

Project Information

Underlying Assumptions

- Underprepared students need more time, but more time only is not enough.
- A rigorous and well-designed algebra curriculum is essential but insufficient.
- The program must influence students' beliefs about themselves as effective mathematics learners and their attitudes about mathematics, as well as their teachers' beliefs about the mathematical capabilities of underprepared students.
- This involves strategically incorporating instruction that historically resides outside of the domain of typical algebra classes but is fundamentally important to struggling students' success.

Need and Overarching Design Principles

- Need was identified by leaders in Urban Mathematics Leadership Network (UMLN) districts
- Targeting two populations
 - Underprepared algebra students
 - Teachers of underprepared algebra students
- Designing for use in double-period high school Algebra I courses.
- Designing for use at scale in urban districts and elsewhere

Key Design Features

- Algebra core
- Efficient review/repair strategies
- Ongoing, distributed practice
- Incorporation of social-psychological learning interventions
- Supports for enactments of high cognitive demand tasks
- Tools that help students organize information and support metacognitive awareness
- Enhanced formative assessment strategies
- Explicit supports for literacy and language development

Project Goals

Goal 1: Iteratively design and test student and teacher materials for a full-year, 9th-grade, double-period algebra program that integrates effective approaches for teaching algebra with instructional features that, independently, have proven to be effective with struggling learners.

Goal 2: Develop and test materials and strategies that enable teachers to effectively implement the comprehensive *Intensified Algebra I* program and that help promote collaboration within and across schools among teachers of the course. A particular target will be novice or inexperienced teachers, who disproportionately teach the double-period classes.

Goal 3: Develop and test structures and tools that promote the program's scalability in large, urban districts and elsewhere. The project will investigate the feasibility and effectiveness of leveraging technology to organize and deliver at scale consistent, high-quality supports for program implementation.

Development Timeline

Preliminary Work (2007-2009)

UMLN leaders established a Design Team of 25 leading researchers, developers, and practitioners who studied existing research and interventions and developed a program model that drew from promising practices and relevant research. That work informed the development and testing of three prototype units.

Year 1 (2009-2010)

Complete Version 1.0 of *Intensified Algebra I*—student and teacher materials for a full year of instruction, organized into 10 units (30 topics). Field test Version 1.0 with 35 teacher/co-developers and 1,400 students in two UMLN districts, Chicago and Austin.

Year 2 (2010-2011)

Conduct field test of *Intensified Algebra I* (Version 2.0) with about 150 teachers and 5,500 students in 4-6 UMLN districts.

Year 3 (2011-2012)

The third year will focus on preparing for large-scale program dissemination. Conduct field test of Version 3.0 with about 250 teachers and 10,000 students in 6-9 UMLN districts.

An Architecture of Intensification

Building a Comprehensive Program for Struggling Students in Double-Period Algebra Classes

Learning Sciences Research Institute
University of Illinois at Chicago

A. Castro Superfine, M. Gartzman, S. Goldman, J. Lynn, J. Pellegrino, D. Briars

Charles A. Dana Center
The University of Texas at Austin

K. Cook, S. Hull, C. Schneider, U. Treisman

Agile Mind, Inc.
L. Chaput

Algebra Core
Agile Mind Online Service

efficient review/
repair strategies

ACTIVITY 2.2. Match It: tables, graphs, equations

On Day 1 you explored multiple representations. You saw that the relationship between the number of bicycles and number of wheels on the bicycles can be represented in different ways:

- In words
- In a picture or diagram
- In a table
- In a graph
- In an algebraic rule (equation)

Moving from one representation to another is an important skill for solving algebra problems. This activity focuses on three representations: tables, graphs, and algebraic rules.

Objective: Create sets of "matching" table, graph, and equation cards. "Matching" is defined as different representations of the same relationship. Each set will have a table card, a graph card, and an equation card.

Materials: Your teacher will give you and your partner pages with cards on them to cut out. There are 10 table cards, 10 graph cards, and 10 equation cards.

Instructions: Take turns with your partner matching a table to a graph and an equation. When you find a match, explain to your partner how you know that the cards match. Your partner should either agree with your explanation, or question it if it is not correct or clear.

When you both agree on a set of matching cards, tape together the cards that form the set. So that you can more easily check your answers, tape each set with the table card on the left, the graph card in the middle, and the equation card on the right as shown here.

Table Card	Graph Card	Equation Card

When you have matched all the cards, answer questions 1-3. Discuss each question with your partner, then write the answer you agree on in the space provided.

- What strategy did you use to match tables, graphs and equations?
- Was there a particular representation that was easiest to use as your starting point? If so, which representation was it and what made it an easier starting point?
- Sort your "matched sets" into groups that are similar. You should create at least two groups, but less than five groups. List your groups below, then answer the questions in parts a-c:
 - What criteria did you use to sort your sets into groups?
 - What is the same about the sets in each group? Consider all three representations: graphs, tables, and equations.
 - How do the groups differ from each other? Again, consider all three representations: graphs, tables, and equations.

ongoing,
distributed practice

Staying Sharp 9

Use the graph shown for questions 1-2.

Manuel surveyed 50 students at his school to find each student's favorite professional sport.

- What is the total number of students whose favorite sport was football or basketball?

Answer with supporting work:

Answer with supporting work:

- Does the graph represent a function?
- Write the following expression without parentheses. Simplify the expression completely.

Answer with supporting explanation:

$3(2x + 4) - 2x$

5. Data are collected for ten different brands of light bulbs. The data are then plotted. Which statement best describes the trend for lifetime in the data.

- The trend is increasing (the higher the price, the longer the light bulb tends to last); the trend is approximately linear.
- The trend is increasing (the higher the price, the longer the light bulb tends to last); the trend is non-linear.
- There is no real pattern to the data.

social psychological
learning interventions

John, on the other hand, knows that with hard work and effort he can get smarter in math.

