Faculty Cohorts: Transforming and Accelerating Developmental Mathematics at El Camino College

The Challenge

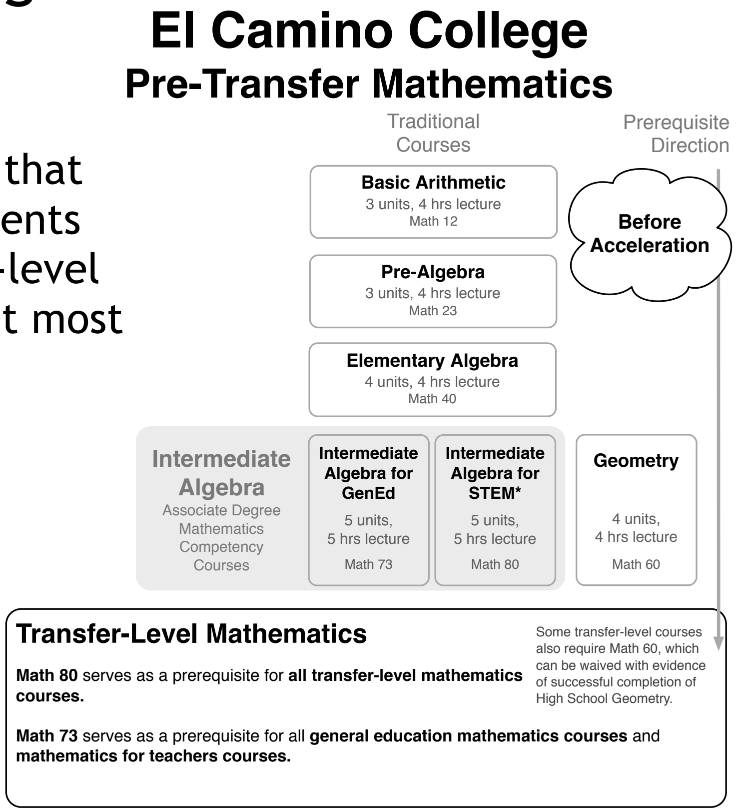
Redesign our curriculum so that **ALL** El Camino College students will be ready for a transfer-level mathematics course after at most two semesters.

Response 1.0

Basic Accelerated Math (BAM)
and
Intermediate Algebra for Statistics (IASTATS)

Students who place at the lowest level face a four-semester course sequence. The two accelerated courses we have created and are testing provide these students with a two-semester pathway into a transfer-level mathematics course.

For those students ready for elementary algebra and for whom statistics is an appropriate transfer-level course, there is now a one-semester pathway to the transfer-level mathematics course, rather than the elementary-intermediate algebra sequence.



