THE POWER OF EDUCATION FOR
SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS
AND
FOR JUSTICE AND A BETTER WORLD FOR HUMANITY

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What do we know and how can we reach our goals?
OUR WORLD, OUR FUTURE, AND A BIG QUESTION

- There are 2,600,000,000 people under the age of 18 in our world. 1,900,000,000 are in schools.
- Almost 40% of the world’s population.

How can we teach science, technology, engineering, and mathematics (STEM) so that people stop hating and killing one another?

- Maisha Winn, inspired by Ihab Hassan
PERMUTATIONS, AND PROOF

Find all the ways to arrange the light green, purple, and yellow rods into three-car trains, using exactly one of each rod.

How are you sure you have found ALL the ways?

Prove that you have all the possible ways to arrange the light green, purple, and yellow rods into three-car trains.
PRIOR TO THIS

1) How many different three-digit numbers can you make using the digits 3, 4, and 5, and using each digit only once? Show all the three-digit numbers that you found. How do you know that you found them all?

123  231  . . .

2) In how many orders can you arrange the letters D, F, and J, using each letter exactly once in each combination?

DFJ, DJF . . .
WHAT DO YOU NOTICE?

About:

- the mathematical ideas and ways of reasoning that children are learning and doing?
- the work of teaching?
- teaching STEM in ways that educate children for justice, for a civilized world, and for democracy?
VIDEO: MIAH, DEEDRAH, MICHIO, ARIANNA

When you- I drew the first part, the first colors first- at first, and then I just mixed the bottom next to them. those two...
WHAT DO WE THINK WE WANT?

- Student-centered classrooms
- Balanced curriculum: Content and ways of reasoning and applying knowledge
- Inquiry-based learning
- Motivated students
- Teachers who are capable of understanding the content and supporting students’ learning
- What else?
WHAT HAVE WE LEARNED FROM TRYING TO BUILD STRONG EDUCATION SYSTEMS?

- Curriculum: Clear goals for learning, materials to teach and learn with, resources (e.g., labs, tools)
- Access for groups who are marginalized
- Assessments that provide information for improvement
- Teacher education and support
- ... And coordination of all of these!
WHAT DO WE KNOW ABOUT TEACHER EDUCATION?

- Content knowledge for teaching
- High-leverage teaching practices
- Orientation of teachers’ attention toward the thinking of students
- Teachers’ awareness of their own identity and how that matters for “teaching across difference” and for disrupting racism and other forms of bias
- Clinical training
- Assessment of teaching, not teachers
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THE DIFFERENCE BETWEEN KNOWING MATHEMATICS YOURSELF AND KNOWING IT WELL ENOUGH TO TEACH IT

49
x 25
_____

KNOWING MATHEMATICS WELL ENOUGH TO TEACH IT: ANALYZING STUDENTS’ ERRORS

What mathematical steps produced each of these answers? Why might someone do the problem in this way?

(a) \[ \begin{array}{c}
49 \\
\times 25 \\
\hline
405 \\
108 \\
\hline
1485
\end{array} \]

(b) \[ \begin{array}{c}
49 \\
\times 25 \\
\hline
225 \\
100 \\
\hline
325
\end{array} \]

(c) \[ \begin{array}{c}
49 \\
\times 25 \\
\hline
1250 \\
25 \\
\hline
1275
\end{array} \]
HIGH-LEVERAGE TEACHING PRACTICES

WHY ARE THEY “HIGH-LEVERAGE”?

- Have significant effect for students’ learning
- Are part of teaching every day
- Are not obvious to do well—must be learned by teachers

EXAMPLES

- Eliciting and interpreting students’ thinking
- Explaining content in ways that students understand
- Choosing productive tasks
- Setting up group work
- Building relationships with students
- Establishing norms for classroom talk and interaction
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THANK YOU!
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Slides will be posted on my website
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