Part I

Dramatic Success for Students in Developmental Mathematics

First Year Results from Carnegie’s Pathways Programs
The Problem

• Nationally, two-thirds of incoming community college students must take at least one developmental math course before they can enroll in college-credit courses.
• Up to 80 percent of these students never get out.
• As a consequence, millions of people each year are not able to progress toward their career and life goals.

We cannot continue using the same approach and expect different results.
A New Way: Coherent, Intensive, Accelerated Learning

Statway
Quantway

Elem. Algebra
Int. Algebra
College Math

Semester 1
Semester 2
Semester 3 or more

College Math Credit
College Math Credit

What Colleges Traditionally Have Done
Who Are Our Pathways Students?

**College Readiness: Math**
- 75% 2 Levels and Below
- 3% College Ready

**College Readiness: Reading**
- 45% Not College Ready
- 55% College Ready
Who Are Our Pathways Students?

**Race / Ethnicity**
- 29% African American
- 27% Hispanic
- 44% Caucasian/Others

**Home Language**
- 64% English
- 36% Home Language Not Primarily English
## Time to Complete College Level Math Course: Statway vs. Traditional Sequence

<table>
<thead>
<tr>
<th></th>
<th>1 Year</th>
<th>2 Years</th>
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<tr>
<td>Traditional Sequence</td>
<td>6%</td>
<td>15%</td>
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<tr>
<td>Statway</td>
<td>51%</td>
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Triple the success rate in half the time.
It starts with…

Professional organizations established learning goals

Critical Thinking

Math that Matters

Benchmarking performance against college and university courses

Lessons, Assessments, Online

Learning Goals, Curriculum, and Pedagogy
Three Essential Supports

A Focus on Continuous Improvement

Language & Literacy

Productive Persistence

Advancing Quality Teaching

Learning Goals, Curriculum, and Pedagogy

Rapid Analytics

Networked Improvement Community

Teaching, Learning, Goals, Curriculum, and Pedagogy
New Roles for Faculty
“Teaching is a lonely job, and it is really great to have others watch and experience what is going on in my classroom to help inform all of us on how to improve our methods to have better student engagement.”

- Julie Phelps, Valencia Community College
“I thought I was a pretty good teacher, but being involved in lesson study forced me to ask the harder questions about how what I did in class impacted student learning.”

- Michelle Brock, American River College
“It’s very refreshing to be not only grasping it, but actually interested in math.... It’s nice to wake up and be excited for my first class of the day.”
“It gave me hope at the beginning of this quarter. And so now it’s kind of like ‘I can [do this]’ but I’m also doing something that I think is very useful. …The stereotypes [that minorities and females can’t do math] aren’t true!”
“This class has helped me in my other classes. This has...exercised my mind enough for me to become a better writer, believe it or not.”
Part II

How do we do it:
Curriculum and Pedagogy
Curriculum and Pedagogy

- Ambitious learning outcomes
- Authentic contexts
- Use of technology
- Communication
- Learning opportunities
  - productive struggle
  - explicit connections
  - deliberate practice
Productive Struggle

Can a person’s birthday determine his or her personality traits, like being kind or jealous?

