

The Ready To Learn Program: 2010-2015 Policy Brief

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Executive Summary

This report was commissioned by the three U.S. Department of Education 2010-2015 Ready to Learn Television Program (RTL) Grantees¹ to provide an independent analysis of the research findings and lessons learned from the RTL Television Program's 2010-2015 grant cycle. The main objective of this policy brief is to summarize findings across the three RTL grantees' projects to examine the impact of the RTL Program, and provide recommendations for future support for and work in children's educational media.

Three educational television production organizations—the Corporation for Public Broadcasting and Public Broadcasting Service (CPB-PBS), Window to the World Communications, Inc. (WTTW), and the Hispanic Information Telecommunications Network, Inc. (HITN)—were awarded RTL grants for the 2010-2015 funding cycle. In partnership with four external evaluators (Education Development Center, SRI International, The Michael Cohen Group, and WestEd), the grantees developed and evaluated the effectiveness of transmedia properties to aid young children's (ages 2-8) learning and development. While all projects included intensive formative research and evaluation (e.g., needs assessments, context studies, pilot

testing), the focus of this brief is on the 15 efficacy/summative research studies. A critical review of these studies, complemented by interviews conducted by the policy brief writers with key personnel at each organization, inform the findings of this report.

Findings from this review demonstrate that the high-quality educational transmedia experiences developed through RTL funding are not only effective mechanisms to teach young children academic skills pertaining to math and literacy but can support parents and educators as well. Major finding across all evaluations include: (1) positive associations between at-home transmedia engagement and children's math learning; (2) home study intervention parents' increased awareness of and engagement in their children's math learning; and (3) positive associations for at least some students in the intervention groups for the school-based evaluations. Beyond the efficacy study findings, interviews with key project personnel provided additional context for the impressive impact that these transmedia experiences had on children, families, teachers, and the community. Furthermore, these interviews provided a deeper understanding into what "transmedia" means and what it actually looks like in practice. Additionally, due to rapid technology development and increases in access to newer technology, particularly the iPad, that occurred over the 5-year grant period, the interviews also provided insight into the way the producers' and researchers' concepts of transmedia developed over the course of the grant period.

In light of these findings demonstrating the unique way that the Department of Education's RTL program contributes to improved educational experiences inside and outside of the formal school environment, we provide the

¹This policy brief was commissioned by the Corporation for Public Broadcasting on behalf of the three 2010-2015 Ready To Learn grant recipients: CPB-PBS, HITN, and WTTW. The contents of this policy brief were developed under a grant from the Department of Education. However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government. The project is funded by three Ready To Learn grants (PR/AWARD No. U295A100025, No.U295A100016, and No. U295A100026, CDFA No. 84.295A) provided by the Department of Education to the Corporation for Public Broadcasting (CPB), the Hispanic Information and Telecommunications Network, Inc. (HITN), and Window to the World Communications, Inc. (WTTW).

following four recommendations. Our recommendations are meant for both the RTL Program specifically and for those more broadly interested in the fields of education and children and media studies. Based on the evaluation of this round of RTL funding, we recommend:

Support for rigorous scientific research that informs media developers and the general public in addition to academic audiences.

Given the importance of using strong scientific methods to evaluate media properties, we recommend that academic researchers engage in future work that not only speaks to an academic audience but provides specific suggestions for media developers and generalizable recommendations to the public. For instance, among the recommended future research initiatives are specific studies that examine the impact of each separate transmedia component on children's learning: whether and how the home and school learning environment moderate learning from digital media; how transmedia may be a way to bridge the home-school divide; and differences in learning outcomes between free-play and carefully structured transmedia experiences. Similarly, while the current RTL work focuses on student learning outcomes, future work could also include investigations into the impact of programming on broader conceptualizations of learning, including student attitudes toward and self-efficacy in different content areas.

Support for dual-generation research that examines the effects of media on children when supported by parents, caregivers, or teachers.

Our analysis of the impact of these RTL programs suggests that both children and their caregivers (i.e., parents and teachers) benefited

from the RTL experience. We recommend that in the future, researchers be encouraged to examine the effect of media on children directly and on the experiences of parents and teachers in supporting young children's learning. Further, we recommend that researchers investigate the pathways between caregivers and children's learning outcomes from media to determine the moderating and mediating factors that influence such outcomes. For example, researchers could measure the impact of media on both parents' and children's learning of the educational content. Similarly, evaluating what types and the extensiveness of support are necessary for teachers to effectively use media and technology in the classroom are needed.

Support early learners by increasing connections between home, school, and communities.

We recommend enhanced support of the home, school, and community connection. Of particular importance is the development of communication and relationships between parents and teachers so that a child's learning environment can more easily extend from home to school and vice versa. We recommend developing ways to leverage the affordances of digital media and technology to help bridge the home/school/community divide and use transmedia as a starting place for developing such connections. As part of this recommendation, we also encourage the support of professional development opportunities for teachers and early childhood education providers to enhance their knowledge of and comfort with technology and to ensure developmentally appropriate, high-quality, and effective media experiences in their classrooms.

Increase broadband Internet access in early childhood education settings.

As a more general recommendation, we highly recommend that the federal government increase the infrastructure and provision of broadband Internet access to all. We recognize that efforts are currently underway to do this, but most of the work occurs in the K-12 environment, without as much attention paid to Internet access in early childhood education. The digital divide restricts individuals' opportunities to learn, grow, and develop with technology. The access to Internet and technology should be provided to ensure that all children are given ample opportunities to learn both at home, at school, and in the community.

Introduction

This policy brief was produced at the request of the three U.S. Department of Education 2010-2015 Ready to Learn Television Program (RTL) grantees.² Our task was to critically review the summative research findings from the RTL projects and conduct interviews with personnel from each project to elucidate the broader implications of RTL funding. Importantly, the 2010-2015 RTL Program emphasized the role that parents and preschool teachers play in supporting and nurturing young children's educational potential, such that our focus

extends beyond children's learning outcomes to examine how these initiatives impacted the families, caregivers, and educators as well. We offer policy recommendations for both the RTL Program participants and others interested in using publically-available media materials (television programs, videos, printed materials, online games, and interactive content) to prepare preschool children for schooling to ensure that they are *ready to learn*.

Methodology

The authors wrote this policy brief based on their objective analysis of the overall results, findings, and lessons learned from the three U.S. Department of Education 2010-2015 RTL awards. The goal of the policy brief was to address two primary questions:

1. What has been learned from the RTL projects' research about the educational value of transmedia for children ages 2-8, especially those from low-income families?
2. What has the RTL Program contributed to our understanding of the field of children's education and media during the past five years?

Materials

Reported Research Findings. In order to capture the full impact of the 2010-2015 RTL Program, the authors examined all available published and unpublished research reports, presentations, and documents from each of the three awardees: Corporation of Public Broadcasting and the Public Broadcasting Service (CPB-PBS), Window to the World Communications, Inc. (WTTW), and the Hispanic Information Telecommunications Network, Inc. (HITN). A total of 15 effectiveness/summative research studies across the three projects were analyzed (See Appendix

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A for citations and Appendix B for summaries).

Interviews. Hour-long phone interviews were conducted with key RTL 2010-2015 awardees in winter 2015-2016. Interviews were conducted with the following individuals: Michael Fragale, Pam Johnson, and Barbara Lovitts (CPB); Sara Dewitt, David Lowenstein, and Jeremy Roberts (PBS); and Shelley Pasnik (EDC); Michael Cohen (Michael Cohen Group); Bonnie Blagojevic and Yolanda Garcia (HITN); and Parke Richeson and Shalom Fisch (WTTW);

The goals of the interviews were to:

1. Understand the researchers' and producers' interpretation of the products created and the research results;
2. Examine the definition and concept of transmedia over the 5-year grant period;
3. Understand the context for the experiences in which the research and production procedures, how researchers would have changed things in hindsight, how measurement influenced findings, and how the context for the research played into results.

Supplemental Materials. A large set of research-related documents developed by each awardee over the entire 5-year grant cycle, including formative evaluations, pilot tests, context studies, and yearly reports, were examined to provide context for the various efficacy studies reported on in this policy brief. Additionally, we examined seven *Journal of Children and Media* manuscripts written by lead personnel from the 2010-2015 RTL projects, which reported findings and reflections on the 2010-2015 RTL projects.

RTL Historical Context

The U.S. Department of Education (DoED) is dedicated to supporting young children and their families in their pursuit of and success in formal and informal education. As part of this commitment, the DoED launched the Ready to Learn (RTL) Television Program (RTL Program) in 1995 in an effort to support the development of high-quality educational media that could help prepare children ages 2 to 8, especially those from lower-income families, for school readiness and success. The earliest iterations of this competitive grant program focused primarily on early literacy, but more recently the conceptual focus has broadened to include science, technology, engineering, and mathematics (STEM). Additionally, the earlier grants provided by the RTL Program focused on the development of television programming and led to the creation and/or advancement of a wide range of successful programs, including *Sesame Street*, *Reading Rainbow*, *Between the Lions*, *Super Why!*, and *Word World*. However, due to the changing nature of digital media and technology, as well as changes in children's media use patterns, the 2010-2015 RTL grant cycle emphasized designing media products that resonate with today's children and technology environment, such as interactive online games and apps. Indeed, the most recent round of RTL funding specifically requested the development of *transmedia storytelling*, which was defined as "conveying content and themes to audiences through the well-planned, connected use of multiple media platforms, including television" (RTL Request For Proposals, 2010-2015). RTL is legislatively required to fund public broadcasting entities and has consistently focused on the use of media as a tool to support the preparation of all children, especially

underserved populations, for future learning experiences.

