AMATYC New Life Dev Math Project, Mathematicians, and the New Curriculum in Mathematics

devmathrevival.net

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(Developmental Mathematics Committee, AMATYC)

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Outline

- Data on Developmental Mathematics
- Traditional Curriculum
- Modern Curriculum (Standards)
- AMATYC New Life Project Curriculum
- Mathematical Literacy Course
- Algebraic Literacy Course
- Implementation Options

Data on Developmental Mathematics

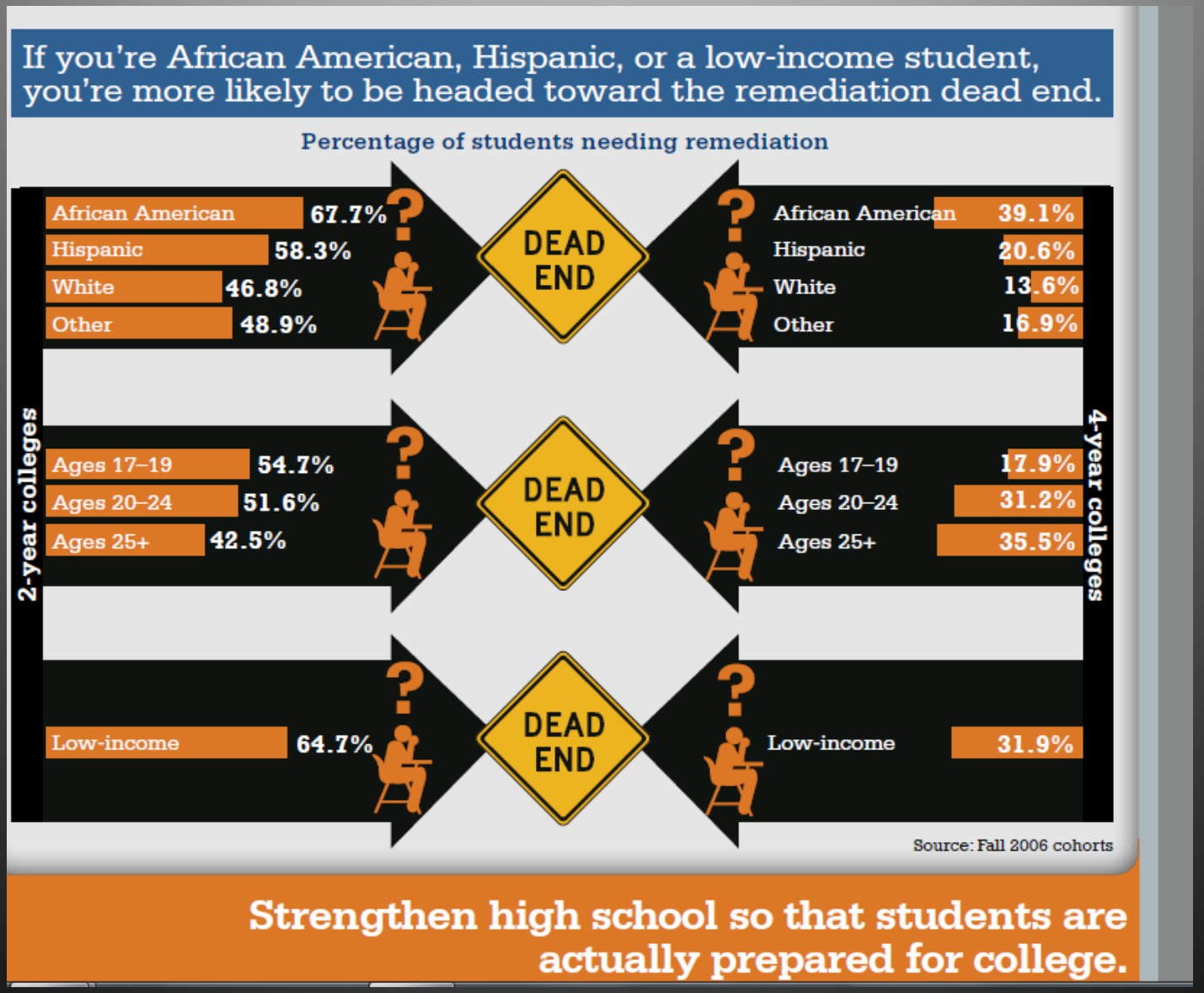
- Demographic Data:
  Of those who need dev math, what portion completes a college course?

- Research Data:
  Do those who take dev math do better than similar students who do not?

Demographic Data

- Classic example: “Bridge to Nowhere”
- Data generated and cited by external groups to influence policy
- Not usable by practitioners to improve the system
- No research question, no null hypotheses … closer to “USA Today” data nuggets

Bridge to Nowhere: Sample



Some "Nowhere Data"