El Camino College
Pre-Transfer Mathematics

Traditional Courses

Prerequisite Direction

Before Acceleration

Basic Arithmetic
3 units, 4 hrs lecture
Math 12

Pre-Algebra
3 units, 4 hrs lecture
Math 23

Elementary Algebra
4 units, 4 hrs lecture
Math 40

Intermediate Algebra
Associate Degree Mathematics Competency Courses

Intermediate Algebra for GenEd
5 units, 5 hrs lecture
Math 73

Intermediate Algebra for STEM*
5 units, 5 hrs lecture
Math 80

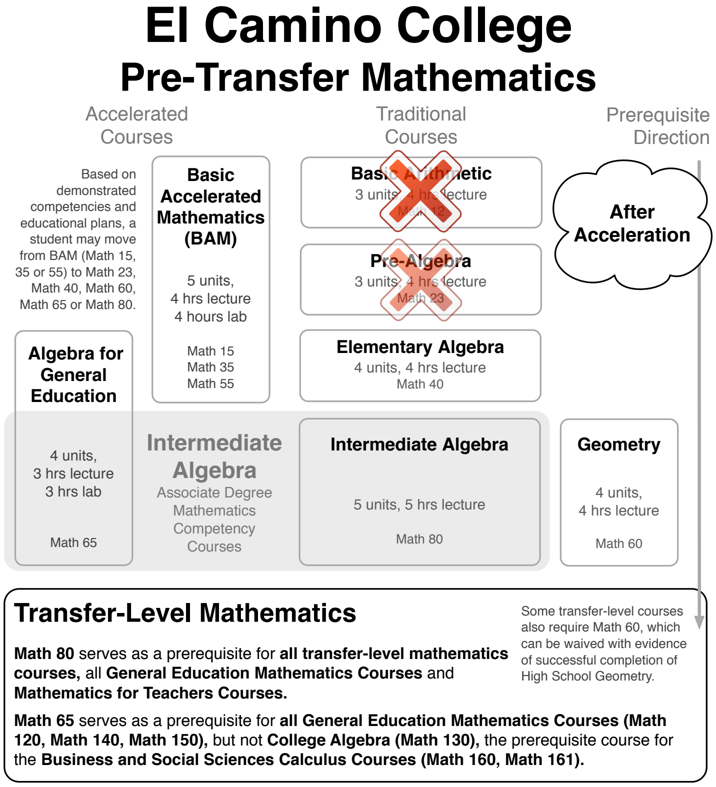
Geometry
4 units, 4 hrs lecture
Math 60

Transfer-Level Mathematics

Math 80 serves as a prerequisite for **all transfer-level mathematics courses.**

Math 73 serves as a prerequisite for all **general education mathematics courses** and **mathematics for teachers courses.**

Some transfer-level courses also require Math 60, which can be waived with evidence of successful completion of High School Geometry.



El Camino College
Pre-Transfer Mathematics

Accelerated Courses

Traditional Courses

Prerequisite Direction

After Acceleration

Based on demonstrated competencies and educational plans, a student may move from BAM (Math 15, 35 or 55) to Math 23, Math 40, Math 60, Math 65 or Math 80.

Basic Accelerated Mathematics (BAM)
5 units, 4 hrs lecture
4 hours lab
Math 15
Math 35
Math 55

~~**Basic Arithmetic**~~
~~3 units, 4 hrs lecture~~
~~Math 12~~

~~**Pre-Algebra**~~
~~3 units, 4 hrs lecture~~
~~Math 23~~

Elementary Algebra
4 units, 4 hrs lecture
Math 40

Algebra for General Education
4 units, 3 hrs lecture
3 hrs lab
Math 65

Intermediate Algebra
Associate Degree Mathematics Competency Courses

Intermediate Algebra
5 units, 5 hrs lecture
Math 80

Geometry
4 units, 4 hrs lecture
Math 60

Transfer-Level Mathematics

Math 80 serves as a prerequisite for **all transfer-level mathematics courses,** all **General Education Mathematics Courses** and **Mathematics for Teachers Courses.**

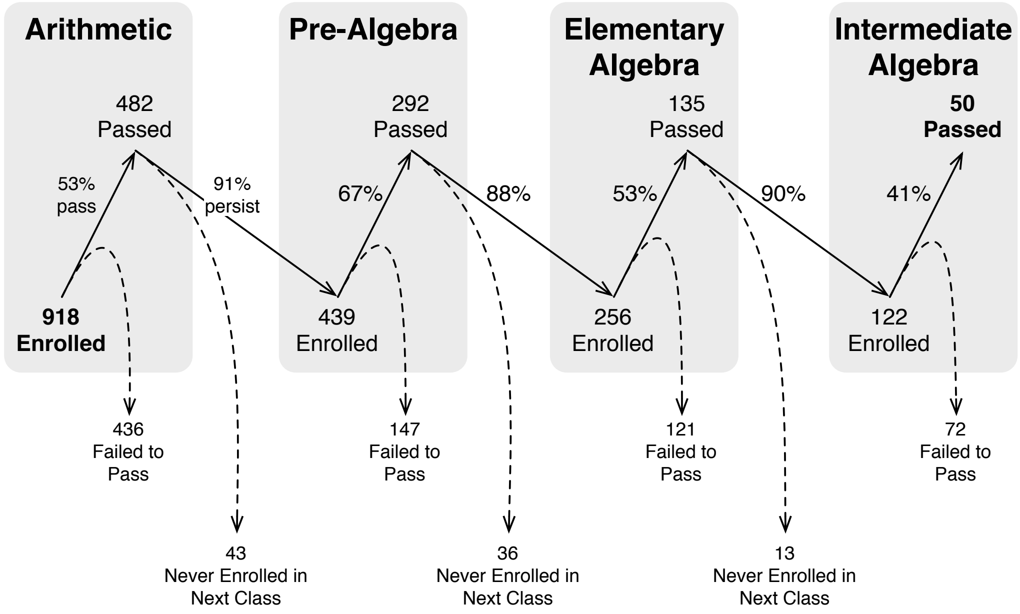
Math 65 serves as a prerequisite for **all General Education Mathematics Courses (Math 120, Math 140, Math 150),** but not **College Algebra (Math 130),** the prerequisite course for the **Business and Social Sciences Calculus Courses (Math 160, Math 161).**

Some transfer-level courses also require Math 60, which can be waived with evidence of successful completion of High School Geometry.

