC3 courses

GAINS IN MATH SKILLS



Scale: 1= "not at all;" 5 = "a great deal."

Based on post surveys from 521 students in 32 MAC3 courses.

INDICATORS OF SUCCESS

- Students in most courses showed attitude and skills improvement
- No difference between the most and least successful courses in gender, subject or course format
- The most successful courses
 - Were smaller
 - Were more diverse
 - Had students who had lower pre-survey scores for "awareness," "concept" and "interdisciplinary."

SUMMARY OF FACULTY INTERVIEWS (MAC)

Faculty responded that they -

- created a wide variety of new ways of incorporating mathematics into their curricula;
- gained valuable insights into their team member's disciplines;
- realized new ways of looking at their own discipline;
- discovered strong connections in terms of linking skillbuilding and critical thinking development from one discipline to another;

SUMMARY OF FACULTY INTERVIEWS (MAC)

Faculty responded that they -

- generated new pedagogical approaches that would carry over to the other classes they taught;
- were stimulated by their work with colleagues;
- non-math faculty described a significant diminishing of their own math-phobia and an increased willingness to incorporate mathematical concepts into non-math classes.

TWO QUOTES FROM MAC FACULTY

• Mathematics Faculty -

 "Being involved in cross-disciplinary discussions keeps me fresh and interested and growing as an educator. Thank goodness for the opportunities that MAC has provided me!"

• Humanities Faculty -

 "I am more open to trying stuff and gradually seeing how creative math can be – and I am increasingly aware of how important quantitative reasoning is, and that today everyone needs to use it."

WEB LINKS

• MAC³ Projects and Courses

- http://www.mac3.amatyc.org/projects.htm
- Dartmouth College Electronic Bookshelf & Little Bookshelf
 - http://www.math.dartmouth.edu/~mqed/index.html
- Statistical Literacy
 - http://www.statlit.org/
- Social Science Data Analysis Network
 - http://www.ssdan.net/chip/exercises.shtml

2008 SUMMER INSTITUTE – Massachusetts (THE APPLICATION DEADLINE FOR 2008 SUMMER INSTITUTE IS June 3.)

June 15-18, 2008

Contact: Carol Hay - hayc@middlesex.mass.edu





YOUR TURN

- What are your interests?
- With whom could you work?
- What fits your school?



Handout (white)

- Brainstorm for 5-10 minutes & answer questions #1-3
- Share answers to #1 & #2 with a partner
- In small groups, answer questions #4 & #5.

THANK YOU!

YOU CAN CONTACT ME AT:

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