From 1995 to 2005, the RTL Program focused on ways in which media content and community outreach, including educator and family workshops, could be utilized to improve young children's cognitive and social-emotional skills to ensure they entered formal schooling "ready to learn." During this grant cycle, the Corporation for Public Broadcasting (CPB), the Public Broadcasting Service (PBS), and 144 public television stations across the country broadcasted RTL television series and developed learning activities for children, parents, and caregivers (Public Television Affinity Coalition Group, n.d.). Additionally, the larger public broadcasting community benefited from the RTL initiative as all stations received materials to support their local community.

The 2005-2010 RTL program specifically focused on improving early literacy and reading skills based on best practices identified through the National Reading Panel. As part of this grant cycle, CPB-PBS developed two television series targeted at preschoolers (*Super Why!* and *Martha Speaks*) and one targeting K-2nd graders (*The Electric Company*), in addition to using existing content from *Sesame Street* and *Between the Lions* to support early academic readiness (Public Television Affinity Coalition Group, n.d.). The Chicago-area public television station Window to the World Communications, Inc. (WTTW) also developed a preschool-targeted program called *Word World*. This grant cycle required that 25% of project funds be dedicated to research and evaluation of program content and its effectiveness on learning. In doing so, RTL funds allowed the time and space for high-quality, evidence-based media products to be developed and disseminated. Further, the

larger public broadcasting community again benefited from the RTL initiative as all stations received content and outreach materials, new models for delivery of content via multiple platforms, and social marketing research to support their local communities. This included the development of messages that would resonate with and motivate target audiences to engage in literacy practices with their children. The 2005-2010 round of RTL was heavily focused on outreach innovations and resulted in stations working closely with low-income families in targeted neighborhoods and enhancing their partnerships with community organizations to increase their reach and impact on RTL's target audience. Furthermore, CPB-PBS content producers developed novel and robust education and engagement models, including summer camps, afterschool programs, and online learning courses for early educators and caregivers.

2010-2015 RTL: New Focus on Transmedia

The most recent RTL grant cycle, and the focus of this report, centered on improving early mathematics and literacy skills through transmedia experiences. Competitively awarded funds went to the 2005-2010 recipients (CPB-PBS and WTTW), as well as to the Hispanic Information Telecommunications Network, Inc. (HITN; HITN Press Release, Oct 2010; PBS Press Release, Oct 2010; WTTW Press Release Oct, 2010). While the focus on developing high-quality media products around specific content areas remained the same as in earlier RTL initiatives, three important changes occurred in the 2010-2015 grant cycle (RTL RFP, 2010-2015). First, the DoED made an explicit request for *transmedia storytelling* as the mechanism for delivering early learning content, specifically defined as "conveying content and themes to

audiences through the well-planned, connected use of multiple media platforms (examples include but may not be limited to: television, websites, cell phones, e-books, electronic games, handheld devices, and other yet to be developed technologies)” (RTL Request For Proposals, 2010-2015). Second, the DoED made an explicit request for the development and dissemination of educational outreach materials and programs through multiple innovative technologies and digital media platforms. Finally, the DoED emphasized the evaluation of RTL projects by prioritizing rigorous research methods that align with What Works Clearinghouse and requiring that a significant amount of funding be specifically devoted to evaluation.

Grantees: CPB and PBS

In the 2010-2015 RTL grant cycle, CPB-PBS committed to delivering high-quality transmedia content to improve math and literacy skills via the Internet, broadcast television, and other dynamic new technologies and community engagement resources. The two organizations provided a comprehensive grant proposal document in which they state their primary objectives of their awarded initiatives (See PBS, 2011):

- 1) Align all content with academic standards and develop new pre-K and early elementary curriculum frameworks for mathematics and literacy.
- 2) Create new mathematics media properties and enhance literacy content.
- 3) Pioneer new styles and methods of gaming, including multiplatform gaming suites, augmented reality, 3D-rendered multiplayer games, and an immersive game.
- 4) Design dynamic new tools for educators and families that aggregate and customize resources and monitor children’s progress.

- 5) Engage leading national partners in the development and deployment of educational resources to children and communities in need.
- 6) Enlist public television stations and community partners in year-round, on-the-ground efforts to test and implement new resources and methods to benefit young children, families, and educators in home, school, and out-of-school settings.
- 7) Conduct extensive research on and evaluation of the design and learning impacts of media content and the overall effort to pave the way for even more effective programs in the future.

CPB-PBS partnered with three independent research and evaluation groups for the 2010-2015 RTL grant cycle: the Education Development Center (EDC), SRI International, and WestEd. EDC and SRI collaborated to evaluate the *PBS KIDS* Transmedia Suites and the *PEG+CAT* transmedia property on preschool children’s early math learning, with a particular focus on counting; subitizing; number recognition; shape recognition, composition, and representation; and patterning. An additional focus on Approaches to Learning (ATL) skills was included in the *PEG+CAT* evaluations. WestEd evaluated preschool children’s learning from the *PBS KIDS* Transmedia Suites, the *Curious George* Transmedia Suite, and the *Measure Up!* app. The first WestEd evaluation focused on numbers and operations in base ten, measurement and data, algebraic thinking, and geometry and spatial sense; the second on numeracy; and the third on measurement. WestEd also evaluated elementary school children’s learning from *The Electric Company* and the *Odd Squad Math* Transmedia Suite. The former focused on math and literacy, with a

specific emphasis on place value, addition, subtraction, measurement, data analysis, and time, as well as phonics related to letter-sound knowledge. The latter focused on math content related to algebraic thinking and numbers and operations. All CPB-PBS evaluations also included parent and/or teacher components to better understand how additional resources and support materials aided adults in their awareness and support of young children's math development; their comfort with early math concepts; and their attitudes toward and self-efficacy in using digital media as learning tools.

Grantees: HITN

As part of its RTL grant, the Hispanic Information and Telecommunications Network (HITN) assembled the Early Learning Collaborative (ELC) to produce transmedia suites for preschoolers, with a special focus on low-income children and English language learners (ELL). More specifically, ELC, in collaboration with Zinkia Entertainment, developed age-appropriate and scaffolded transmedia learning experiences to support early math and literacy skills identified by the National Early Literacy Panel, the National Reading Panel, the National Research Council, and the National Mathematics Advisory Panel, as well as reflected in the 2010 Common Core Standards. ELC also focused on developing transmedia materials that support language development for children whose primary language is Spanish. The resulting media properties—a set of *Pocoyo Playgrounds* targeting literacy, math, and English language development—offer multi-platform experiences, including books, websites, mobile apps, handheld games, touchscreen apps, broadcast TV/DVDs, and audio CDs. The Michael Cohen Group (MCG) served as the external evaluation

partner for ELC. The first *Pocoyo* evaluation assessed early literacy skills and vocabulary acquisition among 3- to 5-year-old English Language Learners, with a particular focus on English language fluency, target vocabulary, and attitudes toward learning English. The second evaluation focused on early literacy skills, especially vocabulary related to colors and community helpers, in a broader population (i.e., not specifically ELL) of preschool students.

Grantees: WTTW

Windows on the World Communications (WTTW) Chicago Public Media partnered with DHX Media's Chief Content Officer and Executive Producer Tina Peel on creative production and The Michael Cohen Group for research and evaluation to develop the *World of UMIGO* (yoU Make It Go). The *UMIGO* curriculum team was led by President and Founder of MediaKidz Research & Consulting Dr. Shalom Fisch, in collaboration with Drs. Carole Greenes and Kevin Clark. The WTTW partnership was dedicated to increasing children's numeracy acquisition, mathematics achievement outcomes, and digital competency through the development and creation of a transmedia-based mathematics curriculum that is presented across multiple platforms. In particular, the first *UMIGO* evaluation assessed arithmetic, inequalities, capacity, and measurement with a sample of 1st and 2nd graders, while the second evaluation focused on addition, skip counting, measurement of height and length, and 2D-shapes with a sample of K-2nd graders.

Focus on Public Transmedia

In the 2010-2015 RTL program, the Department of Education maintained its two primary foci of preparing children for school readiness and future academic success with an emphasis on

low-income families. For the first time, however, there was an explicit request for the development and dissemination of educational outreach materials and programs to occur through the use of multiple innovative technologies and digital media platforms. Further, the Request For Proposals explicitly asked that applicants use “transmedia storytelling” to deliver early learning content. The notice states, “Transmedia storytelling means conveying content and themes to audiences through the well-planned, connected use of multiple media platforms (examples include but may not be limited to: television, Web sites, cell phones, e-books, electronic games, handheld devices, and other yet to be developed technologies)” (RTL RFP, 2010-2015). This definition of “transmedia storytelling” was influenced by extensive conversations with Jesse Schell at Schell Games, who had given a presentation about transmedia models at PBS (PBS Interview, Jan., 2016), and primarily based on work done by Henry Jenkins, one of the leaders in the field. Jenkins (2007) defined transmedia storytelling as “a process where integral elements of a fiction get dispersed systematically across multiple delivery channels for the purpose of creating a unified and coordinated entertainment experience.” Given that transmedia was a relatively new concept in 2010, and due to rapid advancements in technology (e.g., the introduction of the iPad), the term “transmedia” and the way the grantees defined and thought about it changed considerably over the course of the grant period, which played an important role in the eventual products and programming that were developed. In 2010, the term “transmedia storytelling” largely referred to storytelling that occurred on multiple platforms. As a result, some of the early

attempts at transmedia experiences began with expanding already available properties, adding new content, and trying to utilize this content on novel platforms. For example, CPB-PBS used the power of its national-local broadcast service to distribute *PBS KIDS* television shows and the *PBS KIDS* website to deliver online games and videos. However, at that moment in time producers were not yet thinking about how they could intentionally integrate content across platforms to support greater learning. In retrospect, some of the grantees reported problems with this initial approach, noting that it resulted in “a bunch of stuff on multiple platforms that largely had nothing to do with each other” (Interviews, 2015). Indeed, as one individual at PBS noted, in order for transmedia to be successful, “The narrative at its core had to come from a single creator or creative team. The creator of the show would also be connected to the development of the game design and outreach materials so there would be a common thread across production” (PBS Interview, Jan 2016). Other grantees, like WTTW, developed entirely new content for their 2010-2015 RTL initiative. For example, during the first years of the grant, WTTW’s producers created pieces of *UMIGO* content that were effective independently but not working together to enhance learning.