REMEDIAL EDUCATION
Mathematics and English Success in 2-Year Colleges

	Hispanic			African American, non-Hispanic			White, non-Hispanic			Other		
	% enrolling in remedial courses	% remedial enrollers completing remedial courses	% remedial enrollers completing remedial and college-level courses	% enrolling in remedial courses	% remedial enrollers completing remedial courses	% remedial enrollers completing remedial and college-level courses	% enrolling in remedial courses	% remedial enrollers completing remedial courses	% remedial enrollers completing remedial and college-level courses	% enrolling in remedial courses	% remedial enrollers completing remedial courses	% remedial enrollers completing remedial and college-level courses
Arizona	30.7%	15.2%	7.7%	25.9%	9.6%	5.2%	12.1%	12.3%	5.8%	24.7%	13.4%	6.2%
Arkansas	29.2%	61.5%	37.2%	38.2%	41.7%	25.5%	22.9%	54.9%	35.4%	25.7%	57.4%	36.1%
California (CSU system only)	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Colorado	19.4%	42.4%	49.6%	23.8%	34.5%	36.5%	9.7%	50.8%	67.1%	10.9%	46.9%	60.4%
Florida	23.6%	51.4%	12.9%	38.1%	45.5%	10.3%	17.9%	50.4%	12.4%	19.9%	58.3%	16.9%
Georgia	10.5%	45.8%	8.4%	16.2%	37.6%	7.8%	6.3%	52.1%	15.8%	9.9%	42.4%	20.1%
Hawaii	22.2%	NP	NP	33.6%	25.0%	9.6%	19.7%	32.4%	NP	32.3%	32.6%	13.7%
Idaho	38.9%	55.7%	17.7%	NP	NP	NP	17.4%	55.0%	15.4%	16.6%	48.0%	NP
Illinois	24.2%	62.4%	26.7%	29.6%	51.5%	13.4%	10.8%	63.5%	26.0%	10.9%	72.2%	36.8%

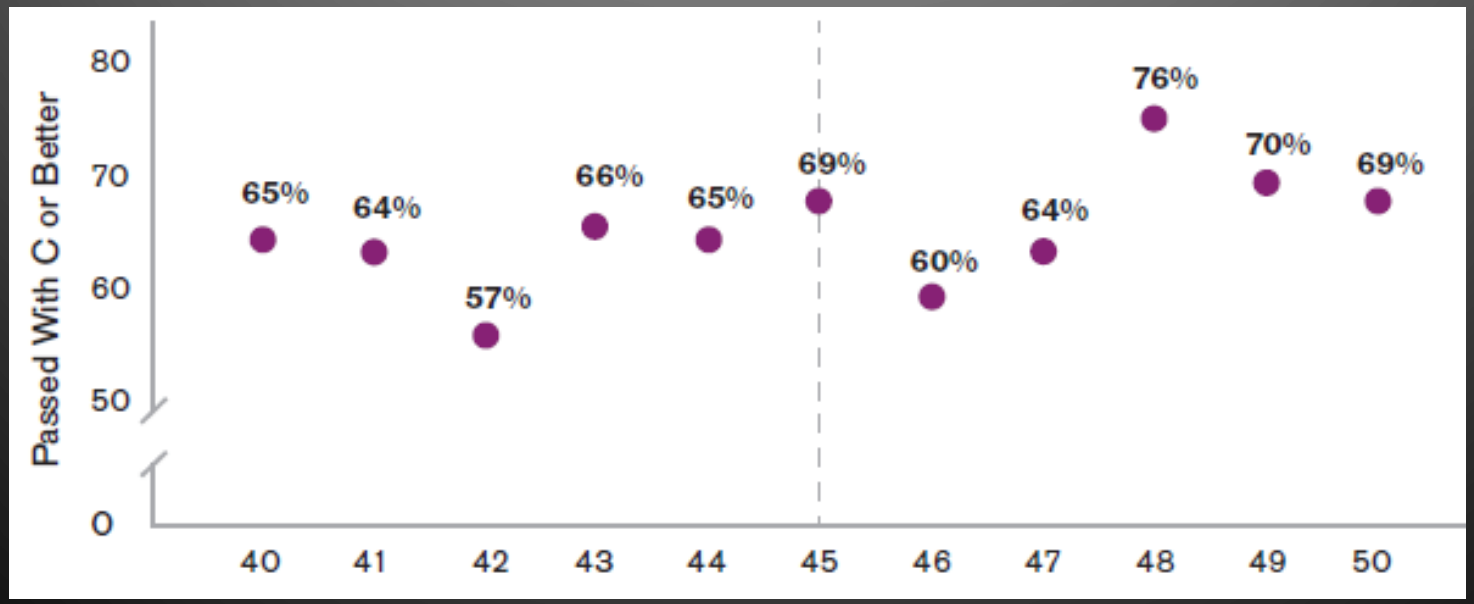
Research Data

- Comparison of outcomes in different groups
- Generated by academia (usually)

- Results have potential use by practitioners
- Basic research question: Does developmental mathematics improve results compared to ‘no treatment’?

Regression Discontinuity

- Examine students with scores just below cutoff (dev math) and those just above cutoff
- **Developmental math should create a 'discontinuity' (improved outcome)**
- Sample data: Success rates in college math by score on placement test



