Why be concerned with STEM Ed?

Math achievement predicts ...
- pursuit of STEM careers
- school dropout risk, under-/unemployment
- midlife socioeconomic status (Ritchie & Bates, 2013)

Math abilities affect ...
- financial decision making (McCloskey, 2007)
- health decision making (e.g., Reyna & Brainard, 2007)
- daily skills: schedules, routes, budgets...
- leisure activities: sports, cooking, home improvement...

Why be concerned with early STEM?

- Evidence base in math education research & math LD research:
  - early gaps widen with time
  - preventative investment (Rolnick)

Math Academic Standards Over Time
Why be concerned with early STEM?

- Evidence base in math education research:
  - early gaps widen
- Evidence base on early brain development (0 to 5)
  - Early experiences matter

Evidence base supports notion that policies to support early STEM can make a difference ... ... so long as children are “developmentally ready” – are they? YES!


Stimulus: a child encounters two objects (e.g., blocks), which are then taken away. They are presented with a choice between the two individual objects or three objects. The child is then asked which they prefer to get. This is repeated until the child correctly predicts that more objects are better.

Wynn showed that 5 month olds differentiate mathematically possible vs impossible outcomes.


McCrink & Wynn (2004) Large-Number Addition and Subtraction by 9-Month-Old Infants

Psychological Science, 15, 776-781

This study showed that infants differentiate mathematically possible vs impossible outcomes.
Foundations of Early Mathematics

• Intuitive sense of number, space, time, ratio since infancy (is associated with later math)

Question: If human infants have mathematical competencies, why is mathematics “under performance” observed among many kindergarten students?

Activity Part I
Solve quickly:
2 + 7 =
8 + 24 =
27 + 13 =
212 + 93 =

Foundations of Early Mathematics

• Intuitive sense of number, space, time, ratio since infancy (is associated with later math)

• Answer: in part because formal mathematics introduces symbols (words, digits, etc.) associated with number / space etc. These must be learned, not merely “presented.”
Activity Part II
Solve quickly:

XXIV + VIII =

XVI + XXIV =

XCIII + CCXII =

VII + II =

Part III: Reflect on differences between Parts I and II

XXIV + VIII = XXXII
24 + 8 = 32

XVI + XXIV = XL
16 + 24 = 40

XCIII + CCXII = CCCV
93 + 212 = 305

VII + II = IX
7 + 2 = 9

Foundations of Early Mathematics

- Intuitive sense of number, space, time, ratio since infancy (is associated with later math)
- Formal (learned) mathematics emerges early via symbols (words, digits, etc.)
- Math talk provides opportunities to talk about, think about, and learn math principles
Preschool Teachers’ Math Talk
Researchers evaluated 140 4-year-olds in 26 preschool classrooms
Recorded preschool teachers’ and measured “math talk”

Findings:
• 4 years olds’ number knowledge varies greatly
• Preschool teachers’ amount of math talk varies greatly
• Teacher math talk predicts gains in number knowledge during preschool year

There’s lots to talk about! Counting, cardinality, equivalence & non-equivalence, shape names & attributes, number symbols, order, calculation, measurement, … (by parents, too!)

Klibanoff, Levine, Huttonlocker, Vasilyeva, & Hedges 2006 Dev Psych

Take home messages
Mathematical thinking is supported by an intuitive sense of number, ratio, space, time, and by connections between intuition, symbols, and concepts.

These connections require input and opportunities to build math vocabulary and ideas via teacher or parent math talk, and free or structured activities (including play).

Children deserve the chance to learn that math is fun, and that they can achieve mathematical success.

Some Possible Policy Focal Areas
• Educate early childhood education workforce:
  – More and better pre-service training for ECE
  – Higher Ed: capacity for trained teacher educators
  – (Include paraprofessional in in-service training)
• Resources for ECE workforce
• Educate / resources for families and family support professionals
• Coherence from preK – Grade 3 instruction
Early STEM:
Thank you!

*Early Learning Fellows Meeting*

*Minneapolis, MN  August 27, 2018*

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