One particular challenge facing producers involved storyline and curricular coherence. Due to different media components being created on different production cycles and distributed in disjointed ways, producers found it difficult to create coherent material that could sustain the disruption that resulted from the move across media platforms. In the middle of the grant cycle, WTTW realized that the original approach to creating quality transmedia content was not

meeting its expectations. WTTW hired a new content specialist, Sholly Fisch, who used his experience working on cross-platform content from *Cyberchase* (a PBS KIDS media property) to enhance the transmedia experience of *UMIGO*. Specifically, Fisch reported that he used parts of Henry Jenkins' (2007) conceptualization of transmedia by putting an emphasis on "creating cross-platform content that was part of the same experience" (Fisch Interview, 2015). However, beyond focusing solely on the storyline, Fisch and the production team tried to match the unique attributes of each media platform to specific learning goals. For example, *UMIGO* used online videos to provide viewers with exposure to examples of using math to overcome problems. These videos were followed by appisodes—a digital experience in which the video pauses to allow the user to interact or play with game-like content—in which the child has to make the correct answer to solve the problem. The problems increased in difficulty over time, and as the child mastered the problems in these appisodes, new online games and videos were unlocked, providing him or her with increasingly challenging but related content. This new concept of transmedia focused on utilizing the strengths of each individual delivery system to enhance the learning experience.

The definition and concept of transmedia changed over the course of the grant partially because of the experiences of the producers and the results of the evaluations but also as a function of the change in the technological environment that children were living in. The first iPad was released in January 2010, and there was interest in and access to tablet technology by young children almost immediately. The addition of this new

technology to the digital media space played a prominent role in redefining the transmedia concept and thinking about the way children use media as a whole. Instead of using different devices to access different pieces of content—for example, watching children's television programing on a TV and accessing websites on a computer—children could engage in almost all digital media experiences on this one device. This played an important role in changing the original idea of "transmedia storytelling" because it rendered the platform less relevant.

Learning from Public Transmedia

The 2010-2015 RTL projects' evaluated the effectiveness of transmedia math and literacy experiences on young children's (2-8 years old) learning at home and in school, with an additional emphasis on supporting caregivers and teachers in using educational media to promote early learning. Across the 15 effectiveness studies, researchers found positive—and often significant—associations between transmedia engagement and children's learning, as well as important influences of the transmedia experience on caregiver and teacher attitudes and confidence around technology and early learning.

Given the breadth of media properties, modalities, content, assessment instruments, and participant populations, it is impossible to review the nuanced details of each study in this policy report. Instead, we highlight findings below that exemplify broader conclusions across the diverse RTL projects that speak to the specific research and policy implications described in Sections 4 and 5 of this report. For more detailed information, we provide a summary of each home study in Appendix B and

each school study in Appendix C. Importantly, it should be noted that only one study (MCG, 2015) assessed the effectiveness of each independent element (e.g., media modality, platform, content, supplemental teacher and parent resources) that comprised the transmedia experience, with the majority of research measuring the “effectiveness” of the interventions in terms of the holistic transmedia experience. Consequently, the findings discussed in this report primarily reflect the child, parent, and teacher outcomes from the entirety of the transmedia interventions.

Learning At-Home

All seven RTL studies that took place in or simulated³ the home environment focused on early math learning, with one study (Pasnik, Moorthy, Llorente, Hupert, Dominguez, & Silander, 2015) also measuring children’s approaches to learning (ATL). Five studies focused on the preschool age group and evaluated the *PBS KIDS Transmedia Math Suites* (McCarthy, Li, & Tui, 2012; McCarthy, Li, Atienza, Sexton, & Tui, 2013; 2015), the *PEG+CAT* transmedia property (Moorthy, Llorente, Hupert, & Pasnik, 2014; Pasnik et al., 2015), and the *Lost Lagoon*⁴ app (WestEd, 2015). One study focused on K-2nd graders and evaluated *UMIGO* (MCG, 2015).

Child Findings. Across all evaluations, researchers found positive associations between at-home transmedia engagement and children’s math learning. Findings held across different transmedia properties, with some variation in the significance of the findings. For example, while

all intervention children in the *PBS KIDS Transmedia Math Suites* made greater gains on the Test of Early Mathematics Abilities (3rd ed.; TEMA-3; McCarthy et al., 2012; WestEd, 2015), only very young children (3-year-olds) made significantly greater gains than comparison children on the Children’s Math Assessment (McCarthy et al., 2013); additionally, children in the intervention group made greater gains in recognizing some specific shapes, but not all shapes. For the *PEG+CAT* evaluation (Pasnik et al., 2015), children in the intervention group made significantly greater gains on 3D shapes, ordinal numbers, and spatial relationships compared to the comparison condition, but no differences were found between groups for teacher ratings of children’s approaches to learning, understanding of math concepts, or problem solving. Similar findings were reported for the *UMIGO* transmedia experience (MCG, 2015), where children from the treatment and comparison conditions both made positive gains in all math content assessed, but the intervention group made significantly greater gains only on 2D geometric shape knowledge. However, this was one of the few evaluations to explicitly investigate the effects of different transmedia components and moderation effects, finding that time spent viewing the 2D shape episodes was significantly associated with performance on the 2D assessment. These results provide preliminary insight into the value of appisodes in particular as well as the importance of repeated viewing of appisode content for children’s learning.

Parent Findings. All home studies provided intervention group parents with some type of support in addition to access to the specific transmedia content. In particular, parent support

³ While the *PEG+CAT* content study (Moorthy, Llorente, Hupert, & Pasnik, 2014) occurred in a lab setting, we considered it a “home” study because parents were present during the lab visits and this evaluation occurred as a precursor to the larger *PEG+CAT* home study evaluation.

⁴ At the time WestEd conducted the evaluation, *Lost Lagoon* was the working title of an app that PBS plans to release in spring 2016 as *Measure Up!*

included curated content guides, suggested supplemental activities, technical support, video models of joint media engagement, and weekly parent meetings. Parents received support related to using media for learning as well as for understanding early math development more generally. Additionally, in the *Lost Lagoon* evaluation (McCarthy et al., 2015), parents were specifically included in the transmedia intervention through the use of PBS KIDS *Super Vision*, a Smartphone app that allowed parents to check in and track their children's progress in the *Lost Lagoon* transmedia adventures.

Across the home studies, findings showed intervention parents increased in their awareness of their children's math learning and were more likely to engage in activities and strategies to aid their children's math learning. Parents also reported connecting transmedia content to everyday activities and creating opportunities for math learning throughout the day. For example, in the *Lost Lagoon* intervention (McCarthy et al., 2015), parents in the intervention group made significantly greater gains in their awareness of their children's math development compared to parents in the comparison condition. Parents also reported intentionally seeking out opportunities to integrate math concepts from *Lost Lagoon* into everyday life, and they felt they grew in their ability to use digital media and technology to support learning. Similarly, in the *PEG+CAT* home study (Pasnik et al., 2015), a larger proportion of intervention parents reported helping their children with less common math skills (drawing shapes, subtraction, and measurement) and engaging in problem solving activities and strategies with their children compared to a comparison group of parents. A significantly larger proportion of intervention parents also

reported using technology with their children and joint media engagement, compared to parents in the comparison group.

Interviews with individuals at PBS provided additional context for the impact on parents. Specifically, there was evidence of improved parent self-efficacy around math skills as a function of engaging with the content with their children. As Sarah DeWitt (PBS), stated, "Early on, parents thought math was hard and didn't have a lot of self-efficacy, but after experiencing the content with their kids, they felt relieved and increased confidence in understanding early math and what their kids need to learn."

Teacher Finding. Given the focus on at-home transmedia experiences, few home studies included any measures related to teachers. Only one study explicitly focused on preschool staff, albeit to a much lesser extent than children and parents. In this study, researchers explored the potential of a scale-up and sustainability model of prior evaluations by training local preschool teachers to facilitate weekly parenting meetings (WestEd, 2015). Findings from researcher observations and teacher interviews showed that preschool teachers not only succeeded in facilitating the meetings with fidelity but also increased and deepened parent engagement with the preschool. In particular, teachers reported enjoying facilitating the meetings and felt they were an integral factor in parents' growth in awareness of and ability to support children's learning and development.

Learning At-School

The eight RTL school studies⁵ that either took place in schools or in informal out-of-school

⁵ The Electric Company Summer Program study (McCarthy, Michel, Tiu, Atienza, Rice, Nakamoto, & Tafoya, 2011), Curious George content study (McCarthy, Tiu, & Li, 2014), and the Odd Squad Math content study (Tiu, McCarthy, & Li, 2015) were considered "school" studies for the purposes of this report.

settings (i.e., summer camps) were more diverse in terms of target age group, content, and structure than the home studies. Two preschool-focused studies evaluated the effects of a curated transmedia math supplement on children's math and self-regulation outcomes (Pasnik & Llorente, 2012; 2013), while a third measured math learning from the *Curious George* transmedia suite (McCarthy, Tiu, & Li, 2014). An additional two studies evaluated literacy outcomes for preschool-aged children who engaged in free play with *Pocoyo Playssets* (MCG, 2013) and *Pocoyo Playgrounds* (MCG, 2015). The final three studies focused on kindergarten through second grade, with one investigating math and literacy outcomes from *The Electric Company Summer Program* (McCarthy, Michel, Tiu, Atienza, Rice, Nakamoto, & Tafoya, 2011), a second focusing on math outcomes from free play with the *UMIGO* transmedia property (MCG, 2015), and the third evaluating math learning from the *Odd Squad Math* transmedia suite (Tiu, McCarthy, & Li, 2015).