CCRC Data

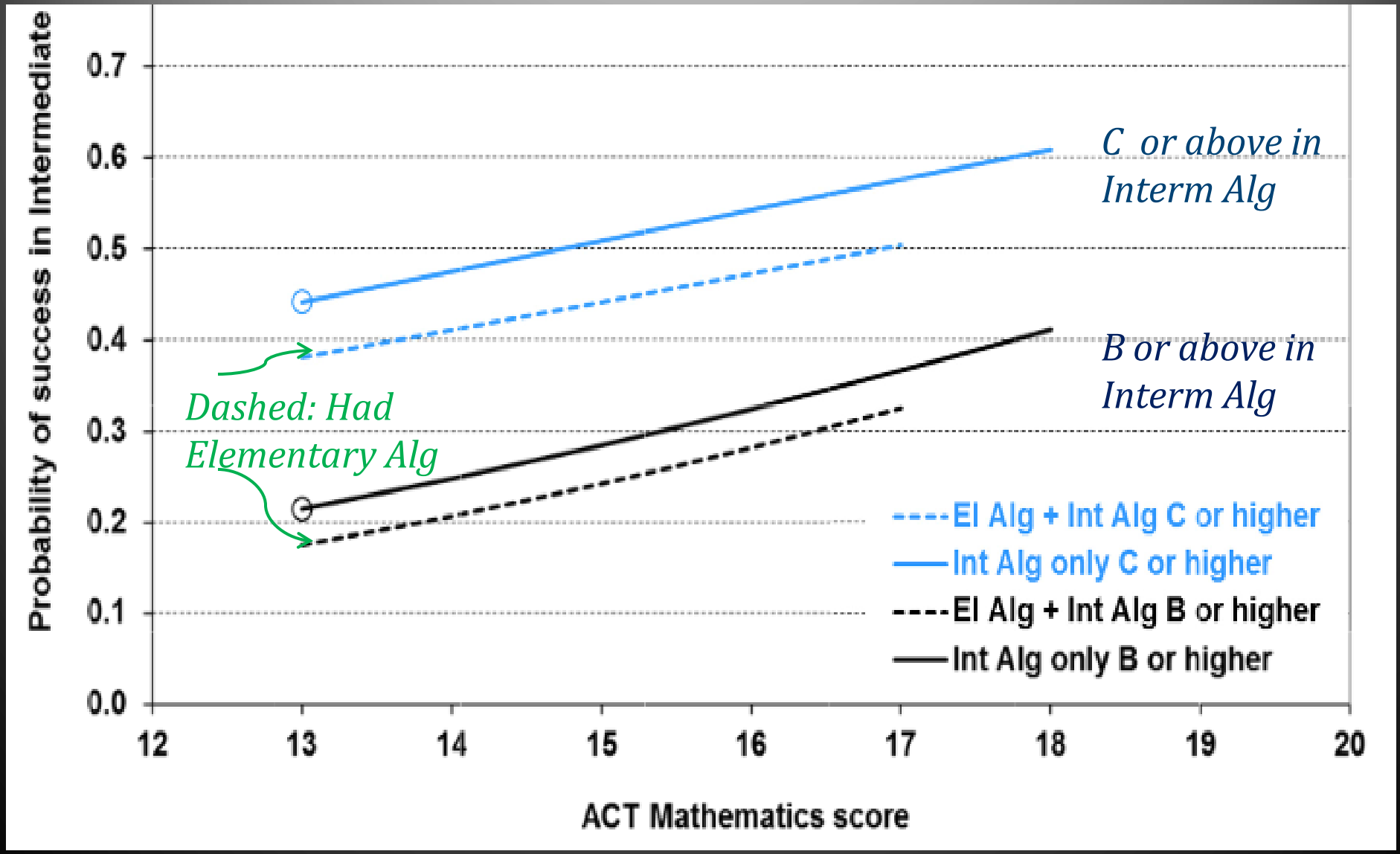
- Community College Research Center at Columbia
- Three large studies used. Results in Dev Math:
  2 null (no effect)
  1 negative (dev math led to lower college level pass rates for similar placement scores)
- These studies focused on the interface with college mathematics (ie, intermediate algebra ➔ college algebra)

ACT Data

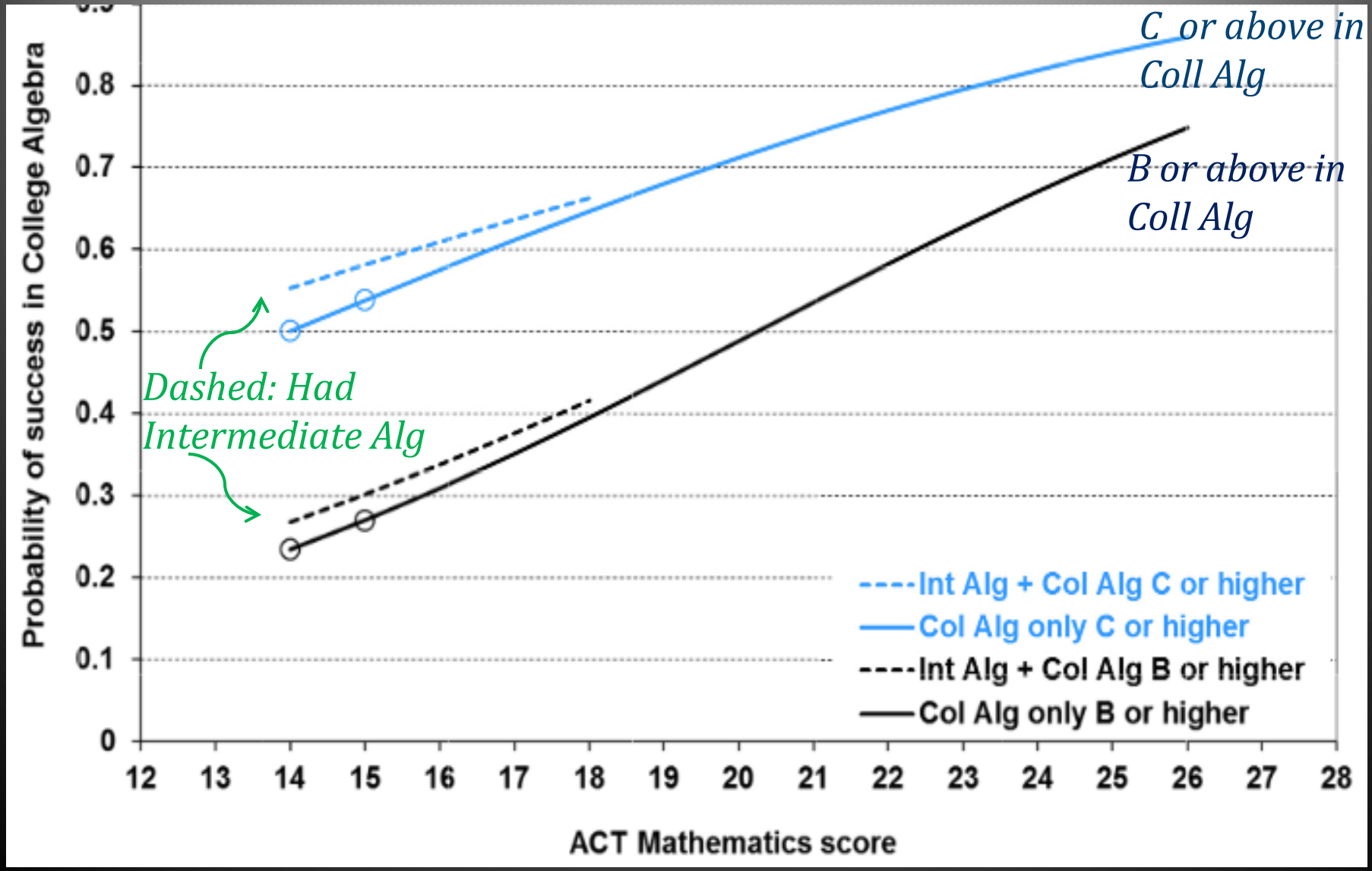
- ACT research study: 75 institutions, over 100,000 students
- All areas of developmental education
- Regression Discontinuity methodology
- Elementary algebra REDUCED the probability of passing intermediate algebra.
- Intermediate algebra increased probability of passing college algebra by 0.02 to 0.05