Success of the Traditional Sequence

The diagram below illustrates, rather bluntly, why we were motivated to change the way we think about developmental mathematics, not as a sequence of courses, but as a program.

Progress over two years through Intermediate Algebra
Basic Arithmetic Cohort Fall 2008, El Camino College



Of the 918 students in this cohort, only 50 (5%) passed Intermediate Algebra within two years.

We lost 776 students (85%) from failure to pass one or more of the courses in the sequence within two years.

We lost 92 students (10%) from failure to enroll in the next class within two years.

Data collected by Marci Myers,
Office of Institutional Research, El Camino College
Art Martinez' original chart reproduced by Lars Kjeseth

Basic Accelerated Math (BAM)[1]:

The **design** of BAM reflects several premises we hold due to research results, our conversations in our faculty cohorts, and our personal experience:

- Students develop numeracy and algebra skills relatively independently.
- Students also develop skills numeracy and algebra more quickly when they are contextualized and intertwined.
- Students need not be proficient at basic arithmetic before they can successfully set up and solve problems.
- Basic skills students do better with a great deal of structured contact hours.

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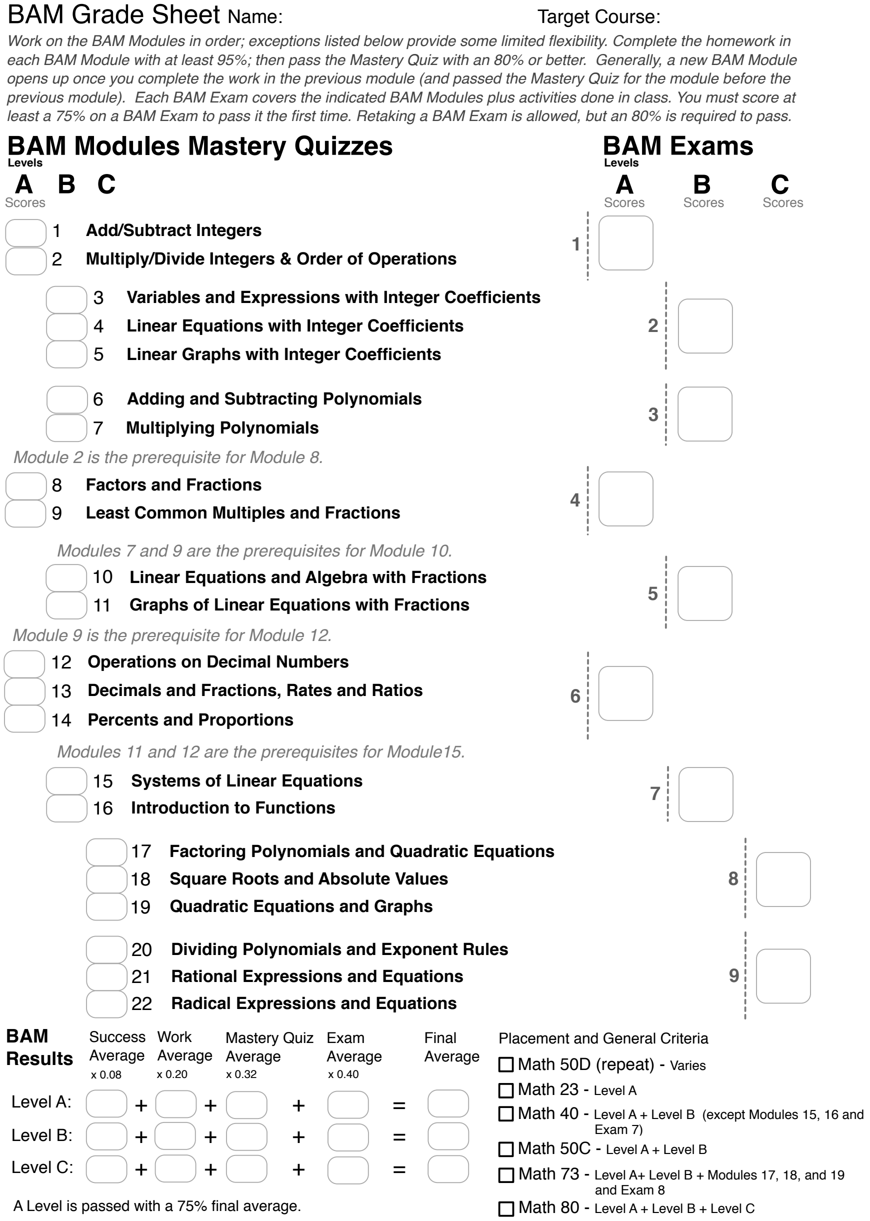
[1] We developed BAM in response to and in contrast to John Squires' Developmental Mathematics, an example of the emporium model for basic skills mastery. We were convinced we could also develop students' critical and analytical thinking skills in BAM. Ironically perhaps, or perhaps appropriately, the online component we use was constructed from Squires.

