Young children and digital media:

Examining impact through three RCTs

Naomi Hupert (EDC)
Megan Silander (EDC)
Regan Vidiksis (EDC)
Phil Vahey (SRI)

EDC Education Development Center

SRI Education

Ready To Learn

- Ready To Learn (RTL) initiative is a partnership between the **US Department of Education**, the **Corporation for Public Broadcasting** and **Public Broadcasting Service**, to examine how digital media supports children's learning.

- The program targets communities where many children arrive unprepared for the demands of school (Claessens, Duncan, & Engel, 2009, Reardon & Portilla, 2016).

- Since 2009, studies have examined the design, development and use of digital media created under this initiative to support early learning (Wartella, E., Lauricella, A.R., Blackwell, C.K. 2016; Hurwitz, 2018).

Focus on three RCTs

- Three randomized controlled trial studies designed to provide insight into the impacts of digital media on math and literacy learning in early learning and home settings.
- Each study identified positive impacts on learning, but took different approaches in assessing impact and conceptualizing the media-based intervention and counterfactual. Each had a different focus in terms of learning outcome.
- Each study employed a consistent media integration model, each study encountered challenges in designing a well structured RCT that would build knowledge about the impacts of digital media on early learning, and would work within the target learning environment.

Evolution of RTL Design across 3 different studies

- Variations in location/setting (PreK Classroom, Home)
- Variations in comparison conditions (two and three condition studies)
- Variations in communication with parents/teachers (provision of teacher coaching and parent guidance)
- Variation in device use (provision of devices including interactive whiteboards, laptops, tablets)
- **Common approach to supporting young children's engagement with digital media across all three studies**

Our Media Integration Model: Content, Curation and Context

- High quality digital content
- Integration of hands-on activities that are closely connected to and can extend instructional goals of the digital content
- Curation of content to support introduction and repeated play and viewing of games and videos, creating a spiraling set of activities
- Child engagement in pairs and groups rather than working in isolation

Early Learning with Digital Media

Features of media that relate to learning:

- Foster intrinsic **interest, motivation and engagement** (Renninger, 2000)
- Develop **parasocial relationships** with characters in media support engagement across time (Jennings et al., 2008; Linebarger & Piotrowski, 2006; Richert, Robb, & Smith, 2011; Schiappa et al., 2007)
- **Support attention** by representing essential content as integral to story lines (Fisch, 2004; Linebarger, Kosanic, Greenwood, & Doku, 2004)

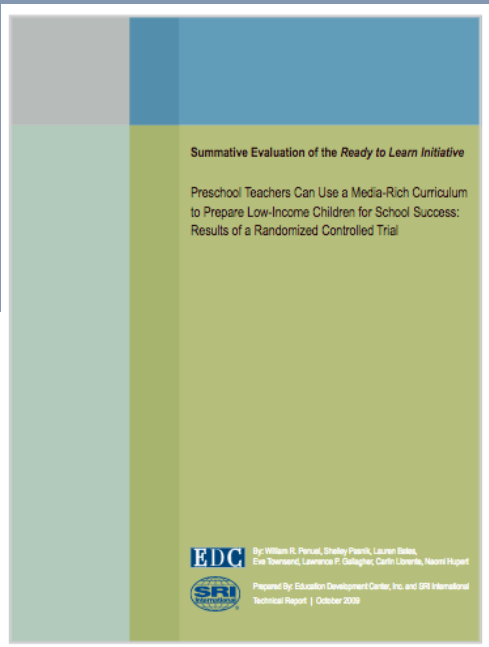
Early Learning with Digital Media, cont.

Features of media that relate to learning (continued):

- **Model behavior**, e.g. ways of thinking, talking, and cooperating and content knowledge (Gola, Richards, Lauricella, and Calvert, 2015; Troseth, Saylor, & Archer, 2006)
- Games provide **feedback** to children and invite their active response, and videos can invite **questioning**, which can support engagement and learning (Anderson et al., 2000; Crawley et al., 2002).