  > Statistically significant … worth a semester?

ACT Report: Elem Alg to Intermed Alg



ACT Report: Progression to Coll Alg



Traditional Curriculum

- Basic Math; Pre-algebra; Beginning Algebra; Intermediate Algebra – copied from the K-12 curriculum
- Presumption of necessity: got to know all of it

- Developmental algebra is not designed to prepare students ("skills" ≠ "readiness")
- Arithmetic is a dis-service as a college course

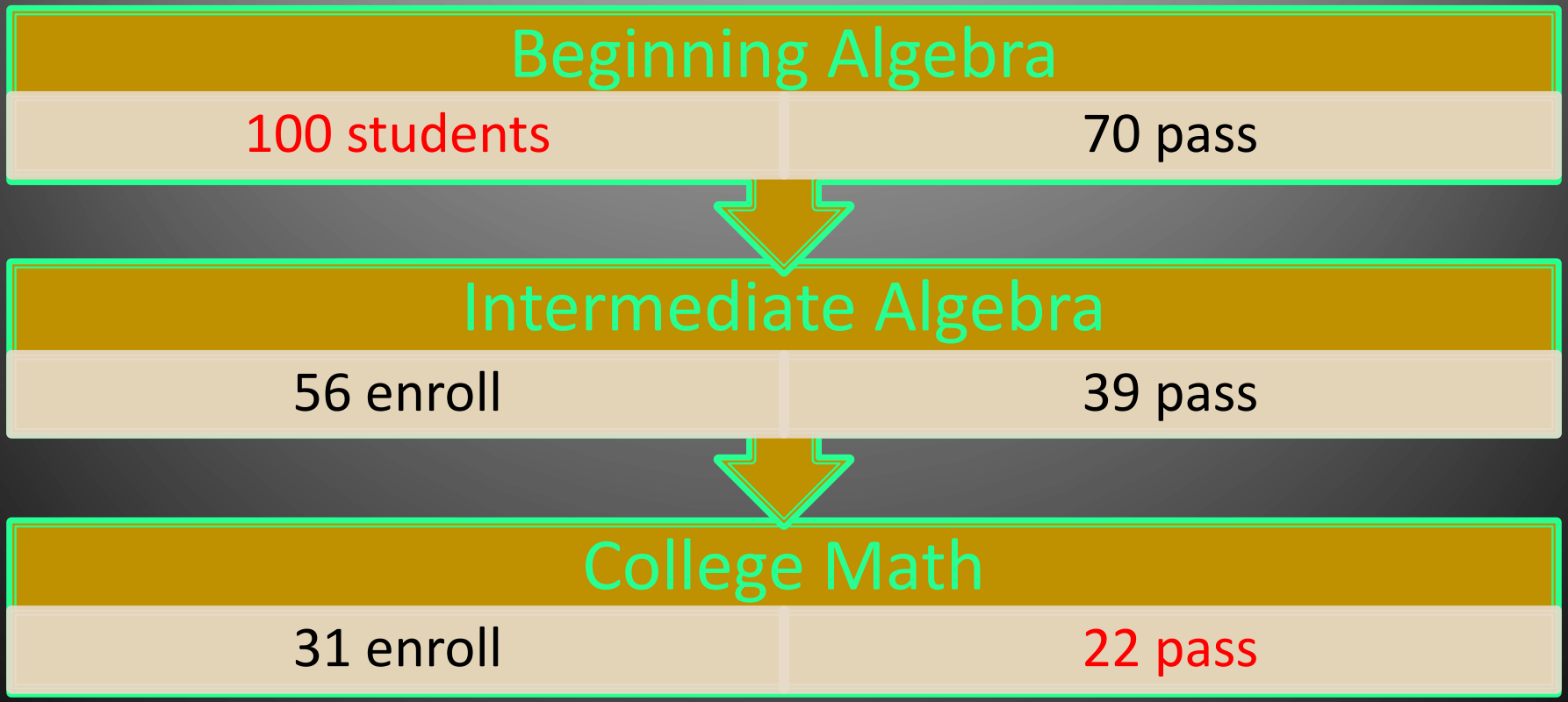
Why It's BAD

- The source K-12 curriculum was pre-Standards, skill-based
- No known connection to needed preparation
- Focus on procedure and answers, when we need concepts and reasoning

