MichMATYC Algebra Curriculum Reform

It is good to be with you at the 22nd Annual AMATYC Conference here in Long Beach to present the problems, process, and results of the MichMATYC implementation of AMATYC Standards. In addition to this, I would like to accomplish the following:

- Convince you that you can make a difference in the implementation of the AMATYC Standards. You can be part of a "unified voice."
- Convince you that your initiative can impact publishers and authors to produce texts that support the AMATYC Standards.

Today, I would like to share the following specific information:

① Chronology of MichMATYC Algebra Curriculum Reform
② Problems Leading to Algebra Curriculum Reform
③ The Process of MichMATYC Algebra Curriculum Reform
④ The Results of Algebra Curriculum Reform Committee
⑤ The Meaning of Endorsement of the MichMATYC Algebra Curriculum Revision Committee's Recommendations
⑥ MichMATYC Outlines for Elementary Algebra and Intermediate Algebra

At the Fall MichMATYC Conference in October 1994, MichMATYC members were invited to participate in a curriculum reform for Elementary Algebra and Intermediate Algebra. This grass roots effort was unique in two ways.

- First, the process resulted in a collaborative effort of 49 community college mathematics educators representing 14 Michigan community colleges. In addition, these were educators who taught the course!
- Second, the primary focus of the group was the content of the courses not pedagogy. I had the privilege of chairing this group.

Chronology of MichMATYC Algebra Curriculum Reform

- In October 1992, Grand Rapids Community College hosted the Fall MichMATYC Conference. Karen Sharp, luncheon keynote speaker, addressed the topic *CPR-MATYC: Curriculum and Pedagogy Reform for MATYC.* She planted the seed of curriculum reform.
- The MichMATYC Algebra Reform commenced between October 1992 and October 1994 as individual schools began their work on Curriculum and Pedagogy reform in Algebra courses. It was interesting how many schools were already participating in reform efforts. Our guide at that time was the yellow AMATYC book, Standards For Curriculum and Pedagogical Reform in Two-Year College and Lower Division Mathematics, Circulating draft, October 1993.
- In October 1994, Delta College hosted the Fall MichMATYC Conference. During lunch, **all** Mathematics Educators interested in debating and establishing MichMATYC curriculum standards for Elementary and Intermediate Algebra Courses were invited to participate on the reform committee, meeting at Lansing Community College on November 8, 1994. In October 1994, we had the beige

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AMATYC book, Standards for Introductory College Mathematics, the Final Draft, as a guide for our work.

- The MichMATYC Algebra Curriculum Revision Committee was formed! We had 3½-4 hour sessions with assignments for the individuals and their schools between the meetings. The member "homework" was shared with committee members to facilitate efficient discussion. Committee members converged at Lansing Community College during the following times: November 8, 1994, from 1:00 - 5:00 pm, February 3, 1995, from 1:15 - 5:00 pm, April 1, 1995, from 10:00 am - 2:00 pm, and June 7, 1995, from 1:30 - 5:00 pm. By February 1995, we had the blue AMATYC book, Standards For Introductorv College Mathematics Before Calculus, Revised Final Draft, to use as a guide.
- In October 1995, Schoolcraft College hosted the Fall MichMATYC Conference. At that time, the MichMATYC membership voted to endorse the MichMATYC course outlines for Elementary Algebra and Intermediate Algebra as published. By September 1995, the AMATYC book, Crossroads in Mathematics Standards for Introductory College Mathematics Before Calculus was available to use as a guide.