Child Findings. All of the school-based evaluations found positive associations for at least some students in the intervention groups. Of note, three studies that used free-play approaches for transmedia engagement only found positive effects for specific math concepts and targeted vocabulary for specific subgroup populations (MCG, 2013; 2015; McCarthy et al., 2014). The remaining three school studies used curated content and found more consistent positive effects for children who engaged with the transmedia properties (McCarthy et al., 2011; Pasnik & Llorente, 2012; 2013).

Anecdotally, curated curricula may be more effective due to the teacher playing a larger role in the guidance and scaffolding of children's

media use, which has been shown to be important for children's learning from quality educational media (e.g., Yelland & Masters, 2007; Mouza & Barrett-Greenly, 2015). Additionally, the learning media and pathways were carefully curated to guide children through different learning concepts in developmentally-appropriate sequences, which also could lead to more consistent learning gains. Indeed, one evaluation, a pilot study, compared a curated transmedia curriculum with a curated hands-on curriculum, and no differences were found in overall learning gains (Pasnik & Llorente, 2012). However, the formal large-scale evaluation found that children in curated transmedia classrooms made significantly greater achievement gains compared to students in the control condition as well as those in a second comparison condition where teachers had access to the same technology, professional development, and coaching as the transmedia condition, but who did not have a curated media-based curriculum (Pasnik & Llorente, 2013).

Importantly, the differences in duration, methodologies, and media properties between free-play and curated evaluations—as well as between the curated evaluations themselves—makes it difficult to draw any definitive conclusions as to whether free play transmedia experiences are less effective than curated ones. Additionally, there may be different—but equally valuable—outcomes that can arise from free play with transmedia other than academic gains. Indeed, one of the original intentions of the CPB-PBS RTL initiative was to take a closer look at children's media use in more natural, less mediated settings given that public media content is able to go directly to all households, regardless of socioeconomic background.

Results from the *Curious George* content study

(McCarthy et al., 2014) showed important initial findings on how self-directed free play with media can lead to increases in collaborative learning and math discourse among preschoolers, which, in turn, can provide opportunities for children to build social-emotional skills (e.g., sharing, cooperating, listening, communicating). As such, while findings suggest that teacher guidance and/or using a specific curricular sequence are important considerations for children's academic learning, other benefits may arise from free play and self-directed engagement with transmedia in the early childhood classroom.

Parent Findings. Given that the school studies took place primarily in formal educational settings, few examined any parent outcomes. However, two content studies explicitly involved parents as part of the interventions. The *Curious George* study (McCarthy et al., 2014) asked parents to have their children watch three *Curious George* episodes at home over the four-week study period, but no parent outcomes were measured. The *Odd Squad Math* evaluation (Tiu et al., 2015) involved a more rigorous transmedia component at home, including co-viewing of five full-length *Odd Squad* episodes and accompanying activities all sequentially aligned to the school transmedia experience. Qualitative data analysis revealed that parents enjoyed co-viewing and co-engaging in the *Odd Squad Math* activities with their children and that they were inspired to create their own activities to support children's learning. They also felt that *Odd Squad Math* helped their children learn the target math skills. However, neither of these evaluations disentangled the effects of the at-school and at-home components of the intervention, nor did they compare children who had only at-school experiences,

only at-home experiences, both experiences, and no transmedia engagement.

Teacher Findings. The RTL school studies resulted in positive outcomes for teachers who used the transmedia properties in their classrooms. Of note, teachers gained confidence in their own math knowledge and math teaching abilities as well as learned new instructional strategies, especially pertaining to using technology to teach math. Further, in the *PBS KIDS* Transmedia Math Supplement evaluation, significantly more teachers in the *PBS KIDS* Transmedia and Technology and Media conditions used technology to teach math concepts, compared to teachers in the control condition (Pasnik & Llorente, 2013). Additionally, those in the *PBS KIDS* Transmedia condition also required less ongoing coaching support for using technology and new instructional strategies, compared to the Technology and Media condition. This suggests that the addition of a curated curriculum made it so that teachers did not need as much just-in-time support (e.g., on-site coaching) over the long-term and felt confident in their ability to effectively integrate digital media supplements into their classrooms.

Perhaps most important, the evaluation of the *PBS KIDS* Transmedia Math Supplement is one of the only studies in the field of children's educational media to provide causal evidence of positive changes in teacher attitudes as a result of a technology intervention (Pasnik & Llorente, 2013). In particular, the *PBS KIDS* Transmedia teachers had significantly greater increases in their beliefs about the benefits of technology in preschool education compared to the control group teachers. Given that technology attitudes are the most difficult to change while also being the most critical to effective technology

integration (e.g., Blackwell, Lauricella, Wartella, 2014; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Koehler, Mishra, & Cain, 2013), these findings are of utmost importance for educators and policymakers alike in understanding what supports and resources are required to shift teacher attitudes in order to make a more positive impact on teaching and learning. In particular, providing educators with up-front and ongoing training alongside high-quality educational media that is curated into a sequenced curriculum and, along with support, appears to be effective.

Challenges to RTL Research and Development

The Department of Education's RTL grant program has led to many positive outcomes in the production and delivery of educational children's media; however, grantees encountered several challenges that impact the overall findings. In the 2010-2015 grant cycle, one particularly powerful challenge came about due to the rapid change in technology with the introduction of the tablet computer. While the initial Request For Proposals anticipated changes in touchscreen technology and the multiplatform digital world, no one could have predicted the powerful impact that touchscreen tablets would have on the digital lives of young children. Unlike passing fads, tablet computers not only became the norm in a child's life, but they sustained their popularity in the lives of children and families. Further, educators and researchers viewed the tablet as having developmentally appropriate properties (e.g., the touchscreen allows for direct manipulation instead of requiring motor skills and hand-eye coordination of a computer and mouse).

Consequently, the meaning of transmedia, the main focus of this round of funding, changed dramatically as a result of this digital tidal wave in children's media. This change required grantees to reconceptualize not only how they delivered content, but also how they specifically developed content in order to leverage the unique capabilities of such a dynamic device.

A second challenge was one of methodology. A key premise of transmedia is that the connected digital media experience is greater than the sum of its parts and therefore should be measured as a complete "package." This becomes problematic when researchers are trying to assess aspects of learning, which may be enhanced or supported on one platform more than another or with one type of media experience compared to another. As a result, the majority of studies in this round of the RTL grant did not test or distinguish the effectiveness of the individual components of the transmedia experience. Because producers, researchers, and educators did not study how learning differs as a function of platform (e.g., video, interactive game, touchscreen tablet), it is difficult to know which content and storylines are best for each part of the transmedia experience. Relatedly, this round of RTL funding resulted in the development and testing of multiple and different transmedia "suites," or content collections, which were assessed for their overall contributions to children's learning. While children learned from these transmedia suites experiences, specifically what they learned varied across the studies and content suites. Because each of the media experiences were so different, it will be difficult to generalize these findings to the development of other children's media experiences. As such, while conclusions can be made about the overall experience that

children, teachers, and caregivers encountered, there is no way to understand whether or which specific parts of the transmedia suites were more effective in driving such outcomes.

Finally, a third challenge related to the external validity of findings. While it was important to study some of these transmedia properties in naturalistic contexts (e.g., classrooms, homes) with specific populations (e.g., low-income, urban areas), it is difficult to ensure the validity of these results in more generalized settings. Additionally, while many of the studies included diverse populations, in terms of geographic location, age, race/ethnicity, and income, none were nationally representative, such that drawing conclusions about the effectiveness of these transmedia experiences for all children may be unwarranted. That said, given the limited number of existing studies of this size and scope that use such rigorous methods, the findings from the RTL 2010-2015 studies are foundational for our understanding of how public media can be used to enhance young children's learning.

Policy Recommendations

Public media serve an important and unique place in education as public media are free and reach 99% of American households. Not only do children learn directly from experiences using public media, but parents and community members are supported by the outreach provided by public broadcast stations, and teachers receive professional development and support from publicly available websites. In response to the important bond between the public/private partnerships that are developed through the RTL grant, we heard from grantees, "There is no one entity or sector that can do this alone and think about underserved kids and how to leverage the

technology to have a positive impact on kids at home, school, and in the community. [The RTL grant] demonstrated how well public media can coordinate these partnerships" (PBS Interview, 2016). Furthermore, public media supported through programs like RTL create high-quality, well-researched media experiences which raise the expectations of all other media development. As a result, the commercial marketplace has tended to look towards public media outlets for innovations in educational media and have been forced to create high-quality, competitive programming. As Michael Cohen from The Michael Cohen Group stated, "If RTL went away, it would lower the bar on children's entertainment and education policy."

Historically, the best example of this is the manner in which *Sesame Street* demonstrated the educational potential of television and led to commercial development of educational programming such as the Nickelodeon television channel.

Indeed, the Ready to Learn projects demonstrate that public media can go beyond traditional television content to help prepare preschool children for schooling and to help parents and teachers in that process, making RTL funding unmatched in its impact on the early childhood educational media environment. Nonetheless, we do have several policy recommendations for future RTL projects, academics and others interested in understanding the impact of media on young children's learning.

Policy Recommendation #1: Support for rigorous scientific research that informs media developers and the general public in addition to academic audiences.

