

# A Study of the Impact of an Early Childhood Intervention on STEM Learning

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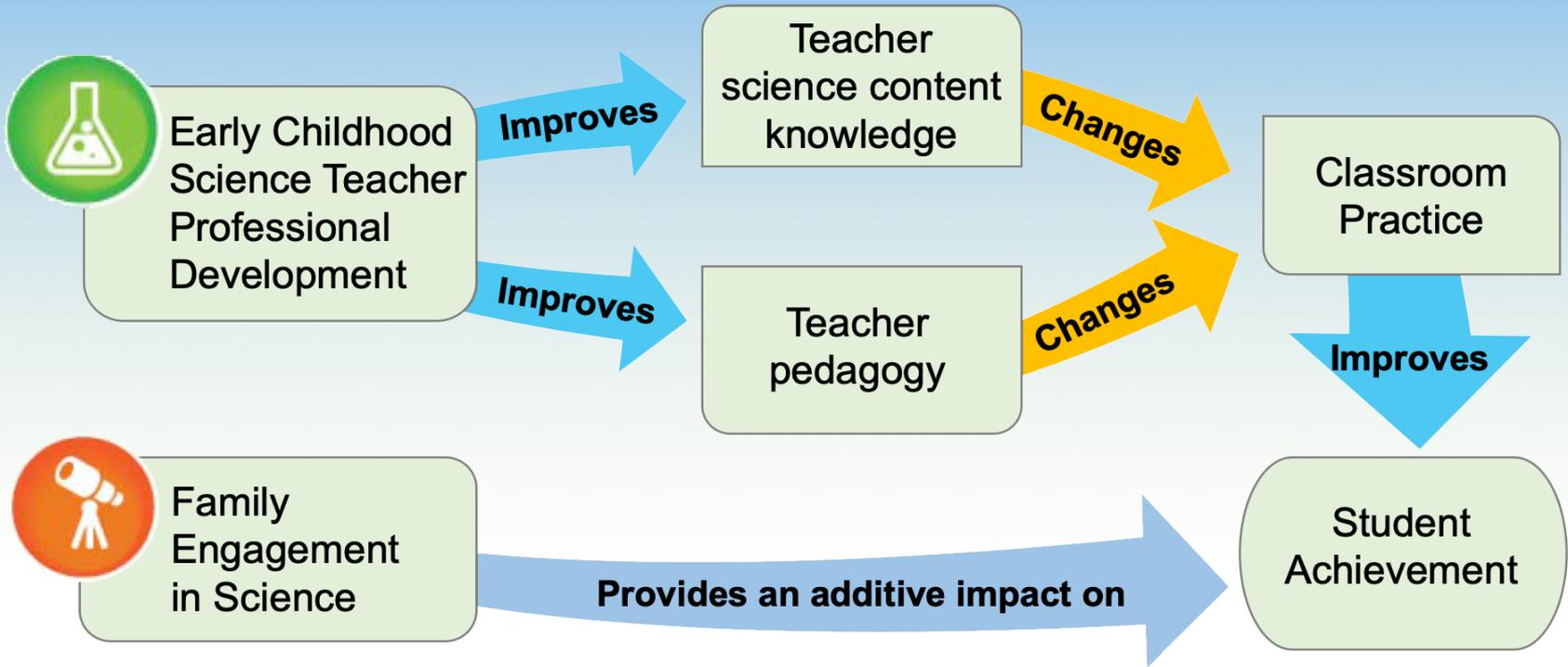


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# NURTURES Program



# Theory of Action



# NURTURES Program

## NURTURES Phase I: 2011-2017

- Notable research findings:
  - Improved student achievement in math, early literacy, reading
  - Longitudinal effects in math, reading, and science

## NURTURES Phase II: 2017-2020

- Research Aims:
  - Student achievement across three samples groups: Control, PD & PD + Family Engagement

*Phase I: NSF #1102808 | Phase II: NSF #1721059*



# Study Focus

- Investigate whether exposure to NURTURES-trained teachers affected student learning outcomes for *PreK-K* in science, mathematics, early literacy, and reading.
- Determine if children whose families participated in family engagement STEM provided an additive positive impact on child outcomes.