Taking a deep breath will help me to relax when I see something difficult.

I can do this if I really focus.

If I don't do well on this test, I can do better next time.

It doesn't matter how anyone else is doing; I just need to focus on my own work.

Because of his mindset, John is not distracted by his anxiety during the test. He thinks about what he can do to meet the challenge... Focusing on these strategies helps John reduce his anxiety.

teacher supports

Move the skateboarder and create a graph that matches the graph on the screen. Pay attention to each segment of the graph.

Distance from motion detector in feet

Time in seconds

Elapsed time: 10 seconds

Move the skateboarder to his starting position.

The big idea: Asking students to think about what the rate will be or what the graph will look like before revealing it to them makes them really think and reason through the situation. The motion detector animation will be fun for them, but you need to make sure that they are getting the "meat" out of the activity and not just moving the character back and forth. The questions suggested for debriefing each activity are designed to help you do this.

Language note: Good language is required to answer the questions in this activity. You can use these students' descriptions of how you should move the skateboarder to strengthen the ability of English language learners (ELL) and other students to communicate using appropriate mathematical language. Repeat ELLs' answers in correct English before carrying out their plans.

tools that help students
organize information and
support metacognitive awareness

Homework Processing Routine

With Your Partner

Review the homework and discuss:

- Compare your answers.
- Did you both get the same answer?
- If not, think things through—which solution is correct?
- Compare how you solved the problem.
- Did you both use the same approach?
- If you used different approaches, look at the other person's approach. How is it similar to yours? How is it different?
- Discuss how you would explain this problem if you are asked to do so.

By Yourself

- Mark a "spotlight" indicator at the top of the homework assignment:
- Green = I understand all of the ideas in the homework.
- Yellow = I understand some/most of the ideas.
- Red = I don't understand most of the ideas in the homework.
- Correct problems that you got wrong.
- Make sure you understand why you got it wrong.
- Don't write down a correction if you don't understand why the answer is correct.
- Use a RED PEN to MAKE YOUR CORRECTIONS.

Finish

- Place your corrected homework assignment in your two-pocket folder. Be sure to place it on the R side.
- Remove any assignments on the LEFT side of the folder and place it in your notebook. Your teacher has looked at these assignments to monitor your understanding and has checked them in.
- Be ready to participate in a brief whole-class discussion of the homework assignment and/or to place a solution on a white board if you are asked to do so.

explicit supports for literacy
and language development

5.3 Math Journals

The table below is an example of a tool that we will call a "triple column journal." This tool will be used in the course to help you organize information about important math vocabulary and concepts. Complete the journal. While you are encouraged to look back in your booklet and notes, be sure to state ideas in your own words and to provide your own examples.

Vocabulary term	My understanding of what the term means	An example that shows the meaning of the term
a. Sequence		
b. Term		

Research Plan

The design-based research involves two levels of field test sites: a small group of six intensive research classrooms and a broader group of implementing classrooms. We will use the intensive research classrooms to engage in a descriptive study of teachers' enactment of units, and of students' academic, social, and emotional learning outcomes through the use of interviews, classroom observations, and assessments. We will use the broader group of implementing classrooms to validate the emergent trends from our intensive classroom studies and to gather data via web-based surveys about specific program implementation issues. Participants from the broader group of classrooms will also serve as a base for the Year 3 research regarding the enactment of the *Intensified Algebra* program in multiple districts. Involving more classrooms in the research/ development process helps solidify an initial constituency for program dissemination once it is completed.

Research Questions

Year 1 (2009-2010)

- Are the lesson elements manageable by teachers and students?
- Do the lessons have the intended outcomes with respect to mathematics content learning, development of strategic/metacognitive skills, and attitudes and motivation toward mathematics, with particular attention to the effects of these elements on the performance of special needs students?
- What supports do teachers need for skillful enactment?

Year 2 (2010-2011)

The research focus in the intensive research sites and the broader group of implementers parallels Year 1 except that it shifts to trends and outcomes exhibited by teachers and students over the extended timeframe of the whole academic year.

In the intensive research classrooms:

- What is the nature of students' understanding of core algebraic concepts and skills as demonstrated across the year, including changes evidenced by pretest to posttest comparisons on various assessment instruments?
- How do students' beliefs and attitudes about mathematics and themselves as learners change throughout the school year? How are teacher beliefs affected?

What are the core issues that arise in implementing the program design? What tools do teachers find useful for promoting student understanding and identity as learners of algebra? For what aspects of their work do *Intensified Algebra I* teachers need additional resources and supports?

How much of the curriculum can be covered and taught well? What is essential and what might be dropped?

What are the challenges of implementation and synthesis of program components?

What are the differences among our six teacher cases in terms of their instructional planning and enactments and how are these differences related to familiarity/experience with the program?

How does the youth-development instruction affect students across the entire year?

Year 3 (2011-2012)

Is there evidence supporting the efficacy of design changes and the efficacy of the program for particular teachers and students?

What kinds of teacher support issues arise when the program is enacted outside the immediate oversight of the program's developers?

We also will significantly expand our efforts to use the web-based teacher and student measures piloted in Year 2 in the broader sample of implementation sites. The goal of this data collection effort is to establish a database of sufficient size and scope to begin to examine possible relationships among student outcomes, teacher implementation issues, teacher and student demographics, and particular district features.

Finally, Year 3 will include a small-scale efficacy study, comparing performance on end-of-algebra assessments of *Intensified Algebra* classrooms to those in a "typical" double-period Algebra I course. Previous year's performance on the district's end-of-year assessments will be used as a covariate.