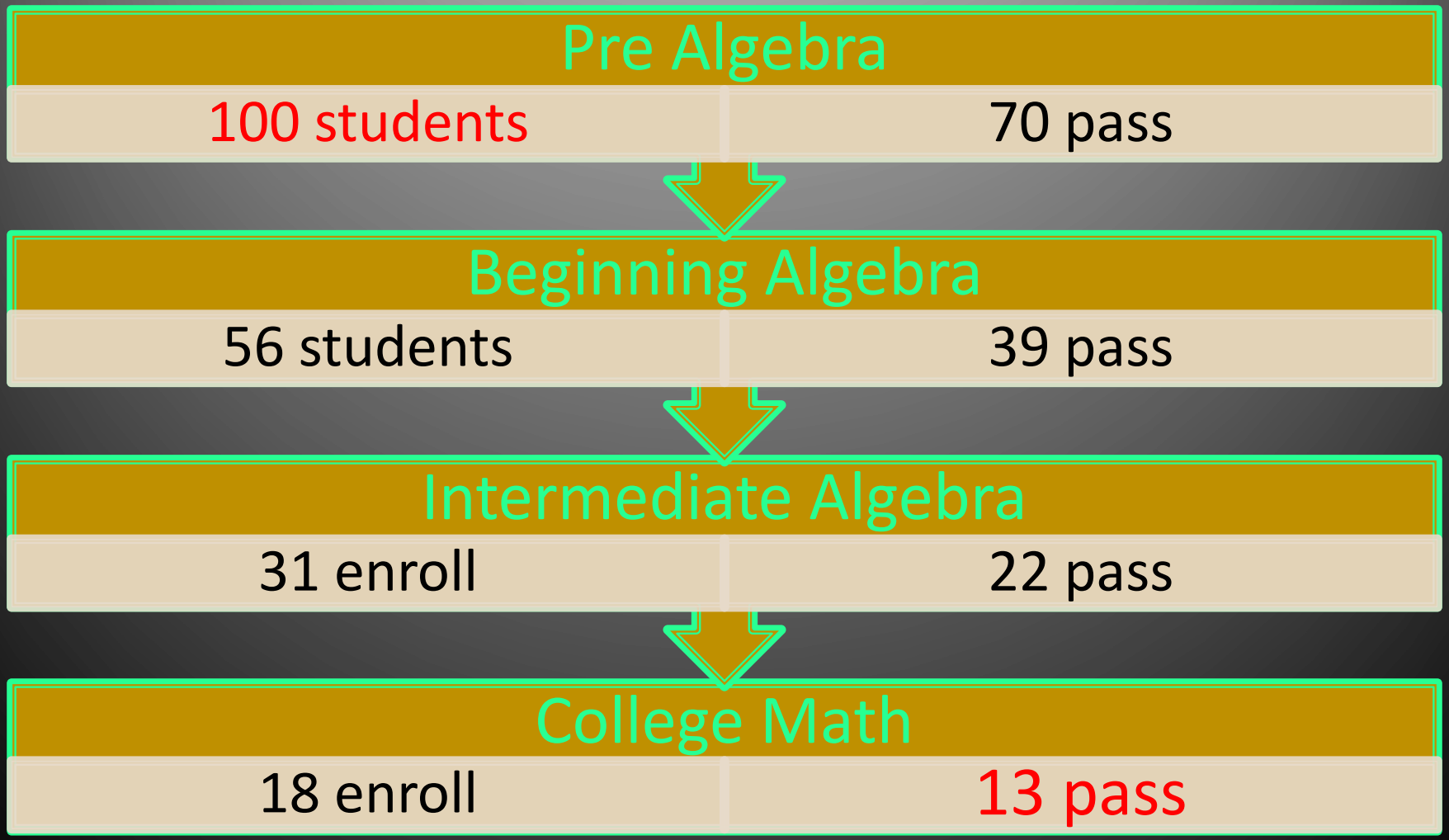
- We have … TOO MANY COURSES!

The Risk of a Longer Sequence: 2 Dev Courses

Assume 70% pass rate, 80% retention



The Risks: Three Dev Math courses (70% pass, 80% retention)



A Solution Must …

- Address known mathematical needs
- Minimize the number of courses (mean of ONE pre-college course; mode zero or one)
- Reflect standards of the mathematics profession

