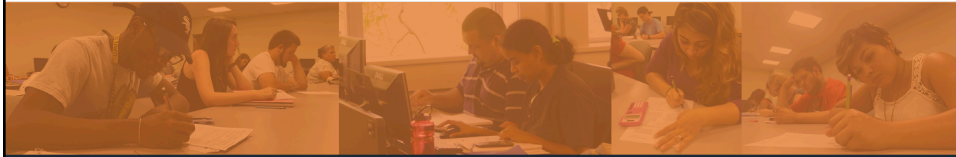




## Research Based Interventions for Underprepared Algebra Students

Kathi Cook, Manager, Online Course Programs

July 11, 2019



## About the Dana Center

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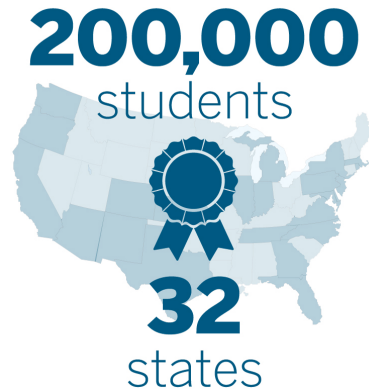
— Equity — Access — Excellence —

2019



## Dana Center by the Numbers

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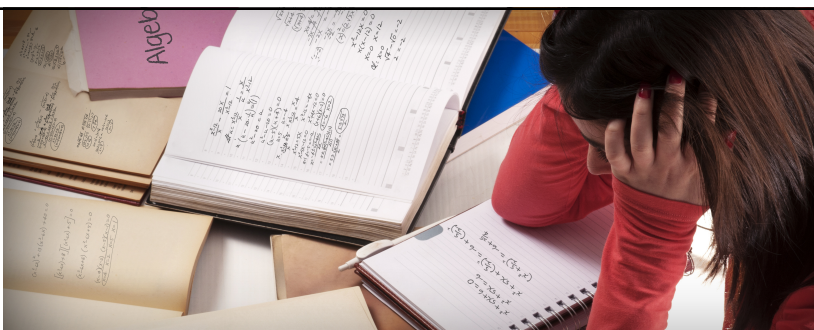


Nearly 200,000 students in 32 states were served by Dana Center–Agile Mind courses, recognized for their quality by multiple review panels including EdReports.org, Louisiana Department of Education, and Texas Education Agency panels.

## Agenda

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- **What is the problem?**
- **A possible solution: Intensification**
  - Components
  - 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

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### Struggling students need



More time



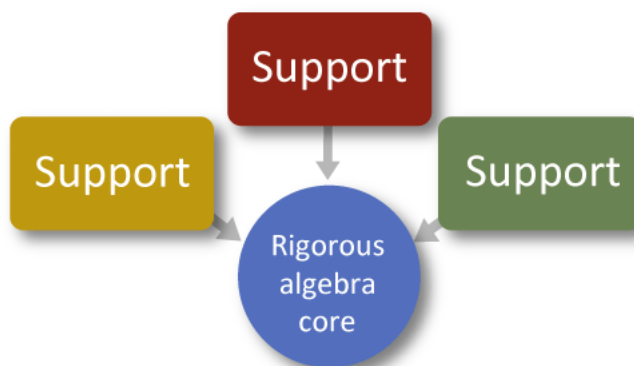
Challenging  
curriculum



Targeted  
Interventions

## An Architecture for Intensification

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## 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



## Key Concepts from Psychology and the Learning Sciences

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

## Three Learning Mindsets

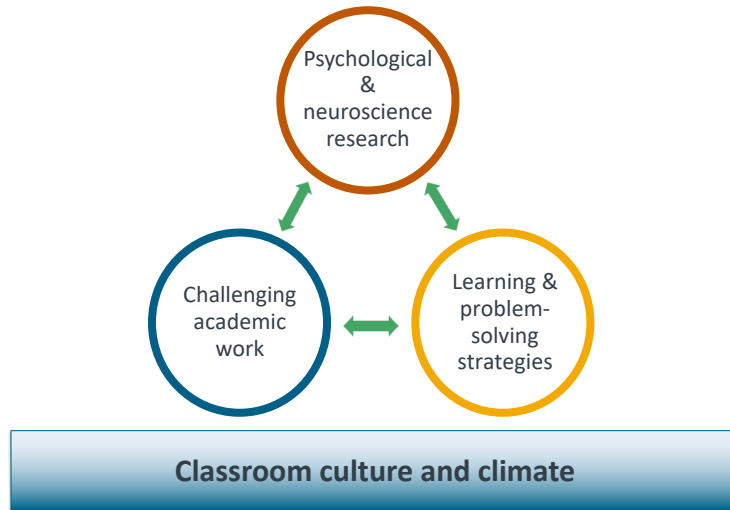
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**CAPABILITY**

**BELONGING**

**PURPOSE**

## Our Approach



## Intensified Algebra: An Integrated, Cohesive Design



## Rigorous Algebra Core through Rich Tasks

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

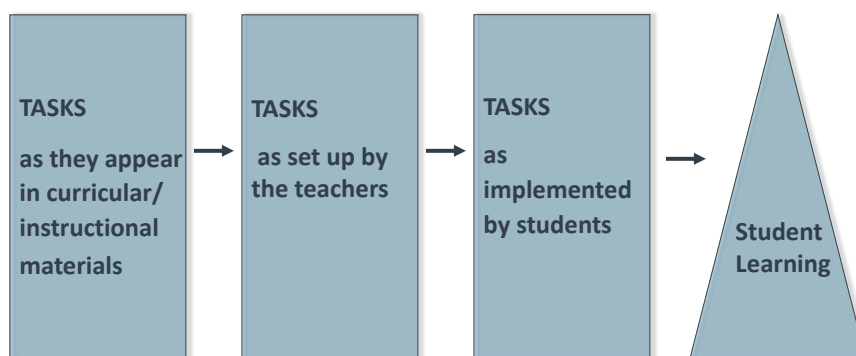
Stein, M .K., Smith, M .S., Henningsen, M. A., & Silver, E. A. (2000). Implementing standards-based mathematics instruction: A casebook for professional development, Teachers College Press, Columbia University, New York.

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

Hiebert, J., Carpenter, T., Fennema, E., Fuson, K., Wearne, D., Murray, H., Oliver, A., and Human, P. (1997) Making sense—teaching and learning mathematics with understanding, Portsmouth, NH: Heinemann.

## Task Implementation and Cognitive Demand

### The mathematical tasks framework



Smith, M .S., Henningsen, M. A., & Silver, E. A. (2000). Implementing standards-based mathematics instruction: A casebook for professional development, Teachers College Press, Columbia University, New York.



## 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.**

Bell, A. & Swan, M. (1993 March). Some experiments in diagnostic teaching. *Educational Studies in Mathematics* 24(1), 115–137.

See also [www.toolkitforchange.org](http://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.**

Caple, C. (1996). *The effects of spaced practice and spaced review on recall and retention using computer assisted instruction*. Ann Arbor, MI: UMI.

## Contact Information

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