BAM Nuts and Bolts

BAM is a **pass/no pass**, **degree-applicable**[2], **five credit-unit** course designed so that students gain the arithmetic and algebra competencies needed for success in an intermediate algebra-level course after one intense semester of work. This course is **open to all students who place below the elementary algebra level**. There are **four hours a week in a computer laboratory**, in which students use a self-paced, mastery-learning online program designed to reinforce procedural knowledge, and there are **four hours a week in a classroom**, where students engage with the activities that strengthen numeracy, problem solving skills, and conceptual understanding. The course has multiple exit target courses depending on each student's educational goals and demonstrated competencies.



BAM Grade Sheet Name: Target Course:

Work on the BAM Modules in order; exceptions listed below provide some limited flexibility. Complete the homework in each BAM Module with at least 95%; then pass the Mastery Quiz with an 80% or better. Generally, a new BAM Module opens up once you complete the work in the previous module (and passed the Mastery Quiz for the module before the previous module). Each BAM Exam covers the indicated BAM Modules plus activities done in class. You must score at least a 75% on a BAM Exam to pass it the first time. Retaking a BAM Exam is allowed, but an 80% is required to pass.

BAM Modules Mastery Quizzes — **Levels** **A B C** Scores

BAM Exams — **Levels** **A** Scores **B** Scores **C** Scores

1 **Add/Subtract Integers**
2 **Multiply/Divide Integers & Order of Operations**
Exam 1

3 **Variables and Expressions with Integer Coefficients**
4 **Linear Equations with Integer Coefficients**
5 **Linear Graphs with Integer Coefficients**
Exam 2

6 **Adding and Subtracting Polynomials**
7 **Multiplying Polynomials**
Exam 3

Module 2 is the prerequisite for Module 8.

8 **Factors and Fractions**
9 **Least Common Multiples and Fractions**
Exam 4

Modules 7 and 9 are the prerequisites for Module 10.

10 **Linear Equations and Algebra with Fractions**
11 **Graphs of Linear Equations with Fractions**
Exam 5

Module 9 is the prerequisite for Module 12.

12 **Operations on Decimal Numbers**
13 **Decimals and Fractions, Rates and Ratios**
14 **Percents and Proportions**
Exam 6

Modules 11 and 12 are the prerequisites for Module15.

15 **Systems of Linear Equations**
16 **Introduction to Functions**
Exam 7

17 **Factoring Polynomials and Quadratic Equations**
18 **Square Roots and Absolute Values**
19 **Quadratic Equations and Graphs**
Exam 8

20 **Dividing Polynomials and Exponent Rules**
21 **Rational Expressions and Equations**
22 **Radical Expressions and Equations**
Exam 9

BAM Results	Success Average x 0.08		Work Average x 0.20		Mastery Quiz Average x 0.32		Exam Average x 0.40		Final Average
Level A:		+		+		+		=	
Level B:		+		+		+		=	
Level C:		+		+		+		=	

A Level is passed with a 75% final average.

Placement and General Criteria
- ☐ Math 50D (repeat) - Varies
- ☐ Math 23 - Level A
- ☐ Math 40 - Level A + Level B (except Modules 15, 16 and Exam 7)
- ☐ Math 50C - Level A + Level B
- ☐ Math 73 - Level A+ Level B + Modules 17, 18, and 19 and Exam 8
- ☐ Math 80 - Level A + Level B + Level C

BAM Levels

The course has three content levels, which we present in a blended fashion. Level A is largely the arithmetic skills used in algebra courses. Level B visits basic algebraic concepts and graphing in the context of studying linear functions, first with integer and later with fractional and decimal coefficients. Level C addresses the rest of the algebra topics from a typical introductory algebra course.