Modern Curricular Standards

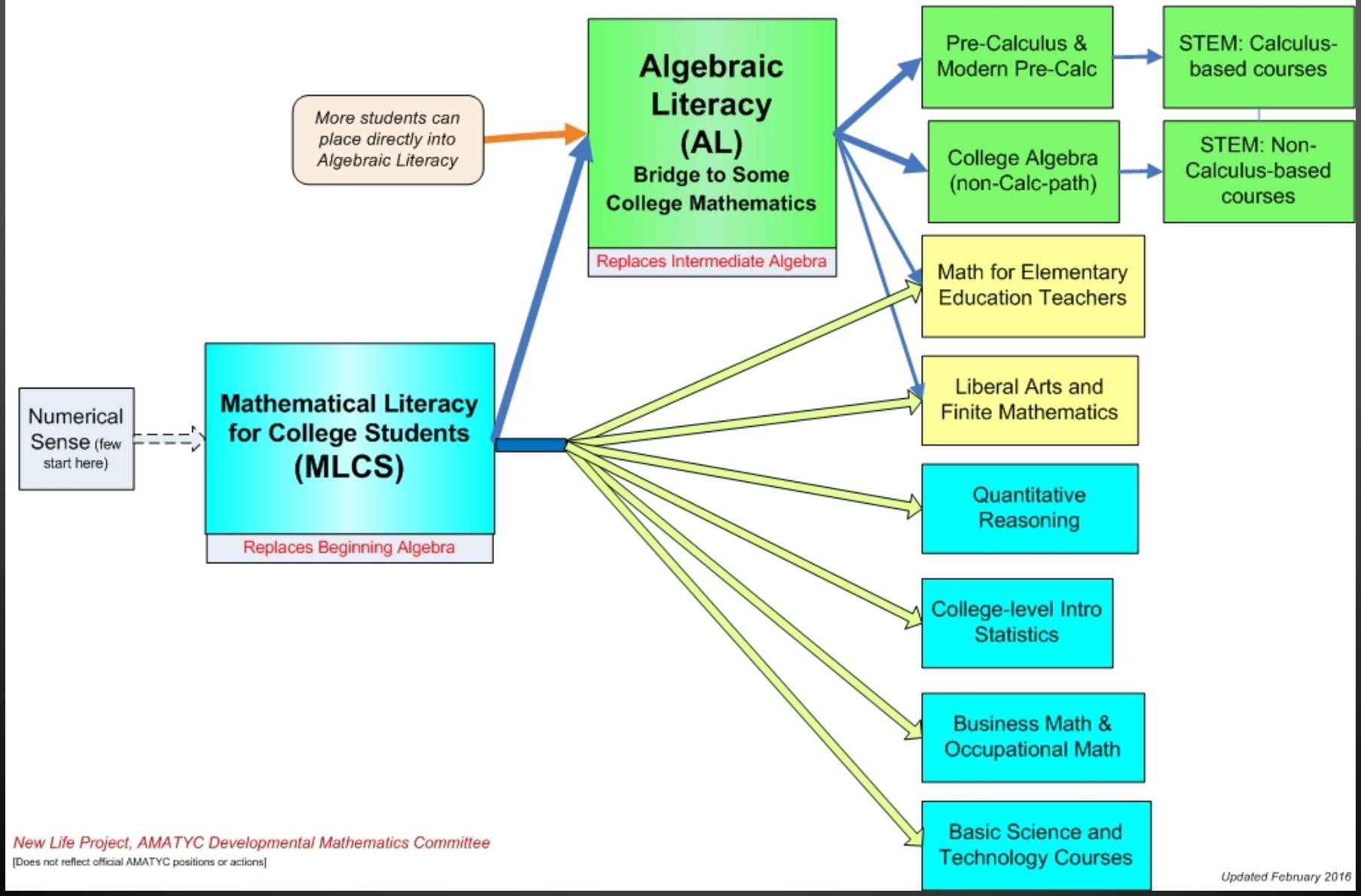
- "The Vision" project AMATYC with MAA: voices of partner disciplines
- MAA Curriculum Guide
- MAA CRAFTY College Algebra
- MAA CRAFTY Biology
- AMATYC Standards (Crossroads; Beyond Crossroads)
- AMATYC “Right Stuff” College Algebra

In a Modern Curriculum …

- Diversity of mathematics: inclusion of multiple domains
- Diversity of learning: knowledge, reasoning, applications
- Complex pedagogy: use of specific methodologies to achieve particular outcomes
- Intentional design: Progression is a reasonable expectation
- Efficiency without sacrificing ‘rigor’

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

from the New Life Project



New Life Project, AMATYC Developmental Mathematics Committee

[Does not reflect official AMATYC positions or actions]

Updated February 2016

Two Pre-college Math Courses

- Mathematical Literacy
  - Replaces beginning algebra and pre-algebra
  - Prerequisite: basic numeracy

- Algebraic Literacy
  - Replaces intermediate algebra
  - Prerequisite: Math Lit OR basic algebra

The Plan: Minimize the Path

- Students who need quantitative reasoning OR intro statistics only need Math Literacy
- Students with some basic algebra knowledge start in Algebraic Literacy … if their program requires College Algebra or similar course
- Only students who need college algebra (or similar course) AND who lack basic algebra knowledge would have 2 pre-college courses

The Idea of Math Lit (MLCS)

- Good mathematics from the beginning
- Focus on central ideas and reasoning

- Symbolism and technology included
- Fewer prerequisite skills (primarily basic numeracy)
- Designed to prepare all students (including STEM-bound students)

Siblings of MLCS

- Similar in purpose to "Foundations of Mathematical Reasoning" in the Dana Center's New Mathways Project
- Core learning outcomes shared:
  a) MLCS
  b) Foundations of Mathematical Reasoning
  c) Quantway I (Carnegie Foundation Pathways)

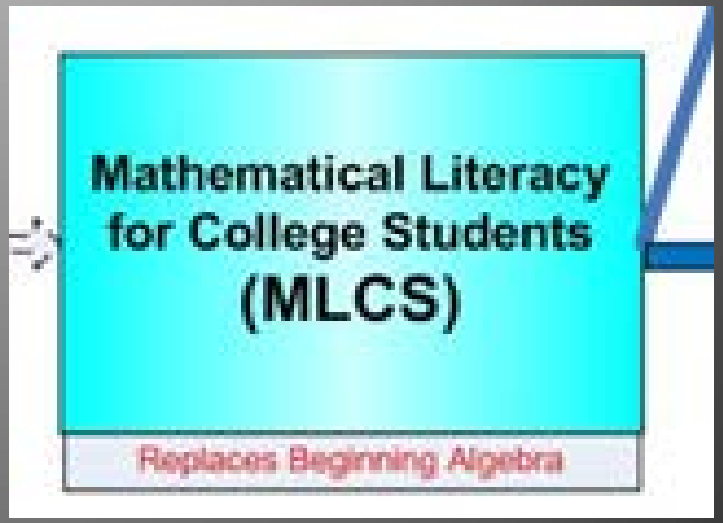
Math Literacy Connections

- On-ramp to Algebraic Literacy and the STEM-paths
- One-semester prep for Quantitative Reasoning
- One-semester prep for Introductory Statistics

