Scientific Inquiry for Young Children: Linking Teacher Professional Development and Family Engagement to Improve Student Achievement

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Nurtures

Networking **U**rban **R**esources with **T**eachers and **U**niversity to en**R**ich **E**arly Childhood **S**cience

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Background

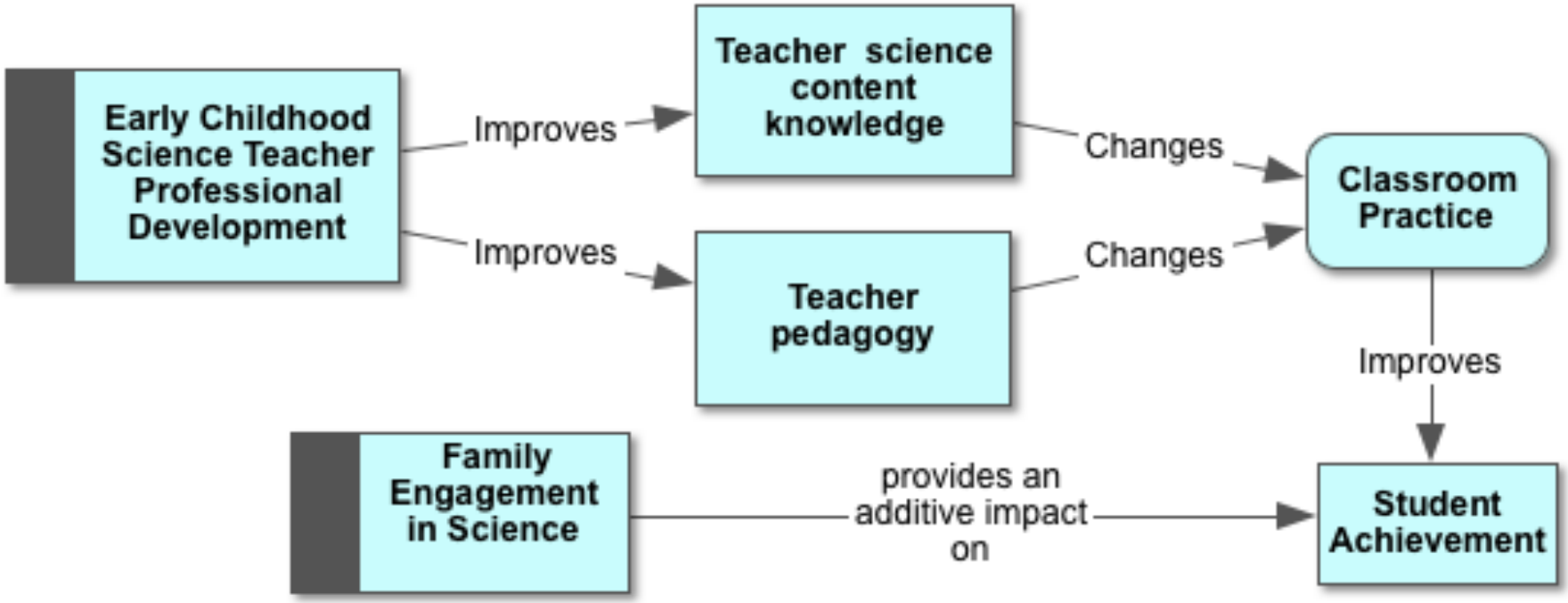
- Kindergarten children with gaps in science knowledge rarely catch up, a deficit that can limit adult career choices (Morgan, 2016)

- Teachers are challenged by inquiry science
  - Little or poor experience with inquiry (e.g., Blanchard, Southerland, & Granger, 2009; Krajcik, Blumenfeld, Marx, & Soloway, 2000)

- Few teachers enact inquiry science in their classrooms (Capps & Crawford, 2013)

- Limited research to date on effects of science inquiry early childhood PD (Capps, Crawford, & Constas, 2012)
  - Early elementary is understudied
  - Unclear how teachers will enact *Framework*-aligned science instruction

NURTURES Theory of Action



NURTURES Goals:

- increased science proficiency in PK-3 children
- align instructional practices of PK-3 teachers with K-12 Next Generation Science Standards Framework
- improve quality of family interactions while learning science together

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NURTURES Program

Teacher Professional Development

Classroom Extension Activities (Family Packs)

Community Sci-FUN Events and WGTE Learning Segments

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Effects on Teacher' Practices

- Increase in teacher science content knowledge
- Changes in classroom practice (on basis of global "overall quality indicator" in SCIIENCE measure), p = .008

Family Pack Use

- Family packs encouraged the talk moves, questions and inquiry behaviors that they were designed to encourage.
- Families also displayed the use of talk moves, inferential/literal and open/closed questions and inquiry behaviors not designed into the family packs.
- If families are provided supportive materials they are capable of facilitating the experiences for their children.

Prior Research: Impact on Early Literacy, Mathematics, and Reading

• **STAR Early Literacy** - 27 items aligned to early literacy skills. Three broad domains: Word Knowledge and Skills, Comprehension Strategies and Constructing Meaning, and Numbers and Operations.