Students demonstrate competencies through the online mastery quizzes (focused more on procedural skills) and nine traditional in-class exams (focused more on conceptual and critical thinking skills).

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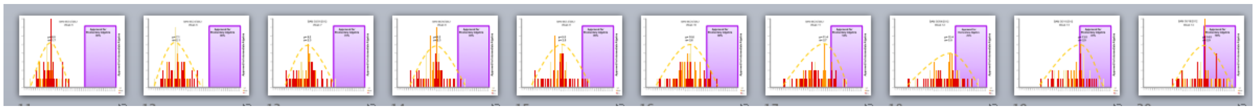
[2] In its experimental phase, BAM cannot technically be degree-applicable, but we do not foresee any difficulties having it approved as such. In contrast, BAM will likely never satisfy the associate degree mathematics requirement.

Students must attain at least an 80% on every mastery quiz and at least a 75% on every related exam. Students may retake mastery quizzes as often as needed and may retake new versions of the nine in-class exams up to three times.

Completing all three levels qualifies a student for any intermediate algebra (IA) courses: IA for Statistics (IASTATS), IA for General Education, or IA for Science, Technology, Engineering and Mathematics. Completing Levels A and B successfully qualifies a student for IASTATS or Elementary Algebra. Students who do not successfully complete Levels A and B have a number of options, including repeating the course and continuing where they left off.

BAM Results

After the first two semesters of BAM, we are pleased by some initial promising results: Last fall, we started with 109 students last fall, ALL OF WHOM PLACED INTO BASIC ARITHMETIC. Of these, 10 students withdrew, 18 students did not complete Levels A and B. The remaining 81 students (over 70%) qualified to enroll in a math course one level below transfer. This is an enormous improvement over the throughput rate for the basic arithmetic → pre-algebra → elementary algebra course sequence, where the completion rate is less than 20%. In about a week, we will know more about the results from this spring, but we predict roughly 80% will progress at least two of the old traditional levels. (In the power point, watch how the students have progressed, week-by-week.)



Intermediate Algebra for Statistics (IASTATS)[3]

Traditional developmental math courses spend too much time and resources training students for the calculus course that most students will never take. For most of our students, a statistics course is the most appropriate transfer-level general education mathematics course. We believe that students will use their numeracy, algebra and mathematical reasoning skills most often in the context of making or understanding the decisions made based on data and statistics. We set out to design a course that tailors the elementary and intermediate algebra skills to fit the needs of the student learning how to pose questions about data and to interpret data in a way that is meaningful.

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[3] We were inspired in no small part by the work of Myra Snell at Los Medanos College.

IASTATS Nuts and Bolts

IASTATS is a **graded**, **degree-applicable**[4], **four credit-unit course** in which students, using descriptive statistics as the primary application, develop the algebraic and mathematical reasoning skills that are necessary to succeed in a transfer-level statistics and are important for a generally educated populace. This class is **open to anyone who is eligible for elementary algebra** and who is planning to take the transfer-level statistics course. Students spend **three hours a week in a classroom** working on group activities that explore algebraic concepts in the context of real world situations often involving data that we have gathered from many sources, including the students themselves. Students also spend **three hours a week in a computer laboratory**, practicing algebra skills often involving contextual problems.

The process of building the course is a dynamic one. We have a committee of five who work on this weekly. We began the process with a lot of discussion on what the desired student outcomes would be. We identified what skills students would need to achieve both algebra competency and stats readiness. Then we laid out the course in chunks and filled in the chunks with homemade activities, online assignments, reading and writing activities centered on displays of quantitative data.