# Family Engagement in STEM Learning During Early Childhood

Need for family engagement:

- Children spend less than 20% of their day in school
- Families focus on reading and math vs. science and engineering
- Parental factors – low interest, anxiety, and confidence

Strategies for family science engagement:

- Community-based – informal science learning venues
- School-based – family engagement kits
- Home-based – family engagement packs



# State of EC STEM Assessment

STEM assessment of very young children poses challenges:

- Aligned with curriculum
- Authentic tasks or observation of abilities - in real time
- Developmentally appropriate-not paper and pencil
- Easily incorporated into ongoing evaluation procedures

Current science assessment tools:

- Science Learning Assessment (SLA-Purdue)
- Woodcock-Johnson-III Science Knowledge Subscale (WJ-III-HMHCO)
- Preschool Science Assessment (PSA-U Miami)
- Early Learning Scale (ELS/KELS-NIEER)



# Methods

## Program

### Professional Development

- Summer Institute & AY PLCs

### Family Engagement Resources (randomized group)

- Family Packs
- Family Engagement Events



## Early Learning Scale Instrument

- Rubric scoring on select items focused on math, science, language & literacy
- Teachers collected Fall & Spring data

## Early Learning Scale Training

- Web-based training on scope and application
- Aim to Integrate with existing assessment protocols



# Study Participants

## Selection:

- RCT research design
- PreK-K programs from sixteen rural Midwestern schools
- Participants active in program for 1 year
- Male/Female students evenly distributed





# Instrument

## Domain: Math/Science

Item 1: Number and Numerical Operations

Item 2: Classification and Algebraic Thinking

Item 3: Geometry and Measurement

Item 4: Scientific Inquiry

## Domain: Language and Literacy

Item 7: Oral Language

Item 8: Phonological Awareness

Item 9: Print Awareness

Item 10: Writing

DOMAIN						
Language and Literacy						
7	<b>Oral Language</b>	1	2	3	4	5
	Speaking	<ul style="list-style-type: none"> <li>Uses gestures to communicate</li> <li>Unlikely to participate in discussions</li> <li>May use very short phrases</li> </ul>	<ul style="list-style-type: none"> <li>Responds using simple sentences</li> <li>Responds to low-level questions</li> </ul>	<ul style="list-style-type: none"> <li>Uses complex sentences and strong vocabulary</li> <li>Participates in discussions by asking questions and making connections</li> </ul>		
	Story Retelling	<ul style="list-style-type: none"> <li>Retells familiar stories using pictures, but with little connection to the actual story line</li> </ul>	<ul style="list-style-type: none"> <li>Retells familiar stories with some main components, but may differ from story line</li> </ul>	<ul style="list-style-type: none"> <li>Retells familiar stories with some accuracy and details</li> </ul>		
8	<b>Phonological Awareness</b>	1	2	3	4	5
	Language Manipulation	<ul style="list-style-type: none"> <li>Responds to rhymes and music</li> <li>Repeats parts of rhymes and chants</li> </ul>	<ul style="list-style-type: none"> <li>Recites chants and rhymes</li> <li>Repeats language with repetitive beginning sounds (alliteration)</li> </ul>	<ul style="list-style-type: none"> <li>Separates words into syllables</li> <li>Creates own rhymes and/or alliteration</li> </ul>		
9	<b>Print Awareness</b>	1	2	3	4	5
	Alphabetic Awareness	<ul style="list-style-type: none"> <li>Identifies few letters, if any</li> </ul>	<ul style="list-style-type: none"> <li>Identifies some letters</li> </ul>	<ul style="list-style-type: none"> <li>Identifies many letters and may comment about letters in the environment</li> <li>Recognizes that letters form words</li> </ul>		
	Knowledge	<ul style="list-style-type: none"> <li>Does not recognize that print carries meaning</li> <li>Recognizes prominent and common print in environment by relying on picture cues</li> </ul>	<ul style="list-style-type: none"> <li>Recognizes that print has meaning</li> <li>Recognizes some print in the classroom, including his or her own name</li> </ul>	<ul style="list-style-type: none"> <li>Understands that print is used for different functions</li> <li>Identifies print in environment, such as classmates' names, signs, and/or symbols</li> </ul>		
10	<b>Writing</b>	1	2	3	4	5
	Composing	<ul style="list-style-type: none"> <li>May identify scribbling as "writing"</li> <li>Does not give meaning to writing</li> </ul>	<ul style="list-style-type: none"> <li>Verbally labels own "writing" or drawing</li> <li>Provides dictation to an adult to be written on a piece of work</li> </ul>	<ul style="list-style-type: none"> <li>Writes symbols for a purpose—to convey information or tell a story</li> </ul>		
	Production	<ul style="list-style-type: none"> <li>Draws or scribbles</li> </ul>	<ul style="list-style-type: none"> <li>Strings conventional letters together (other than his or her own name)</li> </ul>			

ITEM

INDICATORS

STRAND

# Instrument Scoring

Examination and Reconsideration of Prescribed Scoring Procedures

## SCORING PROCEDURES AND GUIDELINES

### Procedures

For further information on the ELS/KELS instrument visit:

[www.myelsonline.com](http://www.myelsonline.com)



# Instrumentation: PreK

Items	Number of Items	Labels
<b>Domain: Math/Science</b>		
Item 1: Numbers and numerical operations	3	01 = Num.1 02 = Num.2 03 = Num.3
Item 2: Classification and algebraic thinking	2	04 = Class.1 05 = Class.2
Item 3: Geometry and measurement	2	06 = Geom.1 07 = Geom.2
Item 4: Scientific inquiry	3	08 = SI.1 09 = SI.2 10 = SI.3
<b>Domain: Language and Literacy</b>		
Item 7: Oral language	2	11 = OLAN.1 12 = OLAN.2
Item 8: Phonological awareness	1	13 = Phon
Item 9: Print awareness	2	14 = Read.1 15 = Read.2
Item 10: Writing	2	16 = Write.1 17 = Write.2
Total	17	



# Measurement Model: PreK and K

*Recommended scoring model did not work well.*

- ▶ Used Polytomous Rasch Rating Scale Model (RSM) (Andrich, 1978a, 1978b) as implemented in Winsteps (Linacre 2009) software to evaluate all items
- ▶ Rating Scale utilized three observable scores for all items:
  - “1” (observed) = “1” (recoded)
  - “3” (observed) = “2” (recoded)
  - “5” (observed) = “3” (recoded)
- ▶ Fall 2018 anchored items measures were used to calibrate Spring 2019 items measures (Fall 2018 frame-of-reference)
- ▶ Obtained scale-free calibrations of all items (not just strands) difficulty levels and children’s ability measures



# Demographics: PreK

Characteristic	Fall 2018		Spring 2019	
	<i>n</i>	%	<i>n</i>	%
Intervention				
Control	136	40	129	41
PD	83	24	77	24
PD+	120	35	111	35
Gender				
Female	161	47	147	46
Male	175	52	167	53
Missing	3	1	3	1



# Linear Regression Results: PreK

Variable	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>
Intercept, $B_0$	2.73	0.25	11.12	< .001
Fall measure, $B_1$	0.94	0.05	20.66	< .001
Gender, $B_2$	0.02	0.23	0.07	.941
Intervention, $B_3$ (PD)	0.96	0.30	3.22	.001
Intervention, $B_4$ (PD+)	0.79	0.27	2.92	.004

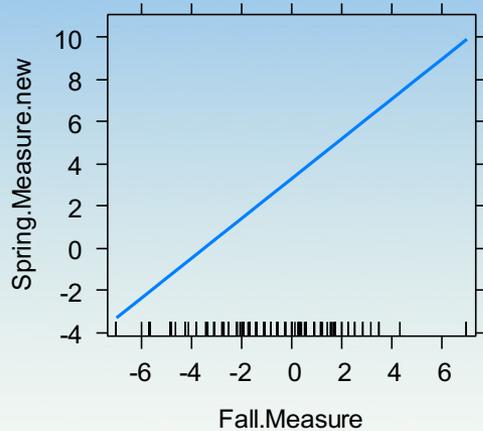
## Regression approach was used:

- Spring 2019 – outcome variable
- Fall 2018 – covariate
- Gender – factor (controlling variable)
- Intervention - factor

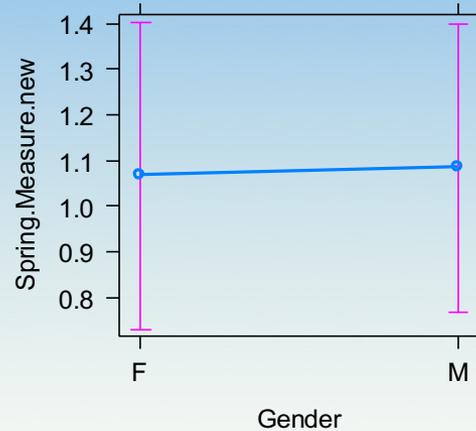


# Results Marginal Effects: PreK

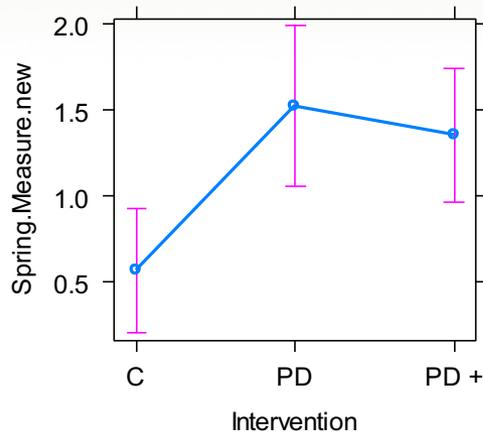
Fall.Measure effect plot



Gender effect plot



Intervention effect plot



# Demographics: K

Characteristic	Fall 2018		Spring 2019	
	<i>n</i>	%	<i>n</i>	%
Intervention				
Control	46	49	45	52
PD	30	32	24	28
PD+	18	19	18	21
Gender				
Female	46	49	41	47
Male	48	51	46	53



