The Missing Link:
Algebraic Literacy to Replace Intermediate Algebra

Curriculum Reform   **Math Paths**   **Accelerated**

AMATYC Conference   Session 064

Jack Rotman   November 2014   Nashville

Before we are done …

- Know what roles 'algebraic literacy' has in our curriculum
- See the math paths that use this course
- Understand nature of the content
- See a sample lesson
- Get 3 handouts (paths, outcomes, sample)

Matching to your Needs

- **Curricular Reform**
  Content that is directly connected to student needs

- **Math Paths**
  Sequence of courses appropriate to student programs

- **Acceleration**
  Shorten the sequence of courses for most students

- Increased Context; focus on reasoning

The KEY Point

- Traditional algebra curriculum wastes student time, does not meet student needs
- Students preparing for math-intensive courses have specific needs
- Students in technology programs have needs which are consistent with those
- Students need preparation for biology courses
- The needs: understanding and reasoning as well as procedure; not just algebra
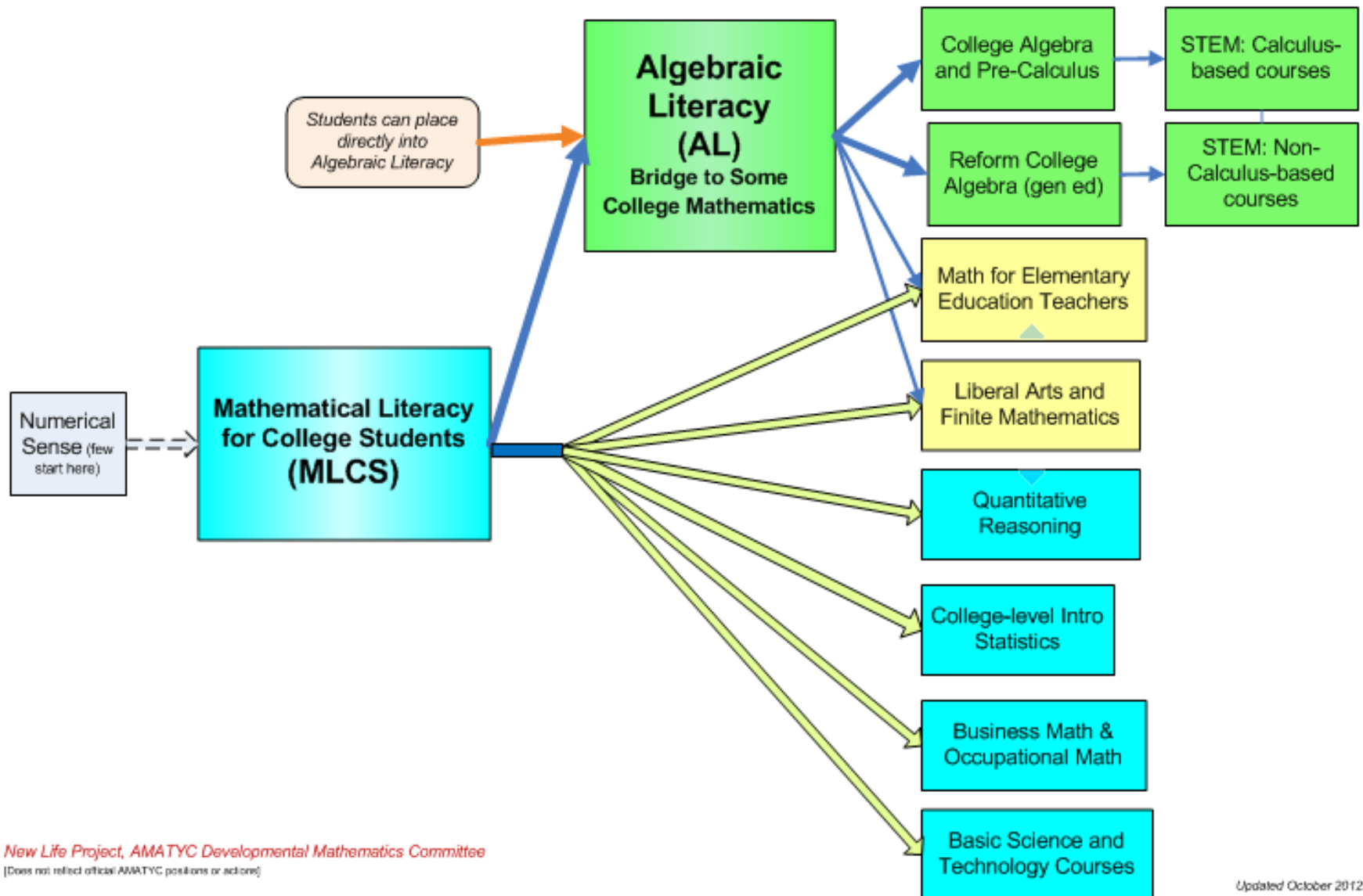
Now and Then (1)