The RTL projects consistently provide content-specific results based on understandably small,

controlled experiences. The required research component of RTL has, in Cohen's view, "raised the bar and demanded a higher level of scientific evidence of effectiveness" (Interview, 2015). Continued efforts through rigorous research are required to ensure advancement in understanding children's educational media experiences across multiple platforms and content and in a variety of contexts. This research will also provide greater leverage to the generalizability of current findings and can be used to inform the development of future educational media properties. We recommend that funding continue to require rigorous scientific research on the effectiveness of products and be supplemented to include more academic research that can address several methodological limitations in order for this research to be more applicable and relevant to a broader audience. We suggest three ways in which future research can be conducted to support the generalizability of the findings.

First, it is important to disentangle some of the effects of the individual pieces of the transmedia experience in order to have a better understanding of how to best match specific content to specific educational capabilities. For example, it may be that a video with a storyline narrative is most effective for teaching literacy skills but that interactive games may be more effective for supporting children's understanding of math or science concepts. While there is value in understanding how the entire transmedia package supports learning, we also need to determine if all components are equally necessary and supportive of the overall outcome. Notably, an important goal of the RTL Program is scaling up the products and models for broad dissemination. Thus, understanding whether all components are necessary to achieve the same

learning outcomes becomes crucial as limitations on resources preclude broad reach.

Second, several of the research studies used different instruments to measure learning. This included different standardized assessments to test similar content areas, different decisions on whether to use researcher-developed assessments, and different decisions as to whether those researcher-developed assessments should be specifically aligned with the content. While diverse measures may provide some evidence of knowledge transfer, this also limits generalizability of the findings. If different transmedia experiences support children's learning of some shapes, but the learning is measured in different ways with different instruments, it is difficult to make clear, conclusive statements about the overall findings.

Additionally, while researchers are certainly limited in the number of skills they can measure and therefore must carefully select from the myriad of concepts often taught throughout the transmedia experience, this results in research findings that assess only part of the transmedia experience. Future initiatives may benefit from more coordinated efforts across projects to decide up front which assessments best measure the focal learning concepts to support the generalizability of the research findings.

Third, while several studies attempted to understand and control the dosage of the transmedia experience, no clear measures were consistently used. Indeed, studies used media diaries and logs, researcher observations, and back-end user data analytics, all of which have particular benefits and drawbacks. Indeed, while the UMIGO study (MCG, 2015) used back-end user data to show important moderation effects from time spent using episodes, this type of

data does not provide more detailed information on how children engaged with the digital media. On the other end of the spectrum, media diaries do not produce as detailed and accurate accounts of time spent on particular media components, but they can provide more contextual information about the child's experience. Triangulation of these various data collection strategies will be an important consideration moving forward as the types of media and technology engagement that children can have continues to evolve.

Further, the studies often failed to account for the comparison group's exposure to media as well as the treatment group's exposure beyond the intervention. Indeed, if children in the comparison group were informally exposed to the same properties as children in the treatment group, it becomes unsurprising when no differences, or only small differences, are found on learning outcomes. Further, even children in the treatment group may have had very different dosages of the transmedia experience during the intervention and exposure to other media content and experiences outside of the intervention. It is likely that there are cumulative effects of educational media experiences and these related variables should be included in assessments. As such, understanding implementation on a more granular level than just "Did they get the treatment or not?" will provide a more detailed understanding of the effectiveness of the transmedia experience.

Policy Recommendation #2: Support for dual-generation research that examines the effects of media on children when supported by parents, caregivers, or teachers.

A related recommendation focuses on the parents' involvement in children's learning from

educational media content. We suggest that there should be research that assesses learning using a dual-generation approach. While there are many opportunities for children to engage with technology independently (e.g., smaller screens and more mobile technology), this does not mean that parent or teacher involvement and support is not valuable. Prior research has also shown that parent-child co-use of media can positively influence parent efficacy, child learning, and parent-child relationships (e.g. Lauricella, Barr, & Calvert, 2014), but a necessary precursor is that parents actually know how to engage with their children during media experiences. Several of the 2010-2015 RTL studies began this research and demonstrated that parent supports for joint media engagement led to increases in parent engagement and self-efficacy, which are essential for children's learning and development. As Shelley Pasnik of EDC remarked, "Part of our findings have to do with learning games for kids, but just as important is the shift in parent and caregiver attitudes. Parents reported having greater confidence when thinking about math and engaging together in game play and exploration." (Interview, 2015). Considerably more research is needed in the transmedia environment to understand the dual-generation use of newer media technologies and platforms. The studies of parents in this round of RTL funding demonstrate the continued need for this type of research and for better measures of joint media engagement to be developed in order to properly assess how parents and children engage with media together.

Policy Recommendation #3: Support early learners by increasing connections between home, school, and communities.

The studies conducted in the 2010-2015 RTL funding period not only assessed the value of educational media on children's learning but considered learning in the broader context of children's lives by incorporating both parents and teachers into the studies. We recommend funding to directly educate and support teachers' professional development, to support the connections between the home and school learning environments through digital media and interpersonal interactions, and to scale up community outreach to ensure that the individual parts of the child's microsystem are connected and communicating.

One major finding from these reports was the crucial role that teachers play in the effectiveness of early educational media experiences. Teachers, when supported and properly trained, are critical assets to the effectiveness of educational transmedia experiences. That being said, it was evident from the interviews with the RTL projects' advisor group members and those that supported the research in the field that many teachers lacked professional development. Indeed, preschool teachers commented that, in addition to this general lack of professional development, there is a lack of support related to the use of educational media in their early childhood classrooms. Specifically, Yolanda Garcia, a practitioner and director of an early childhood program in Silicon Valley stated, "The RTL materials were readily embraced and highly valued [by teachers], but there was a request for more materials and modeling of how to integrate the materials in the classroom" (Interview, 2015). As a result, we strongly recommend that

policy measures be taken to enhance early childhood professionals in their professional development related to technology and media. While providing technology devices and media is a first step, neither is effective without the additional resources provided to teachers, including upfront and *ongoing* professional development. Indeed, evidence from the RTL studies showed that when professional development was provided through RTL resources, children *and* teachers excelled. As such, future initiatives that focus on improving early childhood educators' professional development experiences are essential to ensuring the highest quality and most effective use of media in the classroom.

While the 2010-2015 RTL grant cycle included transmedia interventions targeting the home and school environments, only one study evaluated the value of embedding the transmedia experience across the two contexts. While research suggests that strong home-school connections aid children's learning and development (Bempechat, 1998) and that media may be a way to enhance such connections (Strickland & Morrow, 1991), much of the work has focused on enhancing the parent-teacher relationship through online platforms, apps, and social media. Few have investigated how a child-directed transmedia experience that traverses technology *and* context can aid parent engagement, the home-school connection, and ultimately a child's learning. While the *Odd Squad Math* evaluation (Tiu et al., 2015) showed promising results for children's learning, the limited sample and non-experimental methods make it necessary to pursue these initiatives further. As such, the time is ripe to develop and test media initiatives that engage the entire community of adults in a child's life.

Policy Recommendation #4: Increase broadband Internet access in early childhood education settings.

In keeping with the federal Ready to Learn Program's mission to support early learning through public media, the current RTL Program has overlooked a key element to achieving this goal: *infrastructure*. While policies such as the federal E-Rate initiative currently provide subsidies to low-income schools for Internet access, the program primarily funds the K-12 sector, with Head Start the primary early childhood education beneficiary. Further, the E-Rate program only ensures that children have Internet access at school, not at home or in community learning settings. There is still a considerable digital divide (Rideout, 2013), especially with regard to access to broadband Internet access. Several of the 2010-2015 RTL projects had to provide Internet access to childcare providers and families in order to conduct the evaluations. As one PBS team member noted, "It actually really impacts the education, mobility, economic and work success of citizens. There are still big digital divide issues that have large social and economic implications" (PBS Interview, 2016). While not specifically addressed by RTL, federal support for the distribution of broadband throughout the country is another policy recommendation implied by this RTL initiative. Such discussions are underway nationally.

Conclusions and Implications

The evaluation component of the 2010-2015 RTL grant provides convincing evidence that quality transmedia content and learning experiences can support young children's school readiness and early learning at home and in school. In addition to enhancing children's

knowledge and skills in target content areas that help prepare them to learn, these initiatives also supported parents and teachers in enhancing children's future academic success. While these concrete outcomes are beneficial in and of themselves, they also have critical implications for the field of children's media and education more broadly.

Content, Child, and Context

First, while the positive effects of public media are clearly articulated in the RTL evaluations, these studies also bring to light the importance of what Lisa Guernsey refers to as the 3C's—*content, child, and context*, when considering young children's learning from media. Indeed, the RTL transmedia experiences were more than just high-quality digital properties, they included hands-on activities, specially-selected content, repetition of academic concepts, and, in some cases, curated sequential learning activities. Additionally, some of the experiences focused on one media property, such that children engaged with characters and storylines across media platforms, while others aggregated media properties with different characters and stories with similar academic concepts.

Further, while the RTL grant specifically focused on young children in preschool through second grade, several evaluations found moderating effects of child age, baseline achievement, and English proficiency. As such, while all children may benefit from these transmedia experiences, the recognition that some children may have different outcomes based on demographic characteristics is important to remember.

Finally, parents, caregivers, and teachers in the studies often received additional support from local public media stations and other local or

national RTL partners, such as professional development, resource guides and tips on joint media engagement, technology devices and on-demand help, academic content guidance, and space to discuss and reflect on their experiences. Importantly, findings were not as strong or were non-existent when these additional resources were not available, suggesting parents, caregivers, and teachers require structured support to ensure positive learning outcomes from young children's engagement in media. Notably, these resources not only led to better outcomes for children, but also led to shifts in parent, caregiver, and teachers attitudes toward and confidence in using media for learning as well as increased self-efficacy in math concepts and teaching. As such, findings from the RTL evaluations suggest that public educational media content is most effective when additional and complimentary resources for children and the adults in their lives are provided.