Although digital media hold potential for influencing learning, there is less consensus about the characteristics and conditions required for effective use, and there are potential drawbacks as well. For example, watching or using media alone does not lead to learning.

Study #1: Literacy Study



The Literacy Study's purpose was to measure the impact of video and related media developed by Ready to Learn on pre-k students' early reading skills

- The study included:
  - 398 4-year-old children
  - 80 preschool classrooms in 2 states
  - 2 condition study: early literacy; early science
  - A randomized controlled trial study design (randomized by classroom)
  - A 10 week supplemental learning experience
  - Technology for teachers/classrooms for both conditions
  - Initial training and coaching for both conditions
  - Low income communities, English as primary language of instruction

Study Media

- Instructional media included in the study include:
  - PBS videos from *SuperWhy, Sesame Street, Between the Lions, Sid the Science Kid, Peep & the Big Wide World*
  - PBS interactive games from the same programs
  - Books
  - Posters
  - Alphabet cards
  - Manipulatives, modeling clay, crayons, etc.

Focal Concepts

LITERACY

- **14 Letter Names & Sounds**
  - O, P, S, N, R, F, T, A, G, L, B, X, I, E
- **Concepts of Print**
  - Front cover
  - Title
  - Author
  - Opening a book & turning pages
  - Direction of print
- **Comprehension**
  - Making predictions
  - Retelling story events
  - Changing sentences in a story

SCIENCE

- **Content & Vocabulary**
  - Transformation & Change
  - Decay
  - Reversible Change
  - Irreversible Change
- **Skills**
  - Collecting
  - Sorting
  - Graphing
- **Thinking**
  - Observing
  - Comparing
  - Contrasting

Findings

- Preschool children in the intervention demonstrated greater growth in early literacy skills than peers in the non-literacy program.
- Assessments included three subtests of the Phonological Awareness Literacy Screening (PALS); an assessment of print awareness; and a researcher-developed test of how well the student recognized letters in his/her own name.

Findings

Literacy Outcomes	Literacy Curriculum		Comparison Curriculum		ES
	Pretest	Posttest	Pretest	Posttest	
Impacts on Uppercase Letter Recognition (Letter Naming)	15.8	21.2*	13.6	16.8	0.34 SD
Impacts on Letter Sounds	5.8	10.0*	5.9	6.3	0.53 SD
Children's knowledge of letters in their name	2.4	2.7**	2.3	2.5	0.19 SD
Impacts on Story and Print Concepts	9.7	10.8*	9.1	9.5	0.26 SD
Beginning Sound Awareness	no significant difference p = .082				0.00 SD

*Difference in posttest scores of literacy condition children controlling for pretest scores, was greater than that of comparison condition children at ***p* < .001.**

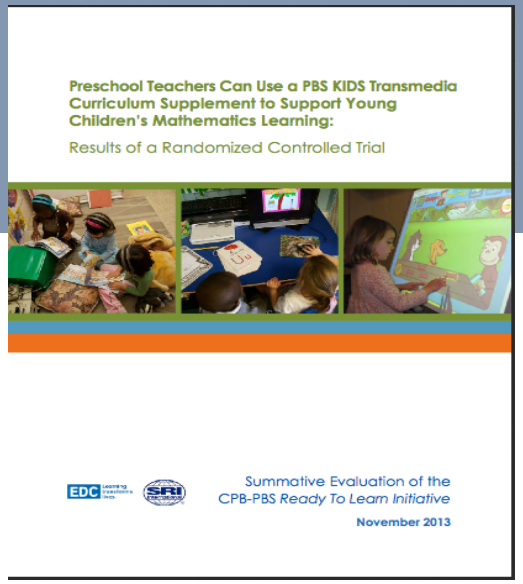
Difference in Posttest scores of literacy condition children, controlling for pretest scores, was greater than that of comparison condition children at ***p* < .05.