- Algebraic Literacy:
  Designed to provide background needed for college algebra, pre-calculus, biology and technology, in a coherent package

- Intermediate Algebra:
  Descendent of high school 'algebra II' traditional content, presumed needed for STEM, often presented as isolated topics

Designing 'Algebraic Literacy'

Path – Prepare students for	Reference
Pre-calculus (➜ calculus)	MAA College Algebra Guidelines (2007) MAA Curriculum Guide (2004)
College Algebra – Reform Models	MAA College Algebra Guidelines AMATYC Right Stuff
Biology	MAA CRAFTY Curricular Foundations – Biology
Technology Programs	AMATYC CRAFTY "Vision" project

New Vision of Mathematics Pathways: Fewer non-credit math courses for most students

from the New Life Project

Students can place directly into Algebraic Literacy

Algebraic Literacy (AL)
Bridge to Some College Mathematics

College Algebra and Pre-Calculus → STEM: Calculus-based courses

Reform College Algebra (gen ed) → STEM: Non-Calculus-based courses

Numerical Sense (few start here) ⇢ **Mathematical Literacy for College Students (MLCS)**

Math for Elementary Education Teachers

Liberal Arts and Finite Mathematics

Quantitative Reasoning

College-level Intro Statistics

Business Math & Occupational Math

Basic Science and Technology Courses

New Life Project, AMATYC Developmental Mathematics Committee
[Does not reflect official AMATYC positions or actions]

Updated October 2012

Handout 1

- References on one side

- Curricular 'vision' from the New Life Project on the other side
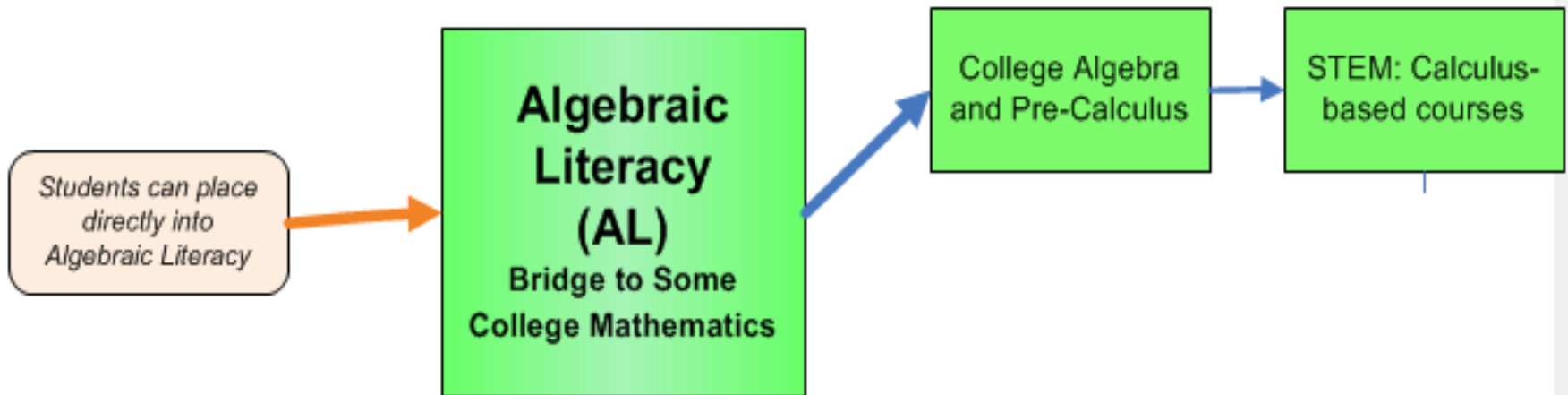
Now and Then (2)