Problems Leading to Algebra Curriculum Reform

- Michigan Community Colleges were impacted by incoming students from high schools already implementing mathematics reform such as the NCTM Standards, the University of Chicago Curriculum, and the Western Michigan University Core Plus Curriculum. Our students were changing and our curriculum was not!
- As mathematics educators, we were racing through material with lack of realistic applications, and there was too much course content for effective conceptual understanding. In addition, many of us were re-teaching Elementary Algebra topics in Intermediate Algebra.
- We recognized that the purpose of Intermediate Algebra was no longer solely a preparation course for calculus, but in many cases, a final collegiate mathematics experience.
- The reality was that inexpensive and accessible technology could and would impact the teaching/learning process. Many of our students had already experienced the use of appropriate technology in their mathematics courses, but in many cases, community colleges were "prohibiting" the use of technology in mathematics education.
- The NCTM Curriculum and Evaluation Standards for School Mathematics had already presented comprehensive recommendations for innovative approaches to curriculum and pedagogy for kindergarten through twelfth grade.
- The AMATYC Standards for Introductory College Mathematics Before Calculus was calling for mathematics curriculum reform.
- There was a lack of available texts that embraced curriculum reform before the level of calculus or precalculus. This was a major roadblock to reform. It didn't make sense to publish materials with content different than instructors were ready to use.
- There were few, if any, grass roots efforts to implement the AMATYC Standards in College Mathematics Curricula. Mathematics educators lacked a unified voice.

The Process of MichMATYC Algebra Curriculum Reform

- Several Michigan Community Colleges had started to study and evaluate their own Elementary and Intermediate Algebra Courses. All of these schools were invited to submit their curriculum work to the committee. Most of these schools were larger schools where there were many mathematics educators debating curriculum changes.
- Other schools had only one or two curriculum reform voices with no one listening. These individuals were invited to present their curriculum ideas.
- At the Fall 1994 MichMATYC Conference luncheon, all community college mathematics educators were invited to participate in Algebra curriculum reform hosted by Lansing Community College. A concerted effort was made to inform all mathematics educators of the open reform process and invite each to participate. To accomplish this, an invitation was sent to every mathematics educator on our MichMATYC mailing list. In addition, an invitation was sent to every mathematics chair listed in Mathematical Sciences Professional Directory (AMS) requesting his/her mathematics staff be informed and invited to attend.
- The Algebra Reform Committee agreed to start with Elementary/Introductory Algebra and then finish with Intermediate Algebra. Lack of available materials **was not** to be a roadblock to course content. We were confident that authors and publishers would respond to our needs.
- The Algebra Reform Committee agreed on the following two guidelines for the reform process:
  - NCTM Curriculum and Evaluation Standards for School Mathematics
  - AMATYC Standards for Introductory College Mathematics Before Calculus
- The Algebra Curriculum Reform Committee agreed that we could agree on content but not pedagogy. The pedagogy issues would certainly be addressed at each school in their approach to the content and the selected text.
- We started each course by inviting every school to contribute the findings of their curriculum revision. Schools were also encouraged to submit their view of the content of each course based on the AMATYC Standards. Committee members studied the findings of other schools/individuals. As a committee, we discussed and debated each of the content topics. Dialogue started!! !! We were not always in agreement on every content topic, but we reached consensus as a group. We recognized that we must have uniformity of purpose!
- Minutes were taken of every meeting and mailed to each committee member. In addition, the minutes and meeting announcements were mailed to each mathematics chair in the AMS Directory. Chairs were asked to distribute the information to his/her mathematics staff.

Results of the Algebra Curriculum Reform Committee

When a group gets together, many mutual concerns arise and communication continues. Some of the information we shared was as follows: mathematics placement testing and "cut off" scores, schools have different credit hours for "the same" course, there are varying sequence of courses at each school, and a directory of committee members so that we can continue communicating.

One of the signifcant new topics included in each course was probability and statistics. It was very clear that the AMATYC Standards advocated the incorporation of these topics in all mathematics courses

prior to calculus. We operated on the premise that if we put the topics into the course content, authors and publishers would meet (and are meeting) that need.

Another significant change was that a scientific calculator would be the minimal technology requirement for Elementary Algebra, and a graphing calculator would be required for Intermediate Algebra.

Even though our attempt was to address the course content, the results also addressed the Standards for Intellectual Development (problem solving, modeling, reasoning, and using technology) and Standards for Pedagogy (teaching with technology and multiple approaches). Individual schools and instructors **will address** the issues of Intellectual Development and Pedagogy as they wrestle with text selection and class preparation.