Media Production

In addition to the focus on increasing young children's school readiness and success, the RTL Program also prioritizes the development and dissemination of research-informed high-quality, developmentally-appropriate educational media. As a result, RTL funding provides the unique opportunity for producers, educators, technologists, and researchers to collaborate and support each other in the production of world-class educational media for children. While this directly improves the lives of young people by providing educationally sound programs, games, and other educational content in which they can engage, a secondary effect of RTL is that it effectively raises the bar for and expectations of producers and creators of children's media content more broadly.

The importance of this RTL initiative's contribution to the larger children's media field is critical, and has taken the coordination among producers, educators, and researchers to the next level. While the practice of formative and summative evaluation has become more prevalent following the lead of Children's Television Workshop (now Sesame Workshop) in the creation of *Sesame Street* (Fisch & Bernstein, 2001), pressures remain in commercial media to develop products as quickly and cheaply as possible that are sure to entertain young audiences. Consequently, commercial producers do not always have the time or inclination to consult with educators and researchers to experiment with new media formats and concepts nor to ensure that products are developmentally appropriate and of high educational quality. This lack of coordination has become even more prevalent with e-books and apps, where the ease and speed at which they are developed and disseminated has led to hyper competition in the app market and a lack of focus on providing evidence-based, high-quality educational media. Indeed, with over 70,000 apps in the Apple store calling themselves "educational" there is serious concern about the extent to which we have understandable guidelines about which apps are developmentally appropriate and educational for young children (Shuler, 2012; Vaala, Ly, & Levine, 2015). Academic researchers are turning their attention to determining what makes interactive media content educational for young children (e.g., Penuel et al., 2009), and public media products are serving as role models and crucial testbeds for the development of successful educational interactive (trans)media for children.

Because of the support provided by the RTL Program, media developers, educators, and researchers are afforded the time and resources necessary to collaborate on developing and formatively and summatively assessing the novel media products that are not only entertaining and engaging but actually support young children's learning. Importantly, RTL funding provides a space in the media industry that does not traditionally exist—one where producers can try out new ideas, get evidence-based feedback on what works and what does not work, and ultimately develop an innovative media property that has real-world impact on the lives of children, parents and teachers.

Future Research

The 2010-2015 RTL grant cycle provided a strong foundation for future research on and development of educational media initiatives, especially those pertaining to media-rich interventions that include more than one educational media property and platform. As such, the evaluations reviewed in this policy brief suggest important lines of research to pursue moving forward. In particular, the studies highlight the importance of dual-generation media interventions that target both children and the adults (i.e., parents, caregivers, teachers,) in their lives. Additionally, nearly all of the evaluations failed to separate the effects of specific transmedia components, instead viewing the interventions more holistically. Only the *UMIGO* evaluation (MCG, 2015) investigated the effects of each of the three digital media components of the transmedia suites; while only one significant finding emerged, this approach allowed for a closer examination of learning outcomes from particular media elements. Given the emphasis by RTL projects on designing transmedia experiences that exploit the unique

affordances of each media technology to match the specific content and learning objectives, comparing the benefits of each transmedia component will become crucial to future media research. Indeed, understanding whether some components are more critical to learning outcomes than others will be especially important given the cost and difficulty of scaling up such large interventions. Finally, while the 2010-2015 RTL grant cycle included both home and school interventions, none truly traversed the two environments. Given the importance of context and the supporting role of parents, caregivers, and teachers in driving children's successful learning from media, there may be even greater benefits derived from programs that coordinate the media experience across the two settings. In future RTL projects, attention to coordinating media experiences and supports across the home and school environments and the connections between the home, school, and community should be adopted and studied. Crucial questions still remain: Will such coordination boost children's learning from media? Will it have broader effects in providing a richer environment for young children's healthy development?

Summary

The 2010-2015 round of Ready to Learn projects demonstrated that transmedia experiences can have an influence on the child, the parents, and the teachers and school environment.

Specifically, research demonstrated positive associations between transmedia engagement and children's math learning at home, parents' increased awareness of and engagement in their children's math learning, and positive outcomes of school-based transmedia experiences. These studies demonstrate the wide effect that the projects had on not only young children, but

their broader ecological system of parents, caregivers, and teachers as well. The RTL projects also provide insight into the broader potential impacts of such federal investments, and this brief has attempted to address several of these.

First, federal investment in public media provides a test bed for the development of age and developmentally appropriate content for young children's learning that can both influence and inspire media innovation and development by both educational and commercial producers. Second, professional development support for preschool and elementary school teachers is necessary if educators of young children are to adopt and adapt educational media into their classrooms. Unlike previous generations of early childhood educators who may have eschewed the use of educational media in their classrooms, findings from the RTL studies suggest that this is not the case with today's generation of early childhood

educators. They are seeking support for the use of media in the most educationally beneficial ways. Third, providing parents with support for co-engagement around media content with their young children may have a spill-over effect in teaching young parents, and new parents, about the importance of interacting with, talking to and engaging their young children beyond the media content. And the importance of learning good parenting practices goes beyond using the media. For instance, the much-cited 30 million word gap between richer and poorer preschoolers (Hart & Risley, 1995; 2003) could be diminished if all parents realized the importance of talking to their babies and preschoolers with high-quality media as a catalyst. Lastly, the RTL experience suggests that policies that support equitable access to digital media by all children, whether rich or poor, and a broadband infrastructure to support such access are national educational priorities.

References

- Bempechat, J. (1998). *Against the Odds: How 'At-Risk' Children Exceed Expectations*. San Francisco, CA: Jossey-Bass.
- Blackwell, C.K., Lauricella, A.R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education*, 77, 82-90. doi: 10.1016/j.compedu.2014.04.013.
- Blackwell, C.K., Lauricella, A.R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. *Computers & Education*, 77, 82-90. doi: 10.1016/j.compedu.2014.04.013.
- Corporation for Public Broadcasting (n.d.). *Findings from Ready To Learn: 2005-2010*. Washington, DC: Author. Retrieved from: <http://www.cpb.org/rtl/>.
- Ertmer, P.A., Ottenbreit-Leftwich, A.T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teachers beliefs and technology integration practices: A critical relationship. *Computers & Education*, 59, 423-435. doi:10.1016/j.compedu.2012.02.001.
- Hart, B., & Risley, T.R. (1995). *Meaningful Differences in the Everyday Experience of Young American Children*. Baltimore, MD: Brookes.
- Hart, B., & Risley, T.R. (2003). The Early Catastrophe: The 30 Million Word Gap by Age 3. *American Educator*, 27(1), 4-9.
- Hispanic Information and Telecommunications Network Press Release (Oct, 2010). *U.S. Department of Education Awards HITN \$30 Million for Ready to Learn Initiative: Partnership with Callaway Digital Arts and Michael Cohen Group LLC Will Create Learning Apps, and Educational Media for Ready and Math Targeted at Closing Achievement Gap*. Retrieved from <http://www.prnewswire.com/news-releases/us-department-of-education-awards-hitn-30-million-for-ready-to-learn-initiative-105162829.html>.
- Koehler, M.J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? *Journal of Education*, 193(3), 13-19.
- Lauricella, A. R., Barr, R., & Calvert, S. (2014). Parent-child interactions during traditional and computer storybook reading predict children's story comprehension. *International Journal of Child-Computer Interaction*. doi: 10.1016/j.ijcci.2014.07.001.
- Mouza, C., & Barrett-Greenly, T. (2015). Bridging the *app gap*: An examination of a professional development initiative on mobile learning in urban schools. *Computers & Education*, 88. doi:10.1016/j.compedu.2015.04.009.
- PBS Press Release (Oct, 2010). *The Corporation for Public Broadcasting and PBS Receive Ready To Learn Grant Funding from the U.S. Department of Education: Grant to Provide Funding for Math and Literacy Content for Young Children*. Retrieved from: <http://www.prnewswire.com/news-releases/the-corporation-for-public-broadcasting-and-pbs-receive-ready-to-learn-grant-funding-from-the-us-department-of-education-105023934.html>.
- PBS (2011). *Public Media's Commitment to Early Learning*. Washington, DC: Author. Retrieved from: <http://pbskids.org/readytolearn/commitment.html>.

- Penuel, W.R., Pasnik, S., Bates, L., Townsend, E., Gallagher, L.P., Llorente, C., & Hupert, N. (2009). Preschool teachers can use a media-rich curriculum to prepare low-income children for school success: Results of a randomized controlled trial. New York, NY: Education Development Center; Menlo Park, CA: SRI International. Retrieved from: <http://www.cct.edc.org/rtl/pdf/RTLEvalReport.pdf>.
- Public Television Affinity Group Coalition (n.d.). *Ready to Learn*. Retrieved from http://www.ptv-agc.org/06RoundRobins/08_obrien_ready_to_learn.pdf.
- Shuler, C. (2012). *iLearnII; An Analysis of the Education Category of the iTunes App Store*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop. Retrieved from: <http://www.joanganzcooneycenter.org/wp-content/uploads/2012/01/ilearnii.pdf>.
- Strickland, D. S., & Morrow, L. M. (1991). Making Home-School Connections: Using the Sesame Street Magazine and Parents' Guide with Kindergarten Children and Their Parents. *The Reading Teacher*, 44(7), 510.
- Vaala, S., Ly, A., & Levine, M.H. (2015) *Getting a read on the app stores: A market scan and analysis of children's literacy apps*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop. Retrieved from: http://www.joanganzcooneycenter.org/wp-content/uploads/2015/12/jgcc_gettingaread.pdf.
- WTTW Press Release (Oct, 2010). *WTTW/Chicago Receives \$32.5 Million grant from U.S. Department of Education to Develop Multi-Media Property Created by Yo Gabba Gabba! Executive Producer: Grant Awarded to Fund Development of UMIGO; W!LDBRAIN Entertainment to Develop Property in Collaboration with WTTW and The Michael Cohen Group LLC, Project Evaluator*. Retrieved from: <http://interactive.wttw.com/about/pressroom/2010/10/14/wttwchicago-received-325-million-grant-us-department-education-develop>.
- Yelland, N., & Masters, J. (2007). Rethinking scaffolding in the information age. *Computers & Education*, 48, 362–382. doi:10.1016/j.compedu.2005.01.010.