Chunk 1. Working with Data (5-6 weeks)	Underlying Skills/abilities
1. Collecting data, displaying data, describing data. 2. Numeracy 3. Variables, symbols	Problem solving 1. Posing Questions and framing questions 2. Technology skills 3. Tetrahedron (numerical, graphical, verbal, symbolic) 4. Student/college skills 5. Ordering, dot plots, verbal descriptions of distributions, graphing and scale, interpreting interpretation from graphs and tables, naming data, qualitative vs. quantitative, mean, medium, mode 6. pie chart, fractions, percents, decimals, ratios, comparing and ordering fractions, proportions 7. self monitor whether answers make sense in context 8. Numbers in context – Contextualizing numbers 9. Read and interpret an article, newspaper report, institutional research report; represent quantitative information with graph or table (How are data used? Main Theme of the course)

There is no ready-made textbook for this type of course, so we have deconstructed a series of textbooks with a similar approach to learning (motivating the study of algebra through the use of contextualized problems) and reconstructed parts of them as a custom text. We will see how the text works and refine after the semester is completed.

For the reading and writing assignments, we used a monograph written by Edward Tufte, in which he compares and contrasts both the useful and detrimental displays of data, for example, Dr. John Snow's diagram tracking the 1854 cholera epidemic in London.

We have launched IASTATS this spring (2012) with three sections of the course. We have had no problem filling our initial three sections of the course. Roughly half of our students reached us through last fall's sections of BAM. The three sections filled easily once students heard about the course from counselors and flyers we sent out to the pre- Algebra sections. The acceleration has great appeal for many students.

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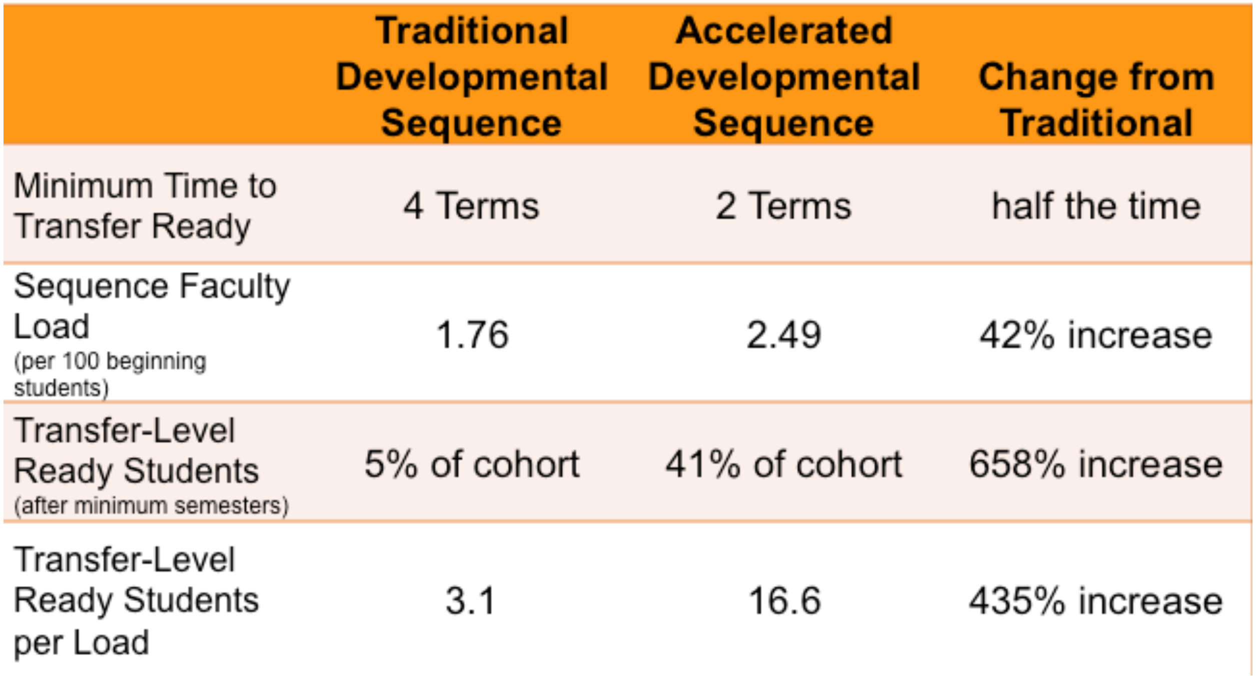
[4] In its experimental phase, IASTATS cannot technically be degree-applicable, but we do not foresee any difficulties having it approved as such. In contrast, we anticipate a bit of controversy in having IASTATS satisfy the mathematical competency requirement for the associate degree.

IASTATS Results

We look forward to sharing the results of this first IASTATS semester.