# Instrumentation: K

Items	Number of Items	Labels
<b>Domain: Math/Science</b>		
Item 1: numbers and numerical operations	3	01 = Num.1 02 = Num.2 03 = Num.3
Item 2: classification and algebraic thinking	2	04 = Class.1 05 = Class.2
Item 3: geometry and measurement	2	06 = Geom.1 07 = Geom.2
Item 4: scientific inquiry	3	08 = SI.1 09 = SI.2 10 = SI.3
<b>Domain: Language and Literacy</b>		
Item 7: oral language	2	11 = OLAN.1 12 = OLAN.2
Item 8: phonological awareness	1	13 = Phon
Item 9: reading	3	14 = Read.1 15 = Read.2 16 = Read.2
Item 10: writing	2	17 = Write.1 18 = Write.2
Total	18	



# Linear Regression Results: K

Variable	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>
Intercept, $B_0$	3.74	0.66	5.69	< .001
Falll measure, $B_1$	0.51	0.14	3.66	< .001
Gender, $B_2$	-0.10	0.71	-0.14	.887
Intervention, $B_3$ (PD)	0.98	0.86	1.14	.258
Intervention, $B_4$ (PD+)	2.46	0.98	2.52	.014

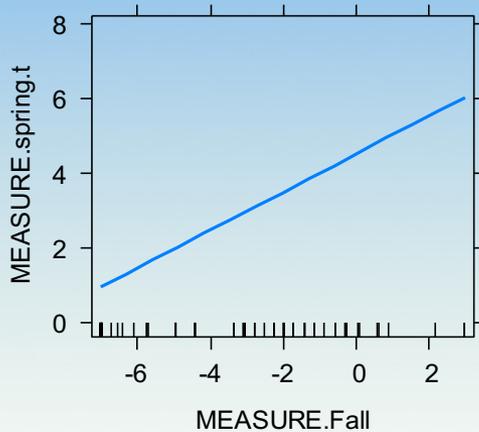
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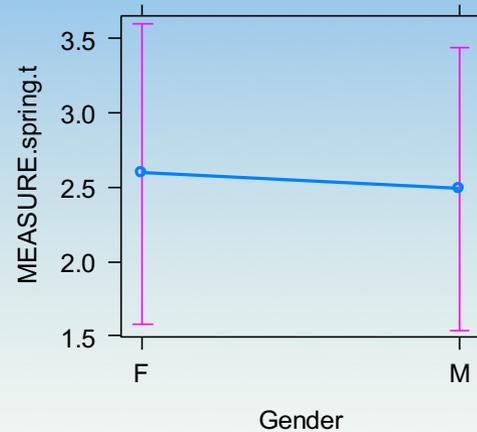


# Results Marginal Effects: K

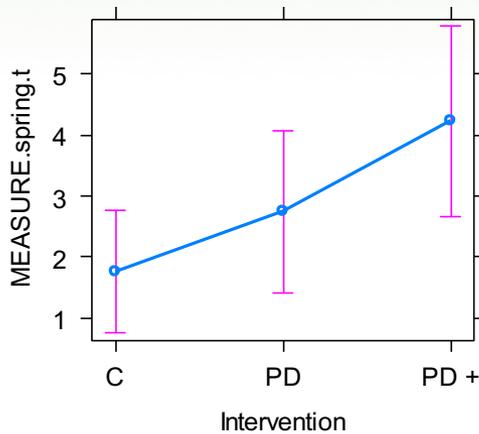
MEASURE.Fall effect plot



Gender effect plot



Intervention effect plot



# Conclusions & Implications

- ✓ NURTURES programming shows a positive impact on PreK-K student achievement.
- ✓ Preliminary findings indicate the usefulness of the ELS/KELS instrument for EC STEM assessment.
- ▶ Further research will involve gathering data on student achievement, fidelity of implementation with family engagement components, and inter-rater reliability.



# Questions & Contact Info

For further information on NURTURES visit:

[nurtures.utoledo.edu](http://nurtures.utoledo.edu)

or email: [nurtures@utoledo.edu](mailto:nurtures@utoledo.edu)

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