- An excellent pre-college course for nursing and other health careers (‘guided pathways’)

Content Goals of Math Lit

- Numeracy
- Proportional Reasoning
- Algebraic Reasoning
- Functions

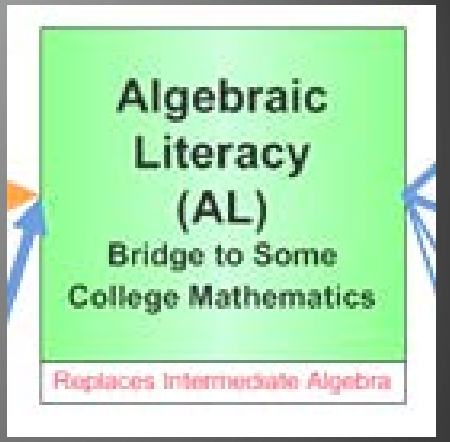


- Symbolic statements, communication, some procedures in symbolic form

Math Lit: Example Topics

- Quantities and measurements
- Intro to dimensional analysis
- Paired data
- Rate of change
- Equations in two variables
- Linear relationships
- Exponential relationships

The Idea of Algebraic Literacy (AL)



- Good mathematics from the beginning
- Focus on central ideas and reasoning
- Procedures and applications in balance
- Designed to prepare students and even inspire students
- “STEM boosting” outcomes identified (needed for pre-calculus)

Cousins of Algebraic Literacy

- Dana Center "Reasoning with Functions" starts at the same level (two-semester pre-calculus sequence)
  >> Algebraic Literacy connects to pre-calculus course

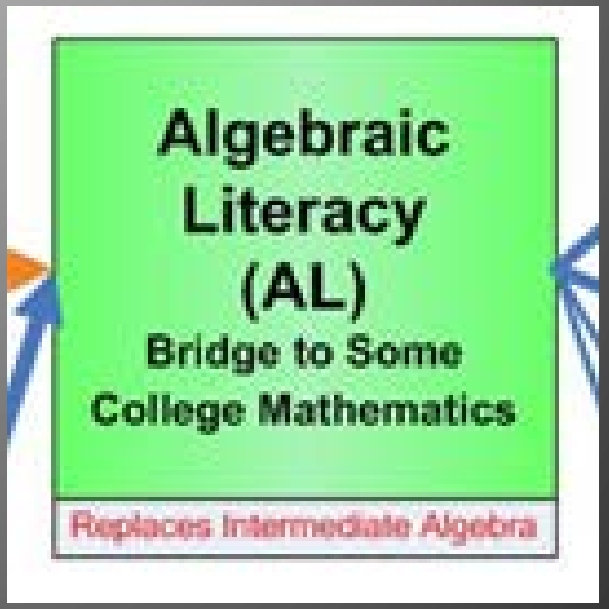
- Carnegie Foundation Pathways "Bridge course" has similar purpose

Algebraic Literacy Connections

- On-ramp to pre-calculus
  [Math Lit] → Algebraic Lit → Pre-Calc → Calc I
- Prep for mid-skill technical programs and emerging technologies, and science courses
- Compared to Dana Center:
  FMR → Reason Function I → Reason Function II → Calc I
- Compared to Carnegie Foundation:
  Quantway I → Bridge → Pre-Calc → Calc I

Content Goals of Algebraic Literacy

- Numbers and Polynomials
- Functions
- Geometry and Trigonometry
- Modeling and Statistics



- Symbolic and numeric methods; focus on reasoning and connections

Algebraic Lit: Example Topics

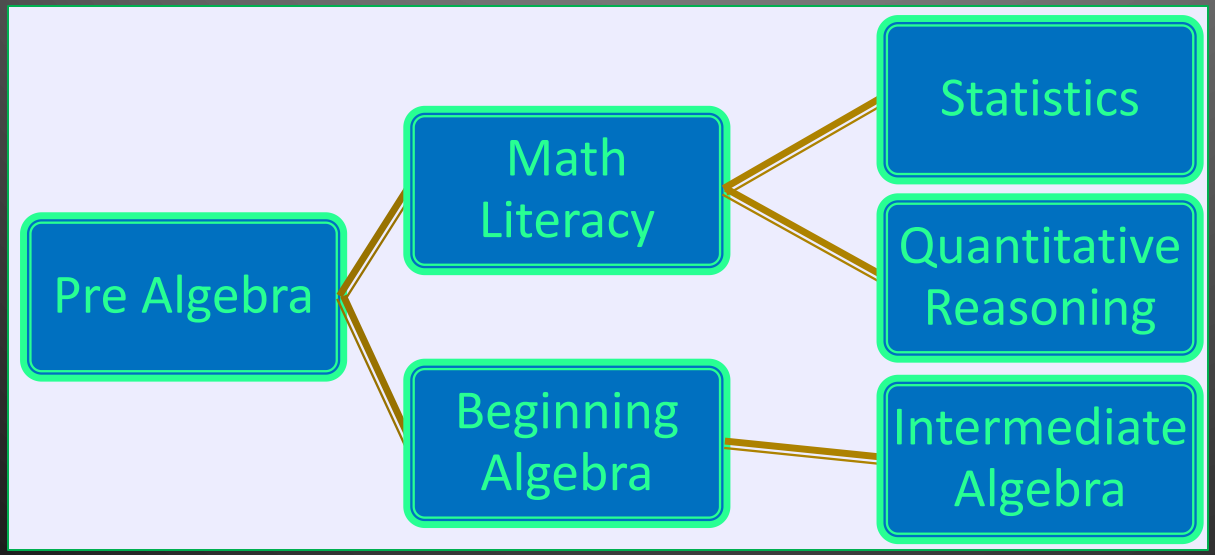
- Properties and equivalent polynomials
- Numeric methods to solve exponential equations
- Symbolic and numeric methods for systems
- Connecting rate of change and the function
- 3 basic trig functions in right triangles
- Models as approximations
- Correlation