• **STAR Mathematics** - 24 items focusing on problem solving, reasoning and proof, communication, representation, connections, adaptive reasoning, strategic competence, conceptual understanding, procedural fluency, and productive disposition.

• **STAR Reading** - 25 items in grades K-2 and 20 items in grade 3. This assessment focuses on vocabulary in context and reading comprehension.

NURTURES Effect on Students' Outcomes in 2015-2016

As compared to students who never had a NURTURES teacher (7991 students), having a NURTURES teacher (6711 students) in a student's academic life prior to or during the 2015-2016 school year was associated with net gains in spring scores of:

- 8.6 points to STAR Early Literacy
- 17.0 points to STAR Mathematics and
- 41.4 points to STAR Reading (Effect size 0.25)

Assessment	Grades	B	SE B	T-ratio	Df	p
STAR Early Literacy	K-12	8.59	3.56	2.41	41	0.020
STAR Math	2-4	16.99	2.56	6.63	40	<0.001
STAR Reading	1-4	41.38	4.17	9.93	40	<0.001

New Research: Longitudinal Impact on Science Achievement and Literacy & Mathematics Achievement

- Examining district assessments of 5th graders comparing those who had a NURTURES program teacher at least once through grades 1 – 3
- data from 41 elementary schools in a large urban school district in the Midwest
- 64.8% of students received free or reduced lunch

New Research: Longitudinal Impact on Science Achievement

- *Total n* =1588: *n* = 434 (27.3%) of the 5th-grade students had a NURTURES-trained teacher at least once in grades 1–3 (treatment group) and *n* = 1154 (72.7%) served as control students.

- Males represented 52.6% and females represented 47.4% of the sample. 60.6% of students self-identified themselves as minorities (non-White). Students who were retained between grades 1–2, 2–3 and/or 3–4 were 4.9%.

- Baseline equivalence established with Fall STAR Early Literacy standardized scale scores.

- A two-level, random-slope mixed regression model was used to assess the effect a NURTURES-trained teacher on student achievement as measured by performance on the Science Subtest of the Ohio Achievement Assessment.

Findings: Longitudinal Impact on 5th Grade Science Achievement

- a student associated with at least one NURTURES-trained teacher modeled to have a 6.14 advantage points

- Effect size (Hedges' g) was 0.156, which is to be interpreted as a treatment group having, on average, 0.16 higher scores in standard deviation units as compared to the scores of the control cohort.

- Non-minority students statistically significantly outperformed minority students by 8.42 points and male students significantly outperformed female counterparts by 5.85 points.

  - However, we are encouraged by results of the model showing that having a NURTURES teacher could eliminate or reduce achievement gaps for female and minority students when compared to male or non-minority students without a NURTURES teacher.

In Process: Longitudinal Impact on Literacy and Mathematics Achievement

- A longitudinal strip of STAR Early Literacy measure of K students in Spring 2014, 1st-grade students in Spring 2015, and 2nd-grade students in Spring 2016 was extracted from the cross-sectional data provided by the school district.
- The sample consisted of 47.3% of females and 52.7% of males.
- 50.1% – White, 35.8% – African-American, 7.4% – mixed, 5.9 – Latino and 0.8% – other. Non-White students were classified as minorities.
- Early literacy sample: 4744 student scores across three measurement occasions defined a student's growth trajectory
- Mathematics sample: growth trajectory included 4672 student scores

Preliminary Findings: Longitudinal Impact on Literacy Achievement

- *Fixed Effects for STAR Early Literacy Outcome Measure:*
  - Statistically significant
    - For *gender:* males 9.08 lower mean achievement than females.
    - For non-minority students: 9.12 higher mean value than minorities.
    - For treatment students: the effect of a time-varying *intervention* variable was statistically significant. The model estimated 16.12 points advantage to the learning curve as a function of a student having a program teacher in a given measurement year. This intervention effect corresponds to 2.5 months developmental advantage for students who had a program teacher(s) over students who did not have a NURTURES teacher(s).

Preliminary Findings: Longitudinal Impact on Mathematics Achievement

- *Fixed Effects for STAR Mathematics Outcome Measure:*
  - The effect for *gender* was not statistically significant
  - There was a statistically significant advantage for non-minority students (7.66 points).
  - For treatment students, the effect of a time-varying *intervention* variable was statistically significant. The model estimated 14.46 points increase to the learning curve as a function of a student having a program teacher in a given measurement year, controlling for all other variables in the model. This intervention effect corresponds to 1.9 months developmental advantage for students who had a program teacher over students who did not have a NURTURES teacher.

Promising Directions

- Framework aligned PD for early elementary educators can positively impact teachers' instructional practices
- Incorporating science inquiry instruction into early childhood classrooms can help to boost the science, literacy, and math skills of inner city students
- Learning gains in K-3 continue into middle grades

Future Directions

- Mixed-method investigations of mediators and moderators that impact change
- Develop early intervention programs that involve families and facilitate a more successful transition to formal schooling
- Systematic and longitudinal work to examine how characteristics of family-involvement programs are related to child (and family) outcomes.

For more…

NURTURES WEBSITE

http://nurtures.utoledo.edu

http://nurtures.utoledo.edu/research.html

And/or contact us:
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