Fiscal Considerations about Accelerated Courses

Our administration has concerns about scaling up BAM when each section constitutes roughly half of a fulltime instructor's load. However, we believe that a one-semester course with a 70% success rate and a faculty load of 46.67% is a much wiser choice, both fiscally and for students, than a three-semester sequence with a 20% throughput rate and a faculty load of 80%. Admittedly, this is a very crude cost-benefit analysis. Below we have the results of a more refined analysis that compares the cost of a lowest-placing student reaching a transfer-level mathematics course through both the traditional and the purely accelerated pathways.



	Traditional Developmental Sequence	Accelerated Developmental Sequence	Change from Traditional
Minimum Time to Transfer Ready	4 Terms	2 Terms	half the time
Sequence Faculty Load (per 100 beginning students)	1.76	2.49	42% increase
Transfer-Level Ready Students (after minimum semesters)	5% of cohort	41% of cohort	658% increase
Transfer-Level Ready Students per Load	3.1	16.6	435% increase

Faculty Course Cohorts

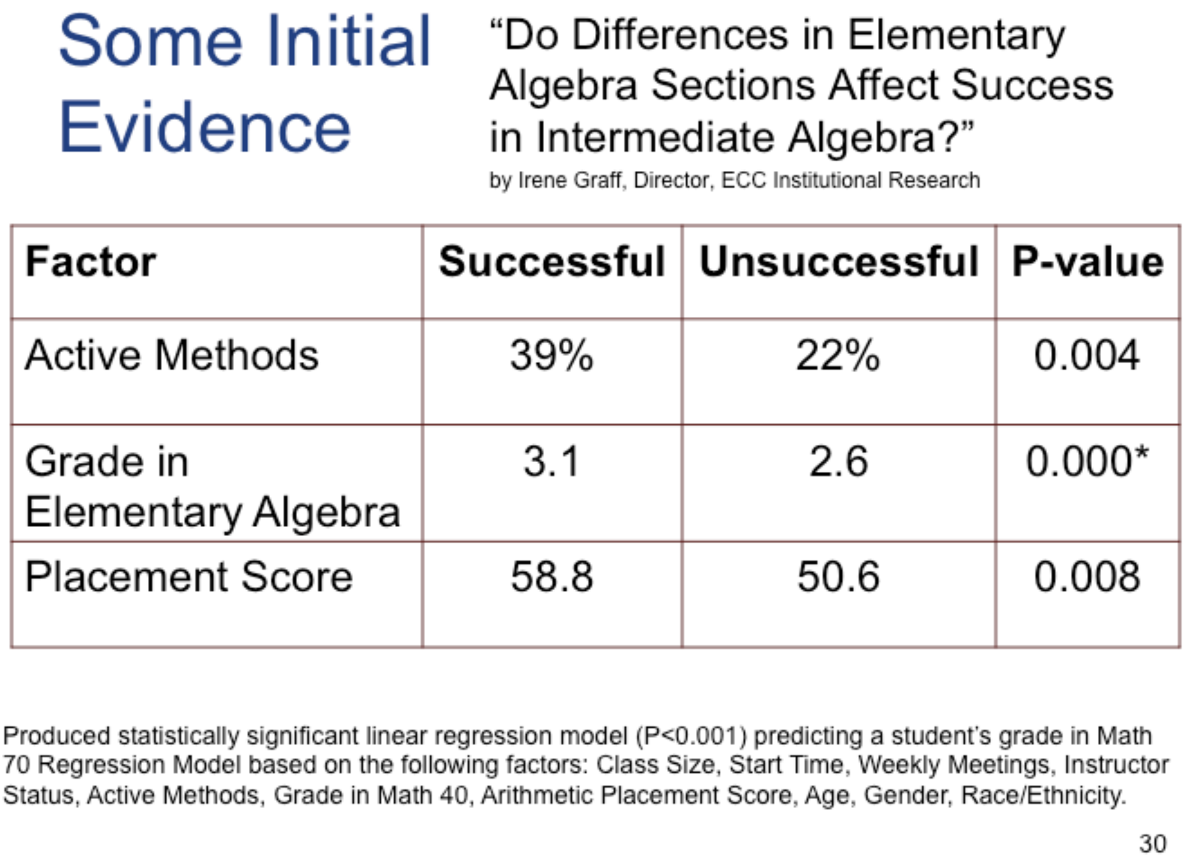
Instructors have always collaborated with one another to various extents. At El Camino College, we have created a space for more formal collaboration – the Faculty Course Cohort:

> A Faculty Course Cohort is a team of instructors, both fulltime and adjunct, who are teaching a common course, who agree to collaborate on a project to improve student learning and success, who commit to weekly meetings and shared evaluation of material, and who also agree to align their courses and share student support resources.