The committee work was "completed" on June 7, 1995, so that we could present the committee findings at the Fall MichMATYC Conference. Our goal was to continue the Algebra reform dialogue with all Michigan Educators and receive the MichMATYC endorsement of the reform Algebra content. A concerted effort was made to inform all Michigan Community College Mathematics Educators of the discussion and endorsement vote. In August 1995, copies of the course outlines and an invitation to the conference/session were mailed to every Algebra Reform Curriculum Committee member, every Mathematics Educator on the MichMATYC mailing list, and every Mathematics Chair listed in the AMS Directory requesting he/she distribute the information to all Mathematics Educators on staff.

We also tried to create dialogue between committee members and other conference participants. Each committee member wore a large blue ribbon with the word "REFORM" imprinted. Participants were invited to discuss the curriculum changes with any member of the "Blue Ribbon Algebra Curriculum Reform Committee." The Blue Ribbon Committee would then serve as panelists on the curriculum discussion after lunch. It was our desire to present the committee recommendations again at lunch. After lunch there would be a single session where all conference participants could question the Blue Ribbon Panel and then vote on endorsement. A major problem arose when there were so many educators willing to share presentations that the single session time slot had to have three concurrent sessions. Since so much effort had been made to keep people informed, we decided to ask for endorsement at lunch, before the discussion. Obviously, many were very upset with the change in process. Despite the circumstances, two exciting events occurred. First, the MichMATYC participants endorsed the committee recommendations by better than a 2 to 1 ratio. Second, almost all of the participants who attended the follow-up session and indicated they voted no, did so because of the process, not the product! There were several who were very opposed to the curriculum changes and vociferously voiced their objections. On the other hand, many participants quietly expressed their support of the curriculum changes to many committee members. The endorsement support spoke volumes in spite of the process.

The meaning of endorsing the Algebra Curriculum Reform was presented as follows:

- **A commitment to the concepts of reform**
- **A guide to assist your school in curriculum reform**
- **A recognition that we support the AMATYC Curriculum Standards**
- **An encouragement to authors and publishers as to the content we are seeking in a text**

The Algebra Curriculum Reform Committee is very encouraged by the endorsement of our colleagues. However, we recognize there will be much discussion and intense debate relative to this reform at every school. The pedagogical approach of the text will be a source of debate! Be encouraged that others have gone through the same discussions. After 34 years in education, I can see that change comes more cautiously to some of my generation. However, support and opposition will spread across the age and experience lines!

The course content for Elementary Algebra and Intermediate Algebra are presented for your **information and encouragement.**

Elementary Algebra Revision
MichMATYC Algebra Curriculum Revision Committee
Adopted February 3, 1995

Class Periods		
(4)	1.	Problem solving techniques e.g., Pages 3-45 in Billstein's Math for Elementary Teachers integrating throughout text. Let students use techniques throughout text.
(4)	2.	Introductory Data Analysis and interpretation of graphs, e.g., Chapter 8 of Basic Mathematics, Keedy/Bittenger. Include mean, median, mode, GPA; tables, charts, pictographs, bar and line graphs; circle graphs. Positive rational numbers.
(4)	3.	Operations with rational numbers - Include order of operations and a de-emphasis of the properties of rational numbers. Include non-negative integral exponents.
(1)	4.	Radicals - use calculators, compare $\sqrt{a+b}$ *with* $\sqrt{a} + \sqrt{b}$
(1)	5.	Application of radicals including Pythagorean theorem
(1)	6.	Variables, expressions, and meaning of solution of equation
(4)	7.	Measures of dispersion - range and standard deviation for sample space, i.e.,
(3)	8.	Solving linear equations. Properties, solving equations, formula usage, applications
(3)	9.	Ratio and proportion with plane geometry. Circles and similar triangles
(2)	10.	Areas of basic polygons and circles; parallel and perpendicular lines
(1)	11.	Linear inequalities in one variable
(2)	12.	Graphing linear equations in two variables - show relationship to the root of an equation
(1)	13.	Slope of a line
(2)	14.	Equation of a line
(2)	15.	Linear systems of equalities
(3)	16.	Linear modeling (integrate through linear topics and include a final wrap-up linear modeling section)
(4)	17.	Exponents and scientific notation (include negative exponents)
(3)	18.	Polynomials including +, -, x, by *monomials*
(2)	19.	Factoring monomials and simple trinomials e.g., 5.1, 5.2, 5.4 of Miller/Lial, Introductory Algebra