Additional Findings

- Parents of children in the study's science program reported their child:
  - Talked about science concepts (such as decay and freezing/melting) or did investigations and experiments at home
  - Pretended to be a scientist or a science teacher at home
  - Expressed curiosity about the how things work, why things change, and the natural world at home
- Preschoolers in the science condition exhibited these indicators at higher levels than their peers

Reviewer concern: The study leaves open the question of impact of technology on child engagement

Study # 2: PreK Math Study



- **86 Early learning classrooms that:**
  - served children from low-income households
  - provided instruction primarily in English
  - Were located in New York City and the San Francisco Bay Area

- **157 teachers** (84 in New York, 82 in the San Francisco Bay Area) randomly assigned to condition (assignment by teacher/classroom)
- **3 conditions:** Intervention, Technology Only, Business as Usual

- **699 children** included in assessments across all classrooms, assessing approximately 10 randomly selected children per classroom

Intentionally curated content

PBS Kids - Media by Week

Click here to view games by week

Week	Video	Guided Challenge Game Play	Easy Game Play
1	Sid the Science Kid: The Dirt on Dirt (Download)		Sid the Science Kid: Crystals Rule
2		Sid the Science Kid: Vegetable Harvest	
3	The Cat in the Hat: Let's Go Fly a Kite (Download)	The Cat in the Hat: Huff-Puff-a-Tron	Curious George: Rabbit
4	The Cat in the Hat: Finola's Farm (Download)	Sid the Science Kid: Vegetable Patterns	Curious George: Flower Garden
5	Curious George: Rocket Ride (Download)	Curious George: Bubble Pop	Curious George: Blast Off
6	The Cat in the Hat: Termite Towers (Download)	The Cat in the Hat: Sketch-a-Mite	Curious George: Bug Catcher

Schedule of weekly activities for Intervention condition

- Co viewing
- Journal
- Circle
- Easy game play
- Guided reading
- Challenge game play
- Hands on center
- Computer Center

Monday	Tuesday	Wednesday	Thursday
Video Co-Viewing (25 minutes)	Mathematics Detective Journal (20 minutes)	Mathematics Circle Routine (10 minutes)	Challenge Game Play (25 minutes)
	Easy Game Play (10 minutes)	Guided Reading (15 minutes)	
Computer Center (~10 minutes per pair of children)	Computer Center (~10 minutes per pair of children)	Computer Center (~10 minutes per pair of children)	Computer Center (~10 minutes per pair of children)
	Hands-On Centers (~10 minutes per pair of children)	Hands-On Centers (~10 minutes per pair of children)	Hands-On Centers (~10 minutes per pair of children)

More on the three conditions

Treatment	Technology & Media	Business As Usual
26 classrooms	30 classrooms	29 classrooms
10-week PBS KIDS Supplement	Math as usual	Math as usual
IWB + laptops	IWB + laptops	Technology as usual
Selected PBS KIDS Videos	Teacher selected	N/A
Selected PBS KIDS Games	Teacher selected	N/A
Hands-on Materials	N/A	N/A
Math + Tech training and coaching	Tech training and coaching	Post hoc PD

Findings: Child Outcomes

- Children in intervention condition showed significant gains (ES=.24) in target skills as measured by researcher developed Supplement Based Assessment compared to BAU (ES=.15) and Technology and media (ES=.22).
- Gains for intervention condition were equivalent to a 9% increase in percentile rank over the Technology & Media and BAU conditions.
- Small, marginally significant increases were found for this group of children using the REMA, as compared to children in the Technology & Media (ES=0.15) and BAU conditions (ES=0.15).
- No effect on self-regulation measure.