Faculty Course Cohorts have been formed for all of our developmental mathematics courses, as well as statistics, trigonometry and pre-calculus courses. Over the past eight years, 14 fulltime and 22 adjunct instructors have participated in three or more cohorts. Most projects focus on building group activities that engage students with authentic data and situations; other projects have helped us create some consistency of experience between face-to-face and hybrid sections of the same course. Our just in time workshops for basic skills, such as “Using Models to Add and Subtract Fractions” also grew out of Faculty Course Cohort work.

Besides allowing us to work smarter rather than harder, engaging with each other on a weekly basis is fun and invigorating for us. We become excited bouncing ideas off each other, critiquing each other’s work, and engaging in deep discussions about student learning and our teaching practice. Without the time commitment we make to our cohorts, when would we find the time?

The cohorts made us feel good about our work, but empirical evidence seemed to indicate that this kind of active learning had a positive effect on student achievement as well.



Some Initial Evidence

“Do Differences in Elementary Algebra Sections Affect Success in Intermediate Algebra?”

by Irene Graff, Director, ECC Institutional Research

Factor	Successful	Unsuccessful	P-value
Active Methods	39%	22%	0.004
Grade in Elementary Algebra	3.1	2.6	0.000*
Placement Score	58.8	50.6	0.008

Produced statistically significant linear regression model (P<0.001) predicting a student’s grade in Math 70 Regression Model based on the following factors: Class Size, Start Time, Weekly Meetings, Instructor Status, Active Methods, Grade in Math 40, Arithmetic Placement Score, Age, Gender, Race/Ethnicity.

Working collaboratively has become a way of teaching for many of the cohort participants that we will no longer do without. We have grown together to know each other’s strengths and weaknesses, as well as our own. We trust and value one another in a deep way. Continual collaboration has become part of our practice.

We have concluded that faculty course cohorts are a fertile community in which to test innovations or grow proven strategies and that faculty course cohorts provide continuity over time, making sustainable changes more likely.

On our eight-year long journey to articulate our visions of classrooms that function well for students and teachers we have come to a set of generally agreed upon motivating principles: (not an exhaustive list)

> Quantitative and mathematical reasoning skills are crucially important for our students and our world. Humans develop these skills through engagement with compelling problems.
>
> Our students arrive with real-life problem solving skills. The curriculum should begin with and build on this *capacity*.
>
> Working collaboratively among ourselves, with students and with the community, we have the *capacity* to transform and to improve our classrooms, our curriculum and ourselves.
>
> As both *practitioners* and as *students* of teaching and learning, we must not ignore the effects *affective* factors have on both effective teaching and effective learning.

It was in this fertile ground that, when the idea of acceleration made its way into our consciousness, instructors who had participated in faculty course cohorts were motivated by the nature of the problem and trusted their capacity to respond creatively.

Response 1.x

Basic Accelerated Math (BAM) for Career & Technical Education (CTE), Algebra for General Education (AGE), and the Scholarship of Teaching and Learning

This is only the first iteration of our program redesign.

Over time, we hope to be able to modify IASTATS so that it becomes Algebra for General Education (AGE), an appropriate prerequisite course for all transfer-level mathematics courses that do not lead to calculus.

We are already beginning to design a CTE version of BAM, where the online component would be CTE-area specific and the lecture portions shared with other BAM sections.

Transforming a curriculum also means finding a way to scale up the program to serve the large population of developmental students. This spring, we are having fulltime faculty and adjuncts shadow both BAM and IASTATS, in order to grow the pool of instructors ready to take on the accelerated curriculum. In the fall, an adjunct instructor will teach one section of IASTATS. In the spring, adjuncts will teach two sections of BAM. We are leveraging our HSI – Graduation Initiative to continue supporting adjunct participation in our program redesign.

Transforming a curriculum is more likely to be sustainable and successful if it is based on experience and evidence. This takes time and hard work, and it takes systematic research. It is our hope that, as we transform our developmental mathematics program, we will create a tradition and expectation for ongoing research into whether, what, how and why our students learn.