- Algebraic Literacy (AL): Understanding; balance of symbolic and graphical methods, often in context with meaningful applications

- Intermediate Algebra: Symbolic procedures, correct answers, and stylized applications

Curricular Context

- Algebraic Literacy can follow either
  ◊ a beginning algebra course or
  ◊ a Math Lit course

- Students placing in to intermediate algebra would be ready for Algebraic Literacy (AL)

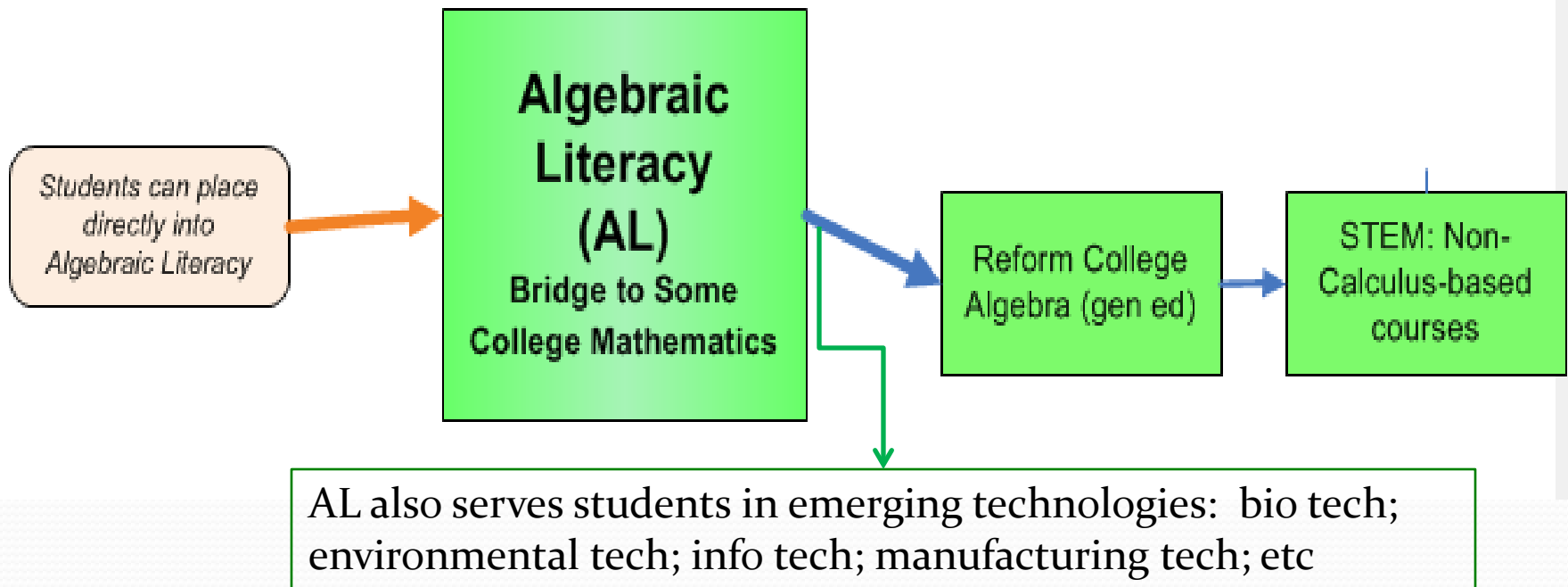- Some students placed in Beginning Algebra could start in AL instead

Algebraic Lit Paths to Calculus

Algebraic Lit → STEM & Calculus Paths

Students can place directly into Algebraic Literacy

Algebraic Literacy (AL)
Bridge to Some College Mathematics

College Algebra and Pre-Calculus

STEM: Calculus-based courses

Algebraic Lit: College Algebra, Biology, Technology Paths

Algebraic Lit – STEM Related (including biology and technology)

Students can place directly into Algebraic Literacy

Algebraic Literacy (AL)
Bridge to Some College Mathematics

Reform College Algebra (gen ed)

STEM: Non-Calculus-based courses

AL also serves students in emerging technologies: bio tech; environmental tech; info tech; manufacturing tech; etc