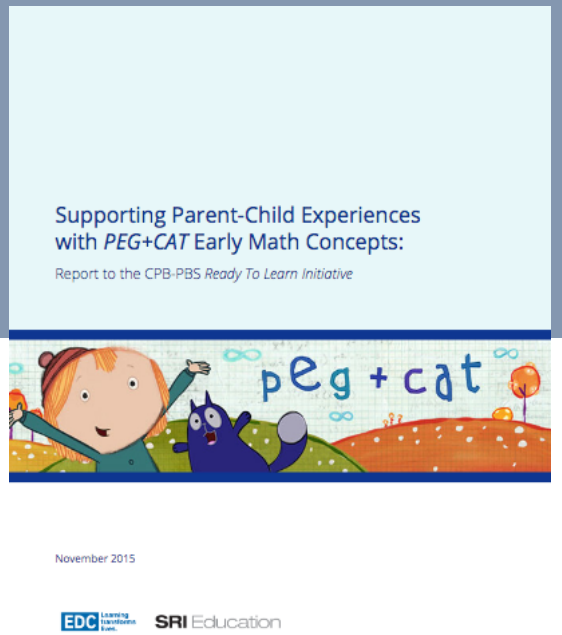
While prior study findings were encouraging, initiative partners were concerned that the findings did not address the environment where RTL resources are used most: in homes

Findings

Impact Contrast	Coefficient	Std. Error	Hedges' g (Effect size)	p	Multiple Comparison Test*
SBA					
(1)PBS KIDS Transmedia Math Supplement vs Business as Usual	1.51	0.302	0.24	<0.001	significant
(2) Technology & Media vs Business as Usual	0.08	0.309	0.01	0.789	---
(3) PBS KIDS Transmedia Math Supplement vs. Technology & Media	1.43	0.288	0.22	<0.001	significant
REMA					
(1)PBS KIDS Transmedia Math Supplement vs Business as Usual	1.09	0.589	0.15	0.064	---
(2) Technology & Media vs Business as Usual	0.00	0.587	0.00	0.996	---
(3) PBS KIDS Transmedia Math Supplement vs. Technology & Media	1.09	0.571	0.15	0.056	---
HTKS					
(1)PBS KIDS Transmedia Math Supplement vs Business as Usual	-0.02	1.432	0.00	0.991	---
(2) Technology & Media vs Business as Usual	-0.89	1.460	-0.05	0.542	---
3) PBS KIDS Transmedia Math Supplement vs. Technology & Media	0.87	1.370	0.05	0.524	---

*Note: thresholds for statistical significance adjusted for nine pair-wise comparisons using the Benjamini-Hochberg False Discover Rate procedure.

Study # 3: PEG+CAT Home Study

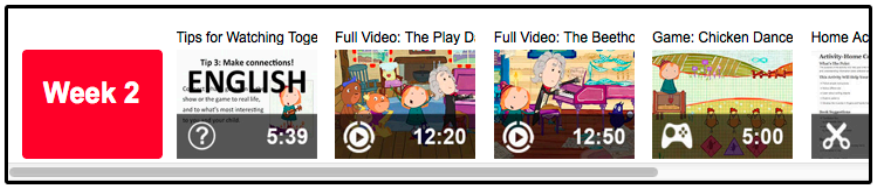


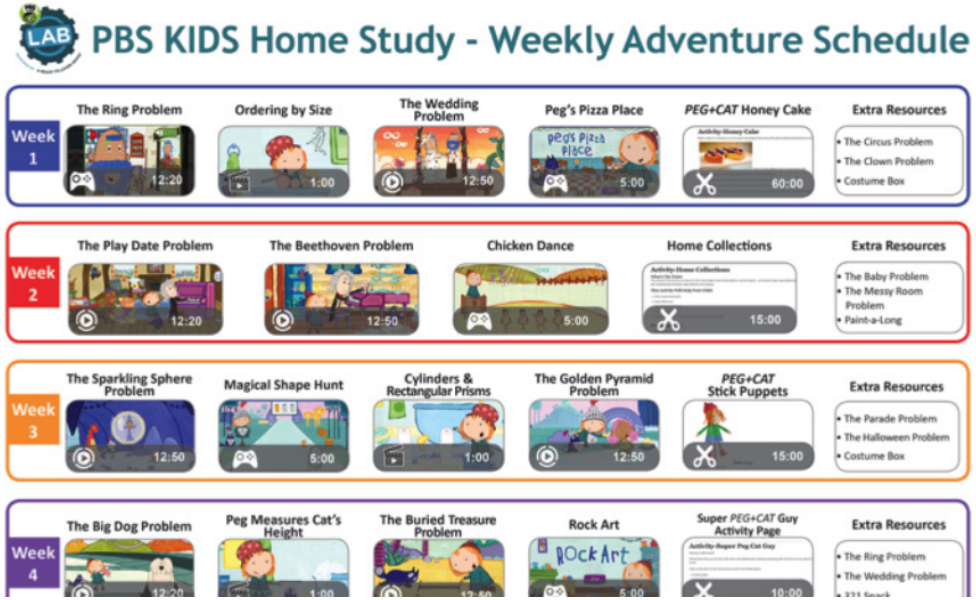
Two-Condition Randomized Assignment Design