Appendix A: References for 2010-2015 RTL Reports

- McCarthy, B., Michel, L., Tiu, M., Atienza, S., Rice, J., Nakamoto, J., & Tafoya, A. (2011). *Evaluation of The Electric Company Summer Learning Program*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: WestEd.
- McCarthy, B., Li, L., & Tiu, M. (2012). *PBS KIDS transmedia mathematics suites in preschool homes*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: WestEd.
- McCarthy, B., Li, L., Atienza, S., Sexton, U., & Tiu, M. (2013). *PBS KIDS mathematics transmedia suites in preschool homes and communities*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: WestEd.
- McCarthy, B., Tiu, M., & Li, L. (2014). *Learning Math with Curious George: PBS KIDS Transmedia and Digital Learning Games in the Preschool Classroom*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: WestEd.
- McCarthy, B., Li, L., Tiu, M., Atienza, S., & Sexton, U. (2015). *Learning with PBS KIDS: A study of family engagement and early mathematics achievement*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: WestEd.
- Michael Cohen Group. (2013a). *Effects of interaction with Pocoyo PlaySets on preschool (Spanish) ELL children's English language learning: A randomized controlled trial*. New York, NY: Michael Cohen Group.
- Michael Cohen Group. (2013b). *Effect of the UMIGO transmedia property on first and second grade students' math ability: A randomized controlled trial (RCT) study*. New York, NY: Michael Cohen Group.
- Michael Cohen Group. (2015a). *Effect of the UMIGO transmedia property on first and second grade students' math ability. Summative evaluation B: randomized controlled trial (RCT) study – year 4 & 5*. New York, NY: Michael Cohen Group.
- Michael Cohen Group. (2015b). *Children's learning through transmedia materials: A clustered randomized controlled trial of two Pocoyo PlayGrounds*. New York, NY: Michael Cohen Group.
- Moorthy, S., Llorente, C., Hupert, N., & Pasnik, S. (2014). *PEG+CAT Content Study*. A report to the CPB-PBS Ready To Learn Initiative. New York, NY & Menlo Park, CA: Education Development Center & SRI International.
- Pasnik, S. & Llorente, C. (2012). *2012 preschool pilot study of PBS KIDS transmedia mathematics content*. A report to the CPB-PBS Ready To Learn Initiative. New York, NY and Menlo Park, CA: Education Development Center and SRI International.
- Pasnik, S., & Llorente, C. (2013). *Preschool teachers can use a PBS KIDS transmedia curriculum supplement to support young children's mathematics learning: Results of a randomized controlled trial*. A report to the CPB-PBS Ready To Learn initiative. New York, NY and Menlo Park, CA: Education Development Center and SRI International.
- Pasnik, S., Moorthy, S., Llorente, C., Hupert, N., Dominguez, X., & Silander, M. (2015) *Supporting Parent-Child Experiences with PEG+CAT Early Math Concepts*. A report to the CPB-PBS Ready to Learn Initiative. New York, NY and Menlo Park, CA: Education Development Center and SRI International.

Tiu, E., McCarthy, B., & Li, L. (2015). *Odd Squad: Learning math with PBS KIDS transmedia math content at school and home*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: WestEd.

WestEd. (2015). *An Early Study of PBS KIDS Lost Lagoon and Super Vision Apps*. A report to the CPB-PBS Ready To Learn Initiative. San Francisco, CA: Author.

Appendix B: Summary of 2010-2015 RTL Summative/Efficacy Home Studies⁶

(Presented in chronological order)

Study: *PBS KIDS transmedia mathematics suites in preschool homes.* (McCarthy, Li, & Tiu., 2012).

Research Questions

RQ1. Does student use of the *PBS KIDS* transmedia suites increase children's knowledge and skills in mathematics?

RQ2. Does parents' awareness of their children's mathematics learning at home increase after interacting with their children around the suites and using support materials related to the suites?

Methodology

Design: Quasi-experimental, non-equivalent groups with random assignment by center.

Intervention: Three *PBS KIDS* transmedia suites (*The Cat in the Hat Knows A Lot About That*, *Curious George*, and *Sid the Science Kid*) with online games accessed on Chromebooks and iPod Touches and hands-on activities from *PBS KIDS* Lab; weekly one-hour parent meetings.

Comparison: Business as Usual.

Math Concepts: Numbers and operations in base ten, measurement and data, and geometry and spatial sense.

Sample: Parent/child dyads (45/46 intervention, 45/45 comparison) from two Head Start Centers in a low-income Richmond, CA community. Approximately half (54.9%) were Hispanic/Latino, and 30.8% were African American, with an average age of M=4.5 years old.

Dosage: 30 minutes a day, four days a week for eight weeks.

Results

Child Outcomes: Children in the *PBS KIDS* Transmedia condition significantly outscored children in the comparison group on the post-TEMA-3 assessment by 4.82 problems ($p<0.01$). There were no significant differences on the researcher-developed assessment.

Parent Outcomes: Parents in the *PBS KIDS* Transmedia group significantly increased in their awareness of their children's math abilities from pre to post-intervention ($p<0.01$). Intervention parents also reported feeling more empowered to promote math activities at home and were more involved in supporting their children's math learning.

⁶While the *PEG+CAT* content study occurred in a lab setting, we considered it a "home" study because parents were present during the lab visits and this evaluation occurred as a precursor to the larger *PEG+CAT* home study evaluation.

Study: PBS KIDS mathematics transmedia suites in preschool homes and communities. (McCarthy et al, 2013).

Research Questions

RQ 1. Does children's use of the PBS KIDS transmedia suites with their parents increase children's knowledge and skills in mathematics?

RQ2. Does parents' awareness and support of their children's mathematics learning at home increase after interacting with their children around the suites and using support materials related to the suites?

Methodology

Design: Quasi-experimental, non-equivalent groups design with random assignment by center.

Intervention: Four PBS KIDS transmedia suites (*The Cat in the Hat Knows A Lot About That*, *Curious George*, *Dinosaur Train*, and *Sid the Science Kid*) with online games accessed on Chromebooks and hands-on activities from PBS KIDS Lab; binder with weekly activity summaries; weekly one-hour parent meetings.

Comparison: Business as Usual.

Math Concepts: Numbers and operations in base ten, measurement and data, sorting and patterns, and geometry and spatial sense.

Sample: Parent/child dyads (60/60 in intervention and comparison groups) from two Head Start Centers in a low-income community in Richmond, CA, with an average child age of M=3.8 years old. The majority (72.5%) was Hispanic, and 18.3% of children were African American.

Dosage: 30 minutes a day, four days a week for eight weeks.⁷

Results

Children Outcomes: Children in the PBS KIDS Transmedia condition made positive but *not significantly* greater gains on the Child Math Assessment compared to the comparison group. Three year olds in the intervention condition made significantly greater gains compared to the comparison group (p=0.034). Parents also reported that their children learned the target math concepts, especially in terms of counting, shapes, numbers, and estimation.

Parent Outcomes: Parents in the PBS KIDS Transmedia condition significantly increased in their awareness of their children's math abilities and in the number of math activities they engaged in with their children from pre to post-intervention (p<0.01). They also reported connecting transmedia content to everyday activities.

⁷ Weeks 1 and 10 of study did not include actual transmedia suite activities, such that the actual program intervention lasted eight weeks.

Study: *PEG+CAT Content Study*. (Moorthy, et al, 2014).

Research Questions

RQ 1. Do children who engage with selected *PEG+CAT* videos and games independently in a controlled, non-instructional environment over the course of five sessions improve in target mathematics skills as measured by a standardized assessment and researcher-developed aligned measure?

RQ2. How do children attend to particular *PEG+CAT* media experiences? What assistance or support, if any, do they require to participate while engaging in the media experiences?

RQ3. How do parents view the potential of *PEG+CAT* content to support children's mathematics learning?

Methodology

Design: Pre/post, no comparison.

Intervention: *PEG+CAT* online videos and games accessed on laptops and Nabi tablets in a controlled environment (i.e., lab setting).

Comparison: N/A.

Math Concepts: Patterns and shapes (3D/2D), with a secondary focus on number relationships and counting.

Sample: Preschool children aged 4 to 5.5 years old and their parents from low-income communities in the New York metropolitan and San Francisco Bay areas. The majority (60%) was Hispanic or Latino, and 25% of children were African American.

Dosage: 45 - 75 minutes, once a week for five weeks.

Results

Child Outcomes: Children made small, statistically significant gains ($M=1.42$ points) on the REMA assessment ($p<0.05$) and improved significantly in their ability to identify a cylinder ($p<.05$) from pre to post test. No significant gains were found for any other items on the research-developed measure.

Children demonstrated positive signs of engagement in *PEG+CAT* videos and games, such as watching intently and counting along. Children were also able to use the games independently during most, but not all sessions. They could also identify and talk about the characters, stories, and settings of the videos, but had difficulty articulating the specific math problems and solutions.

Parent Outcomes: The majority (95%) of parents reported strong, positive impressions of *PEG+CAT* resources for supporting early math learning, and some parents reported that their children talked about *PEG+CAT* in between sessions. Half of parents also reported doing activities related to *PEG+CAT* with their children at home.