<table>
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<tr>
<th>Dates of Zodiac Sign</th>
<th>Choice 1</th>
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<th>Choice 2</th>
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<td>3/21 to 4/20</td>
<td>Adventurous</td>
<td></td>
<td>Adaptable</td>
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<td>Optimistic</td>
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<tr>
<td></td>
<td>Energetic</td>
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<td>Versatile</td>
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<td>optimistic</td>
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<td></td>
<td>Pioneering</td>
<td></td>
<td>Communicative</td>
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<td>Careless</td>
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<td>Courageous</td>
<td></td>
<td>Witty</td>
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<td>Irresponsible</td>
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<td>Enthusiastic</td>
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<td>Intellectual</td>
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<td>Superficial</td>
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<td></td>
<td>Confident</td>
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<td>Eloquent</td>
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<td>Happy</td>
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<td></td>
<td>Dynamic</td>
<td></td>
<td>Youthful</td>
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<td>Honest</td>
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<td></td>
<td>Quick-witted</td>
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<td>Lively</td>
<td></td>
<td>Good-humored</td>
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<td>Nervous</td>
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<td>Optimistic</td>
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<td></td>
<td>Quick-tempered</td>
<td></td>
<td>Tense</td>
<td></td>
<td>Freedom-loving</td>
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<tr>
<td></td>
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<td>Superficial</td>
<td></td>
<td>Jovial</td>
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<td></td>
<td>Impatient</td>
<td></td>
<td>Inconsistent</td>
<td></td>
<td>Good-humored</td>
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<tr>
<td></td>
<td>Foolhardy</td>
<td></td>
<td>Cunning</td>
<td></td>
<td>Honest</td>
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<td>Daredevil</td>
<td></td>
<td>Inquisitive</td>
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<td>Straightforward</td>
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<td>4/21 to 5/21</td>
<td>Modest</td>
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<td>Jealous</td>
<td></td>
<td>Adventurous</td>
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<td>Shy</td>
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<td>Possessive</td>
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<td>Energetic</td>
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<td>Inflexible</td>
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<td>Enthusiastic</td>
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<td>Self-indulgent</td>
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<td>Confident</td>
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<td>Greedy</td>
<td></td>
<td>Dynamic</td>
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<td>Analytical</td>
<td></td>
<td>Security-loving</td>
<td></td>
<td>Quick-witted</td>
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</table>
Authentic Contexts

Algebraic Evaluation
Evaluate:
3x - 5 when x = 4

Quantway™ Evaluation
The formula for the braking distance of a car is

$$d = \frac{V_0^2}{2g(f + G)}$$

1. Let \( f = 0.8 \) and \( G = 0.05 \). Write a simplified form of the formula using these values for the two variables.
2. How can you verify your predictions about the relationship between velocity and braking distance?
Curriculum

- Online component
- Instructor & student in class lesson materials
- Homework
- Assessments
- Online faculty resource site
Course components

- Online component
- Instructor & student in-class lessons
- Homework
- Online faculty resource site
- Assessments

Quantway™ Summative Assessment

1. If you have 30 students in your math class and 1/6 of them were out sick with the flu on the same class day, there are numerous ways to calculate how many students were left in class that day. Which of the following choices is a correct method?

   a. $30 - \frac{1}{6} \times 30$
   b. $(30 + 6) \times 5$
   c. $5 \times 30 + 6$
   d. $\frac{5}{30} \times 30$

   - $\times 30$

Statway™ Module 2 ASSESSMENT ITEMS version 2.0

Part 1: Multiple-Choice Items

Remember to UNBOLD the answer before you copy and paste it to any assessment. In most cases, the broad course outcome is followed finer grained measureable outcomes in blue.

2.1.10 Given a univariate data set, select an appropriate graphical display for summarizing the data based on the type of data and the purpose of the analysis.

1. Josephine is a baseball fan who likes to keep track of statistics for the local high school baseball team. One of the statistics she recorded is Batting Average. A player’s batting average is the proportion of hits obtained by the player based on the number of times at bat as shown in the table below.

<table>
<thead>
<tr>
<th>Player</th>
<th>Proportion of hits</th>
<th>Player</th>
<th>Proportion of hits</th>
<th>Player</th>
<th>Proportion of hits</th>
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</thead>
<tbody>
<tr>
<td>BH</td>
<td>0.305</td>
<td>SU</td>
<td>0.270</td>
<td>BC</td>
<td>0.301</td>
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<td>HA</td>
<td>0.229</td>
<td>DH</td>
<td>0.136</td>
<td>AA</td>
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<td>JS</td>
<td>0.281</td>
<td>TO</td>
<td>0.218</td>
<td>HK</td>
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<td>TC</td>
<td>0.097</td>
<td>RL</td>
<td>0.267</td>
<td>RS</td>
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<td>0.167</td>
<td>JB</td>
<td>0.270</td>
<td>CR</td>
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<td>GV</td>
<td>0.333</td>
<td>WG</td>
<td>0.054</td>
<td>MD</td>
<td>0.125</td>
</tr>
<tr>
<td>RC</td>
<td>0.085</td>
<td>MH</td>
<td>0.108</td>
<td></td>
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</tbody>
</table>

