Shape Up! Spatial (and Math) Skills Matter for Florida's Future

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When was the last time...

- You read a map?
- Had trouble fitting things into the trunk of your car?
Or...

Told a waiter in a restaurant to divide your check into fifths?

Asked your children to divide the remaining pie into thirds?
All examples of spatial and mathematical knowledge

- Where did this knowledge come from?

Are young children being encouraged to do puzzles and play with blocks?

- Kindergarten: NCLB and ESSA pushing high stakes tests and didactic instruction

- When do kids get to muck around with spatial toys?

Why should we care?
Importance of STEM knowledge

Of the 30 fastest growing occupations through 2016, 16 will require substantial mathematics or science preparation.

@NMSI
“Having reviewed trends in the US and abroad, the committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength (p. 3)”

And
”Alarmingly, about 1/3 of 4th graders and 1/5 of 8th graders lacked the competence to perform even basic mathematical computations (P. 15).”
Why is it okay to say...

- “I’m terrible at math”
- “I’m terrible at spatial skills”
- Would you EVER say, “I’m terrible at reading? NO!

We need to change the math
Where does STEM interest start?

Preschool! We can’t we afford to wait.
Spatial and geometric knowledge are key components to success in STEM subjects:

- Science
- Technology
- Engineering
- Mathematics

(Newcombe, 2010; Wolgang et al., 2001)

“Indeed, the connection between space and math may be one of the most robust and well-established findings in cognitive psychology” Our work extended this down to age 3! (Mix & Cheng, 2012).
Why is developing early strong spatial skills important?

- Children’s appreciation of the composition and decomposition of forms like squares and triangles related to understanding of fractions
- Children’s knowledge of space related to number line → appreciation of magnitude
- Measurement - ruler is a number line! Children need spatial skills to understand math!
To understand origins of spatial and number knowledge - 3-year longitudinal study

- Year 1: Children were 3; n= 100
  - Half middle class; half lower class (Head Start)
  - Balanced gender
- Year 2: Children were 4; n= 82
- Year 3: Children were 5; n= 60
Introducing the TOSA
Tests of Spatial Assembly: 2-D and 3-D

2-D TOSA items

3-D TOSA items
Assessments: Age 3, 4, and 5

- Language
- Spatial skills
- Early Mathematics
- Executive Function
Could children duplicate the designs? Did children perform similarly by SES?

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What does it take to get kids off to a good spatial and mathematical start?

Children learn best through *playful learning* …

- Puzzles
- Shape sorters
- Cutting
- Tangrams
- Blocks
- Coloring

Any empirical evidence to support this assertion?
• Guided play with blocks increases parental and child spatial language (words like over, under, big) (Ferrara, Hirsh-Pasek, Newcombe, & Golinkoff, 2011)

• Puzzle play between 2-4 years predicted performance on spatial transformation task at 4.5 (Levine, Ratliff, Huttenlocher, Cannon, 2011)

• Experience with spatial toys (Legos, Wikki Stix, etc.) improved math and spatial skills in K and 1st grade (Grissmer et al., 2013)

• Block play correlates with math skill (Casey et al., 2008; Verdine 2016)
What promotes learning of spatial and mathematical concepts?

- PRESCHOOL EXPERIENCES!

- Don’t just tell ‘em, ask ‘em to think! – Guided play wins over direct instruction! (Fisher et al.)

- Encourage teachers and parents to ask open-ended, playful questions to guide children’s learning – Guided play works!

- Guided play turns on the “flashlight” subtly telling children what they should focus on
Researchers in America are ready to tear their hair out!

- Our practices fly in the face of these data!
- Children need early and varied exposure to spatial materials to grow their mathematical and spatial concepts (Verdine, Golinkoff, Hirsh-Pasek, & Newcombe, 2014) – only 29% in preschool!
- Kindergarten: schools are taking away the block corner! Taking away cutting and coloring and construction of geom forms in favor of “drill and kill” and number facts
The Economic Argument for Quality Early Education

For every dollar spent on quality early childhood education, society saves a minimum of $7 and a maximum of $17 on each person.

On productivity grounds alone, it ... makes sound business sense to invest in young children from disadvantaged environments... Enriched pre-kindergarten programs... coupled with home visitation programs, have a strong track record of promoting achievement..., improving labor market outcomes, and reducing involvement with crime.

QUALITY PRESCHOOL

- Invites children to engage in spatial and number activities they might not get to do at home
- For US: Building our future work force!
- Preschool matters! Preschool learning sticks!
- Florida needs to prepare its children for a prosperous future and our country for further growth and innovation!
Thanks go to...

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- Nora Newcombe, co-author on papers
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- **New IES grant to study training of spatial skills**