(3)

20. Solving quadratic equations by factoring and the quadratic formula and applications
21. Rational Expressions/Equations with monomial denominators
22. Technical applications
23. Integrate projects through the text

Notes: A scientific calculator is the minimum requirement to be used in Elementary Algebra. Topic #16, Linear modeling, will be integrated throughout the course. Some time will then be available to include non-core topics at instructor discretion. Our course is a 4 semester credit hour course.

Intermediate Algebra
MichMATYC Curriculum Reform Committee

Guidelines:

- Graphing calculator required and used as a tool in this course
- Early introduction of functions
- Applications integrated throughout text/course
- Topics will be presented numerically, graphically, and symbolically

Unit 1: First Degree Equations, Functions, and Inequalities

1. Sets, function notation, domain, range, zeros of a function, and the Cartesian coordinate system
2. Review solving of linear equations
3. Formulas
4. Linear inequalities in one variable
5. Slope and equation of a line
6. Linear regression **(optional)**
7. Absolute value = and ≠
8. Linear systems (2 variables)
9. Linear systems (3 variables)
10. Matrices **(optional)**
11. Direct variation

Unit 2: Probability and Counting Techniques

1. Probability experiment - intro (including odds)
2. Counting methods
   a. factorials
   b. fundamental counting principal
   c. permutations
   d. combinations
3. Theoretical probability
4. Comparing results: experimental vs. theoretical

Unit 3: Data Analysis

1. Representation of data by tables and graphs
2. Frequency distribution and graphs
3. The normal distribution

Unit 4: Polynomials and Rational Expressions

1. Integer exponents review
2. Add, subtract, and multiply polynomials and rational expressions
3. Divide polynomial by monomial and 1st degree binomial
4. Limited varieties of factoring
5. Limited study of the operations on rational expressions. Limited study of the domain of rational functions.
6. Limited study of complex fractions
7. Rational equations
8. Graphs of rational functions with linear denominators
9. Inverse variation

Unit 5: Exponents

1. Rational exponents
2. Relationship to roots
3. Radicals
    a. approximating radicals
    b. using a calculator (square roots and higher)
    c. roots with both even and odd indices
    d. limited simplification of radicals
    e. limited addition, subtraction, and multiplication of radicals
    f. division by radical expressions containing one term
    g. solving radical equations

Unit 6: Quadratic Function

1. Graphing parabola
2. Solving quadratic equation
    a. graphical solution
    b. factoring
    c. square root method
    d. quadratic formula using completing the square
    e. complex numbers
3. Factor theorem and roots (discussed in 2a and 2b of Unit 6)
4. Least square parabola
5. Fitting a parabola to 3 points by solving system
6. Graphing quadratic inequalities
7. Non-linear system of equations
8. Joint variation

Unit 7: Exponential Functions and Natural Logarithms (A Brief Introduction)

1. Exponential functions - graphs, domain, and range
2. Inverses and natural logarithms introduced
3. e and ln
4. Models and applications including curve fitting

Optional Topics

Unit 8: Sequence and Series
Unit 9: Logarithmic Functions
Unit 10: Systems of Linear Inequalities appropriate for Linear Programming
Unit 11: A Brief Introduction to Conic Sections - Circles and Ellipses (center @ origin)
Unit 12: Algebra of Functions and Graph Shifts

1. +, -, x, ÷ of functions
2. Composition of functions
3. Translations, etc.

It was our desire to have a "leaner" Intermediate Algebra course so that we could be more effective with our students. We also found that a few colleges had special needs in Intermediate Algebra and those needs are met with the optional topics. Units 1-7 will be a full four semester credit course.

MichMATYC Algebra Curriculum Reform
Adopted, June 8, 1995