Using this data, we want to create a graphical display that allows Josephine to describe the shape, center, and spread of the proportion of hits. Choose the graph that will help Josephine give the best description of center, shape, and spread.
Learning Opportunities
Stigler, Givvin UCLA

Primary Drivers:

Statistics and Mathematics Proficiency: Flexible and stable knowledge of concepts, procedures, strategies; and productive disposition

- Struggle with important mathematics/statistics
- Explicit connections to mathematical/statistical concepts
- Deliberate practice applying concepts/procedures to solving problems

Secondary Drivers: How do these teachers use these instructional resources to create learning opportunities for these students

- Students engage productively with learning opportunities:
  - Believe they are capable of learning math, gradually over time
  - See math as something that makes sense, that one can “figure out”
  - Willing to invest persistent effort

- Teachers effectively implement curriculum with students to create learning opportunities:
  - Belief that these students are capable of learning math and statistics
  - See math as something that makes sense, that one can “figure out”
  - Skills and knowledge to implement instructional system: engage students in problems; make concepts explicit in ways students can understand; provide emotional support

- Instructional resources that afford creation of learning opportunities:
  - Relevant to students interests
  - Statistics (as distinct from math, to allay anxiety)
  - Focus on understanding/thinking with concepts
  - Clear learning goals (concepts & skills) aligned with formative and summative assessments
  - Lesson structure: struggle, then instruction
  - Conceptual flows to structure instruction
Productive Persistence
Tenacity + Good Strategies

Practical Theory
• Centered on a problem of practice
• Co-developed with practitioners and students
• Tested with academic experts

Practical Measures
• Brief and practical
• Face-valid for practitioners
• Recognizable to researchers
• Designed to inform improvements
• “Can’t improve what you can’t measure”

Improviable “Starter Package”
• Initial set of activities
• Systems for collecting data
• Strategies for improvement
• Field tests that inform practice and theories
Student Background & Follow-Up

Fixed Mindset About Math (1 item)
ES = .38*

Interest / Relevance (3 items)
ES = .28*

Anxiety (3 items)
ES = .17*

Stereotype Threat (1 item)
ES = .10*

ES = Effect size in SD units

First Day of Class
3+ Weeks Later

* P < .001
Questions

Understanding: Overall, how well did you understand the material from the last class you attended?
Language: Overall, how difficult was it to read and understand the language in the assignments in this lesson?
Interest: How interesting was the lesson material and problems you worked on?
Relevance: How relevant to your goals or interests were the assignments you worked on in this lesson?
Feeling: Overall, how do you feel about the Statway course RIGHT NOW?
Networked Improvement Community

- Changed role for faculty
- A community tackling on a high leverage problem – dev math
- Combining the worlds of research and practice
- Focused on continuous improvement
I praise the fact that someone finally had enough sense to realize that a great deal of students have been kept from furthering their education due to this overpowering wall, and now there is hope for alot of us, not only to pursue higher education but to learn something that would really apply to our everyday life.

“I feel that if one person put in the work to really understand the concepts they can pass. I was never a "math person" but coming into Statway has completely made a 360 degree turn about how i feel about math. It is great!”

“I panic alot when I hear anything to do with testing”

Course relevance

Math and test anxiety

A growth mindset
What Students are Saying

“It really makes you think critically for math instead of just getting answers.”

“This class was really interesting and even though I hate math, I started to like it.”

“This course actually relates to the real world and made math more easy.”

“…less calculation, fewer formulas, greater thinking….It will help you in everyday life.”
Part III

Course materials: What do the teachers and students use?