Research Based Interventions for Underprepared Algebra Students

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About the Dana Center

Equity — Access — Excellence
Dana Center by the Numbers

200,000 students
32 states

Nearly 200,000 students in 32 states were served by Dana Center–Agile Mind courses, recognized for their quality by multiple review panels including EdReports.org, Louisiana Department of Education, and Texas Education Agency panels.

Agenda

• What is the problem?
• A possible solution: Intensification
  o Components
  o Research based elements
• Classroom examples
• Closing
Challenges

1. Half of students fail Algebra the first time they take it.
2. Students’ beliefs and motivation impact their success.
3. Math failure impacts students’ success in high school, their chance for college without remedial courses, and their lifelong earnings.

We need a new approach: Intensification

Intensification is a systemic effort to address the contextual needs of students in learning on-level content. Intensification may mean:

- Increasing the amount of time with content
- Using a variety of pedagogical supports
- Developing students’ sense of socio-motivational well-being around the content.

Intensification does not mean delaying rich mathematical experiences until students acquire “the basics.”
An Architecture for Intensification

Struggling students need

- More time
- Challenging curriculum
- Targeted Interventions

An Architecture for Intensification

Support
- Support
- Support
- Rigorous algebra core
What Research Tells Us

- Promoting learners’ beliefs about their own intelligence can increase their motivation and effort to learn mathematics (Dweck, Goode, Midgely, Aronson).
- Engaging students with challenging tasks that involve active meaning making increases learning (Horizon Research, Hiebert & Grouws).
- Accessing prior knowledge and addressing students’ misconceptions increases learning (Swan & Bell, Burkhardt, Shell Centre).
- Routines and structures help struggling students organize critical mathematical content and increases their learning (Deshler & Lenz).
- On-going, cumulative distributed practice improves learning and retention (Rohrer, Mayfield).
- Formative assessment is a key intervention for improving student achievement (Black and William, Hiebert & Stigler).

Intensified Algebra: An Integrated, Cohesive Design

- Supports for teachers
- Rigorous algebra core
- Efficient review and repair
- Assessment strategies
- Literacy & language supports
- Shaping attitudes toward learning
- Tools to organize learning

agile Mind
Key Concepts from Psychology and the Learning Sciences

- Learning Mindsets (self belief)
- Effective effort
- Culture of learning (belonging to a community of learners)

Three Learning Mindsets

CAPABILITY

BELONGING

PURPOSE
Our Approach

Psychological & neuroscience research

Challenging academic work

Learning & problem-solving strategies

Classroom culture and climate

Intensified Algebra: An Integrated, Cohesive Design

Supports for teachers

Shaping attitudes toward learning

Tools to organize learning

Rigorous algebra core

Literacy & language supports

Assessment strategies

Ongoing distributed practice

Efficient review and repair
Rigorous Algebra Core through Rich Tasks

“Not all tasks are created equal, and different tasks will provoke different levels and kinds of student thinking.”


“The level and kind of thinking in which students engage determines what they will learn.”


Task Implementation and Cognitive Demand

The mathematical tasks framework

Intensification Strategy: Targeting Misconceptions

A study by Alan Bell and Malcolm Swan found that students whose teachers addressed and corrected misconceptions, rather than simply using remedial measures, achieved and maintained higher long-term learning results.


See also www.toolkitforchange.org

An Example from Intensified Algebra

The Lost Hiker

A hiker has radioed the police for help. He has broken his leg and is now stranded in the middle of a forest with no food or water. A helicopter rescue team is sent to find the hiker and take him to safety. Unfortunately, because the trees in the forest grow very close together, the helicopter pilot cannot get a visual of the hiker and is forced to call the dispatcher for guidance. The dispatcher has the hiker’s location on a map and must guide the pilot to that location.

From Intensified Algebra I, part of the family of programs in mathematics by the Charles A. Dana Center and Agile Mind, Inc.
Intensified Algebra: An Integrated, Cohesive Design

Intensification Strategy: Distributed Practice

Strong positive effects of spaced practice have been found in a wide variety of contexts. Carlous Caple summarized this body of research as follows:

The *spacing effect is an extremely robust and powerful phenomenon*, and it has been repeatedly shown with many kinds of material. Spacing effects have been demonstrated in free recall, in cued recall of paired associations, in the recall of sentences, and in the recall of text material.... Also the *effect of spaced study can be very long-lasting*.

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