Implementation Options

- Low: Math Literacy for Pathways
- Medium: Drop arithmetic & pre-algebra; Math Literacy replaces beginning algebra
- High: Drop arithmetic & pre-algebra; Math Literacy replaces beginning algebra … Plus Algebraic Literacy replaces intermediate algebra

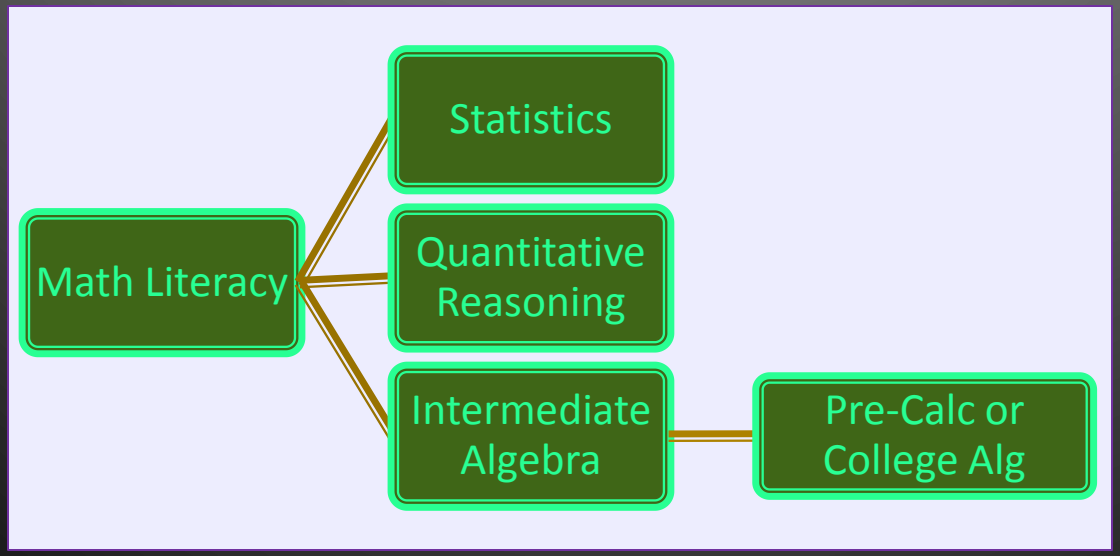
Low Implementation

- Refer students to Math Literacy based on QR or Statistics as general education course
- Maintain beginning algebra for all other students
- Issue: Depends on ‘advising’ to recruit students



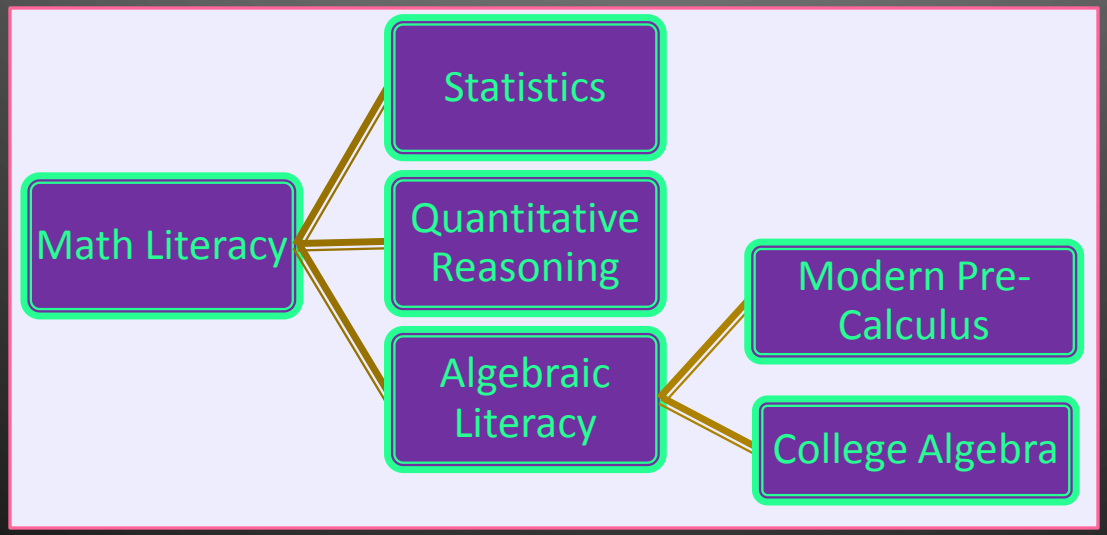
Medium Implementation

- Eliminate all courses below beginning algebra
- Use Math Literacy for all students (going to QR, Statistics, or Intermediate Algebra)
- Provide boot camps or just-in-time remediation for Math Lit prereqs (numeracy)
- Avoids advising issue; simpler structure



High Implementation

- Includes ‘medium’ (dropping courses before math literacy, replacing beginning algebra) … AND drop intermediate algebra.
- Use Algebraic Literacy for students going in to precalculus, etc (and for technical programs)
- Place the top 30% to 40% of ‘beginning algebra’ students in to Algebraic Literacy
- Provides modern curriculum for all students



Wrap Up

- >125 institutions in 24 states have implemented one or both Literacy courses (as of Fall 2015)

- Presentation and handouts available at devmathrevival.net
- Emails and questions welcomed!

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- Thanks for being here ☺