- **Study Sample**
  - Recruited from preschools in low-income neighborhoods in New York metropolitan and San Francisco Bay areas
  - Child proficient in English
  - Caregiver fluent in English, Spanish, Mandarin, Cantonese
  - Technology: Android tablet and Chromebook laptop, Internet connectivity
- **Treatment: (n=101)**
  - Provided with media experience structured in weekly units over 12 weeks
  - Supports for parent-child joint engagement, math talk, problem-solving
- **Business as Usual: (n=95)**
  - Continued with their children's typical media use activities

Intervention

Full Video: The Play Date Problem





Targeted Learning

Mathematics

- Patterns
- Geometry (2-D and 3-D shapes, spatial relationships)
- Measurable attributes
- Ordinal numbers
- Counting

Approaches To Learning

- Flexible problem solving
- Persistence
- Collaboration

Outcome Measure – Pre/Post

Early Mathematics Assessment

- Researcher-developed
- Aligned to target concepts, but not resources
- T-scores

Teacher Ratings

- Children's mathematical and problem solving skills, researcher-developed scale:
  - Math Concepts and Problem Solving checklist (MCPS)

- Children's approaches to learning using a standardized scale:
  - Preschool Learning Behavior Scale (PLBS; McDermott, Green, Francis, & Stott, 2000)

Other Measures

Engagement with Media

- **Web- and app-based electronic logs** of participant usage and engagement with the media and technology resources (Tx only)
- **Weekly media diaries** designed to capture daily and weekly use and interactions around media
- **Home visits and focus groups** with subset of families

Parent Attitudes and Behaviors

- Pre/post survey
- Media use, home support for math, children's behaviors at home

Findings

Impact on Parent Attitudes and Reported Behavior

Compared to BAU caregivers, those in the intervention

- reported more joint media use;
- were more confident about supporting math learning for their children;
- were more likely to agree that technology and media could be tools for math learning; and
- were more likely to report engaging in problem-solving strategies (such as exploring “what if” scenarios) with their children.

Findings: Impact on Learning

Impact Contrast	Coefficient	Hedges g (Effect Size)	Std. Error
Factor 1: Ordinal Numbers, Spatial Relationships, and 3-D Shapes	5.26	0.51***	1.12
Factor 2: Measurable Attributes and Pattern Creation	-1.02	-0.10	1.06
Factor 3: Counting, 2-D Shapes, and Pattern Continuation	-0.40	-.038	1.00

***p<.001

[1] Model covariates include student-level pretest score, home language, mother's education, child gender, and child age.

Findings: Continued

- **PBS KIDS *PEG+CAT* intervention had a significant positive influence on some of the mathematics skills promoted by the program.**
  - positive outcomes for skills less commonly taught by educators and in informal settings, such as ordinal numbers, spatial relationships, and 3-D shapes
  - no effects for other skills that are more commonly taught, such as measurable attributes, pattern creation, counting, 2-D shapes, and pattern continuation
  - no impacts on teachers' ratings of ATL

- **Parents in the intervention condition were more likely to report supporting media use and math learning at home**

3 Studies: Implications for Policy

- Engagement with public media resources at home holds potential to support math learning for children living in underserved communities and their caregivers.

- It may be important to provide opportunities to explore foundational mathematics skills beyond those that children are typically likely to encounter at home and at school

- The role of media to support ATL skills is unclear.

- More research is needed on curation of content (as opposed to sequencing), and on family supports for joint engagement.