Now and Then (3): Content

- AL:
Primary focus: Algebra concepts and procedures.
Secondary focus: Geometry, Trigonometry, Statistics

- Intermediate Algebra:
Algebraic symbolism and puzzle word problems. Some coincidental geometry

Second Handout

- AL Content Goals and Outcomes

[Cross-referenced to the four paths (targets)]

Overview of Content in AL

- **Numbers and Polynomials**
Expressions and Equations; symbolic and numeric

- **Functions** (linear, exponential, power)
Representations, key concepts ('rate of change')

- **Geometry & Trigonometry**
Properties of shapes; patterns of measurement
Basic Right Triangle Trig

- **Modeling & Statistics**
Theoretical versus modeled functions; use technology; basic understanding of correlation

Now and Then (4): Taglines

- AL:
  Balance of symbolic work and applications of good mathematics

- Intermediate Algebra:
  1000 answers and a cloud of dust

Benefits of Algebraic Literacy

- Content based on student need

- Fits 4 key math paths

- Shorter course sequences: shorter paths (acceleration)

- More context, increased focus on reasoning skills

- Adapts to local needs

Related to Algebraic Literacy …

- The Algebraic Literacy course is from the AMATYC New Life Project (Dev Math Comm)

- The Dana Center New Mathways project will have a path similar to AL

- New Mathways focuses on state or district implementation

- New Life: focus on faculty; adapting to local conditions

- Carnegie Foundation Pathways do not have this path … yet

Now and Then (5): Basic Story Line

- AL: Key algebraic concepts and procedures, with functions and rate of change, using symbolic and numeric methods, to understand science and the world

- Intermediate Algebra: Ten chapters of skills organized around the type of objects being used, with very little continuity between topics and minimal connections for concepts

Third Handout:
Sample AL Lesson ('4.x')

- See the Handout
- Content is integrated, often represents a real situation
- Four content goals are not likely to be 'chapters' in a book
- Connections – multiple methods – understanding – representations

Lesson 4.x – Rates of Change and Health

We've seen situations where there is a constant 'adding' rate of change, and we know that this type of change is related to the general linear model $y = mx + b$. In our work with this model, the rate of change has been called the slope of the line. The rate of change is the same everyplace on the line. [If the rate of change varied, the graph would not be a straight line!]

> **Reminder: Rate of change is "output changes this amount per 1 unit of input change".**

> **Additive change means a linear equation** $y = mx + b$
> **The slope is the rate of change**

We've also looked at situations where change is based on multiplying, and the exponential model. This lesson involves exponential patterns … and others.

> Disease specialists use both kinds of information (per person, and per day). One tells us how contagious the disease is (number infected per person); the other estimates the number infected over time.

PART A:

Infection diseases are tracked by specialists who are interested in predicting how many people will become ill. One recent infection had two characteristics: Each infected person passed along the infection to two other people, and the number infected grew by 5% each day.

First, here is a chart of the number infected starting with one person. The 'step' listed is not a time value like a day; the step represents people passing along the infection … which can happen several times in one day or could take several days.

Step	1	2	3	4	5	6	7	8
Number infected	1	3	9	27	81	243	729	2187

> *The danger of a disease spreading is measured by "R0" (two in this example). For more information, see http://ocw.jhsph.edu/courses/publichealthbiology/PDFs/Lecture2.pdf*

For the percent change table below, we start with 729 infected people on day 1.

Day	1	2	3	4	5	6	7	8
Number infected	729	765	804	886	930	977	1026	1077

Materials for AL

- Some authors are currently writing materials

- Perhaps you will want to be involved

- Some existing materials can be adapted (books with a strong 'multiple representations' focus) and supplemented

Implementation

- Two years ago, about 15 colleges has implemented the first "New Life" course – Mathematical Literacy

- Fall 2014 – about 75 colleges have done so … over 500 sections … over 10,000 students this semester

- **Fall 2014 – about 10 colleges have implemented the second "New Life" course – Algebraic Literacy**

- **Publishers know that the market is growing for Algebraic Literacy**

- **See references and resources listed**

Closing

- Optional Handout – MLCS content
- Other Questions
- Discussion

- See handouts for email and web sites

Jack Rotman   rotmanj@lcc.edu
www.devmathrevival.net
dm-live.wikispaces.com