3 Studies: Limitations

- Study volunteers: motivated parents and teachers
- Researcher-developed measure: potential bias in favor of treatment group
- Long-term or broader impacts unclear
- Did not separate effect of media from either technology equipment and connectivity or parent supports

More Information:

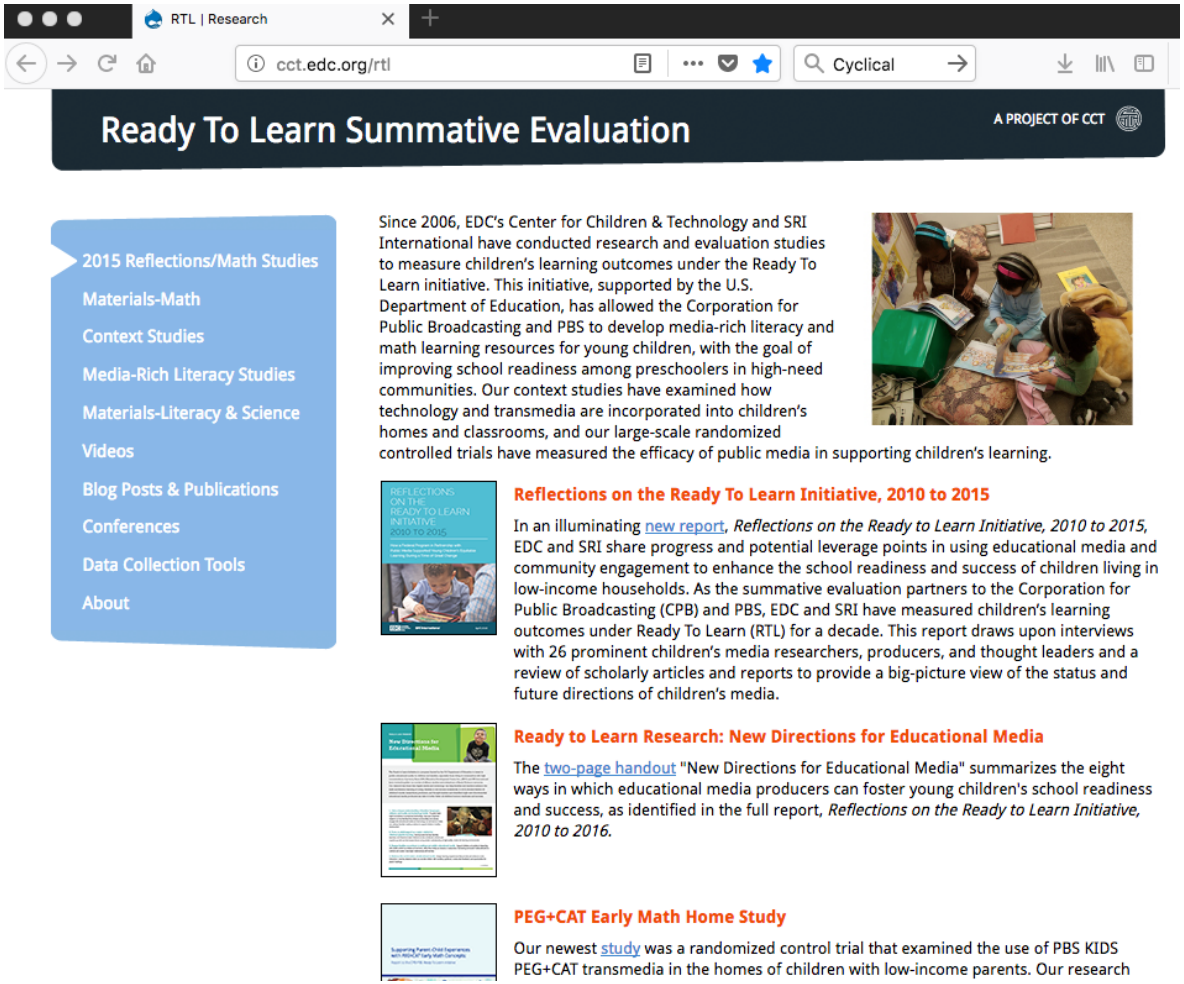
All our technical reports and instruments are available on our website:

http://cct.edc.org/rtl

Contact:

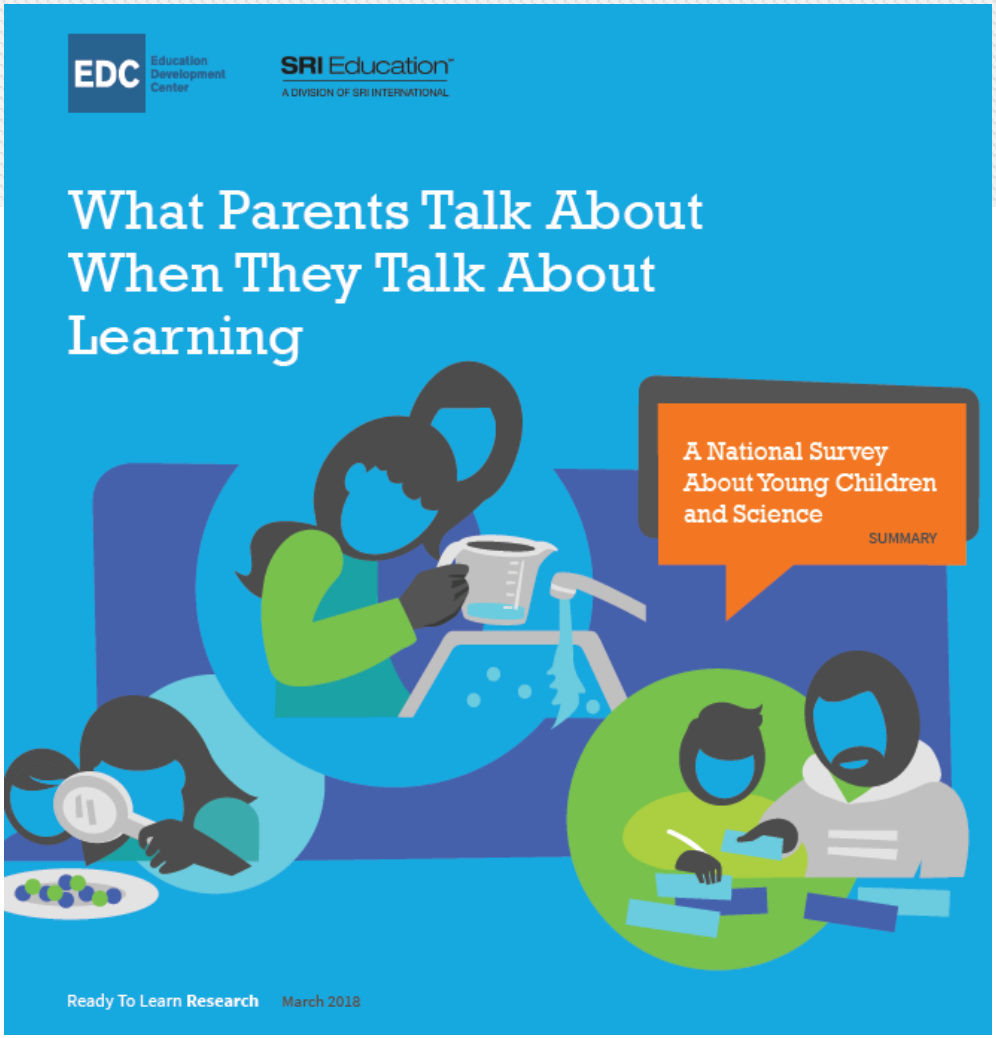
Naomi Hupert:
nhupert@edc.org

Regan Vidiksis:
rvidiksis@edc.org



Latest study

Released March 1



You can find this study at:
http://www.edc.org/what-parents-talk-about

Acknowledgements

Funding from the U.S. Department of Education Ready To Learn Initiative (U.S. Department of Education Award Number U295A100), in collaboration with CPB-PBS.

Corporation
for Public
Broadcasting