Study: *Learning with PBS KIDS: A study of family engagement and early mathematics achievement.* (McCarthy et al, 2015).

Research Questions

RQ1. Does the parent engagement model intervention increase children's knowledge and skills in mathematics?

RQ2. How did any changes in students' knowledge and skills in mathematics relate to the students' socioeconomic status?

RQ3. Do parents' awareness and support of their children's mathematics learning at home increase after taking part in the intervention?

Methodology

Design: Quasi-experimental design with random assignment by preschool center.

Intervention: Five *PBS KIDS* transmedia suites (*The Cat in the Hat Knows A Lot About That*, *Curious George*, *Dinosaur Train*, *PEG+CAT*, and *Sid the Science Kid*) with online games accessed on Chromebooks and hands-on activities from *PBS KIDS* Lab; binder with weekly activity summaries; weekly one-hour parent meetings.

Comparison: Business as Usual.

Math Concepts: Numbers and operations in base ten, measurement and data, sorting and patterns, and geometry and spatial sense.

Sample: 153 families (71 in the intervention and 82 in the comparison) from nine economically and ethnically diverse communities in San Mateo County, CA, with an average child age of M=4.5 years old. The majority was Hispanic (70.9%).

Dosage: 30 minutes, 4 days a week for 9 weeks.

Results

Child Outcomes: Compared to the comparison group, children in the intervention group made significantly greater gains from pre to post test on the TEMA-3 standardized assessment ($p<0.05$) and on recognizing specific shapes (circle, triangle, trapezoid, and pentagon) on the researcher-developed shape assessment. All children in the intervention group, regardless of income level, increased in their math learning on TEMA-3.

Parent Outcomes: Parents in the *PBS KIDS* Transmedia group significantly increased in their awareness and support of their children's math abilities from pre to post-intervention ($p<0.05$). They also reported learning new skills and becoming better prepared to support their children's learning, as well as integrating math learning into everyday activities and setting aside time for learning each day.

Study: *Supporting Parent-Child Experiences with PEG+CAT Early Math Concepts.* (Pasnik et al, 2015)

Research Questions

RQ1. Did children who engaged with *PEG+CAT* resources at home improve in target mathematics skills, as measured by a researcher-designed assessment, compared to children in a comparison condition?

RQ2. Did children who engaged with *PEG+CAT* resources at home improve in target approaches to learning (ATL) skills, as measured by teacher and/or parent observation, compared to children in a comparison condition?

RQ3. What role did parents/caregivers play in supporting children's engagement with *PEG+CAT* media and, by extension, their learning of target mathematics and ATL skills?

RQ4. In contrast to a comparison group, did parents or caregivers using the *PEG+CAT* resources change their attitudes, beliefs, or knowledge about:

- a. Educational media- and technology-supported learning
- b. Early mathematics
- c. Children's approaches to learning,
- d. Their role in supporting children's math learning?

RQ5. What were the experiences of families while using the designed *PEG+CAT* materials (e.g., videos, games, and family support materials) to support learning at home?

RQ6. What facilitators and barriers did families encounter while using the *PEG+CAT* materials? What supports, if any, helped families overcome the barriers?

RQ7. What were the contexts in which families engaged with media? What, if any, were the similarities and differences between families using the *PEG+CAT* intervention materials and families in a comparison group with respect to engagement and joint engagement with educational media and technology?

Methodology

Design: Randomized controlled trial.

Intervention: Joint parent/child engagement around curated *PEG+CAT* experience composed of full episodes, short video clips, interstitials, online games, and hands-on activities; additional *PBS KIDS* online games and hands-on activities; parent supports for joint engagement; weekly text messages with content tips and media diary reminders; and technology (Android tablet, Chromebook laptop, and data plans).

Comparison: Business as Usual.

Math Concepts: Patterns, geometry (3D and 2D shapes), measurable attributes and spatial relationships, and ordinal numbers and counting.

Approaches To Learning Skills: Problem solving, self-regulation, and perseverance.

Sample: 197 children and their families (101 intervention, 96 comparison) from 14 preschool centers

serving low-income communities in New York City (10 centers) and San Francisco, CA (4 centers), with an average child age of M=4.5 years old. The majority was Hispanic/Latino (56.85%), with 18.78% Asian and 12.69% African American.

Dosage: 30 minutes of curated content and 30 minutes of suggested additional materials per week for 12 weeks.

Results

Child Outcomes: Children in the *PBS KIDS PEG+CAT* intervention made significantly greater gains in spatial relationships, ordinal numbers, and 3D shapes as measured by a researcher-developed skills-aligned assessment compared to children in the comparison group ($p<0.01$). No statistical differences were found for measurable attributes, patterns, 2-D shapes, or counting, nor were differences found for teacher reported ATL skills, math concepts, or problem solving skills.

Parent Outcomes: Parents in the intervention group reported significantly greater increases in their confidence to support their children's math learning, and a larger proportion reported helping their children with drawing shapes, subtraction, and measurement as well as engaging in problem solving strategies with their children compared to parents in the comparison group ($p<0.05$). They were also more likely to view technology as tools to support math learning compared to comparison group parents ($p<0.05$).

Parent/Child Joint Engagement Outcomes: A significantly larger proportion of parents in the *PBS KIDS PEG+CAT* intervention reported using technology with their children and more instances of parent-child joint media engagement (e.g., using technology together, playing digital games and apps together) compared to parents in the comparison group ($p<0.05$).

Study: *An Early Study of PBS KIDS Lost Lagoon and Super Vision Apps.* (WestEd, 2015).

Research Questions

RQ1. Does preschool children's use of the *Lost Lagoon* app, in conjunction with their parent's use of the *Super Vision* app, lead to increases in children's mathematics knowledge in the domain of measurement?⁸

RQ2. Does parents' use of the *Super Vision* app, in conjunction with their children's use of the *Lost Lagoon* app, lead to increases in parents' awareness and support of their children's mathematics learning?

Methodology

Design: Quasi-experimental design, with half of parent/child dyads assigned to the intervention and half to the comparison group.

Intervention: *Lost Lagoon* app for children, consisting of three "adventures" composed of games and videos from various *PBS KIDS* media properties, including *PEG+CAT*, *Dinosaur Train*, and *Sid the Science Kids*; *Super Vision* app for parents, which allowed them to see which games, videos, and math concepts children used on *Lost Lagoon*; weekly parenting meetings.

Comparison: Business as Usual.

Math Concepts: Measurement: height and length, weight, and capacity.

Sample: Parent/child dyads (40/40 in intervention and comparison groups) from five preschool centers in the San Francisco Bay Area. All families reported being comfortable using apps with English-only audio and text.

Dosage: 30 minutes a day, four days a week for three weeks.⁹

Results

Child Outcomes: Parents in the intervention group reported growth in their children's math learning, including mastery and verbalizing of target concepts. Some also reported that their children applied *Lost Lagoon* math concepts to their everyday lives.

Parent Outcomes: Parents in the intervention group made significantly greater gains in their awareness of their children's math development compared to comparison group parents from pre to post intervention ($p < 0.02$). They also reported intentionally seeking out opportunities to integrate *Lost Lagoon* math concepts into everyday activities and felt they increased in their ability to use digital media and technology to support learning.

⁸ This research question was not directly measured with a child assessment, only through parent report of their children's learning.

⁹ The study lasted four weeks, but the first week only consisted of a parent meeting, while the remaining three weeks included the actual transmedia program intervention.

Study: *Effect of the UMIGO transmedia property on first and second grade students' math ability. Summative evaluation B: randomized controlled trial (RCT) study – year 4 & 5.* (Michael Cohen Group, 2015a).

Research Questions

RQ1. Do children who use *UMIGO* at home show significantly greater increases in math knowledge and skills taught in *UMIGO* compared to children who do not?

RQ2. Do children who use *UMIGO* show significantly greater increases in affinity for mathematics than children who do not?

RQ3. Is learning from *UMIGO* moderated by:

- a. Participant characteristics?
- b. Amount of time spent using *UMIGO*?
- c. Exposure to multiple *UMIGO* suites?

Methodology

Design: Two-Wave Randomized Controlled Trial

Intervention: *UMIGO* transmedia property, including four transmedia suites composed of full-length Appisodes (interactive online videos with embedded short games), online games, and music videos accessed via computers, tablet computers, and Smartphones. Wave 1 assessed transmedia suites 1 and 2 (measurement and addition), and Wave 2 assessed transmedia suites 3 and 4 (skip counting and 2-D shapes).

Comparison: Business as Usual.

Math Content: Measurement of height and length, addition, skip counting, 2-D shapes, and math affinity (i.e., children's attitudes toward and self-efficacy in math).

Sample: Wave 1 included 383 K-2nd graders (196 intervention, 187 comparison) and Wave 2 included 335 K-2nd graders (165 intervention, 170 comparison) from the New York City and Chicago, IL areas, with an over-sampling of low-income children. The majority of children were African American (Wave 1: 43%, Wave 2: 37.6%), White (Wave 1: 28%, Wave 2: 30.4%), or Hispanic (Waves 1 and 2: 20%). Half of Wave 2 participants (51.4% or N=172) had participated in Wave 1 and were randomly assigned with even distribution to the Wave 2 intervention and comparison conditions.

Dosage Wave 1: At least 90 minutes per transmedia suite over two weeks

Dosage Wave 2: At least 5 hours across both transmedia suites over 1 week

Results

Child Outcomes Wave 1: Children in both the *UMIGO* and comparison conditions made positive gains in measurement and addition skills from pre to post-intervention, with no significant differences between the groups. Both groups also experienced negative—but not significantly different—trends in math affinity from pre to post.

Child Outcomes Wave 2: Children in the *UMIGO* condition made significantly greater gains in 2-D shapes from pre to post-intervention, compared to children in the comparison condition ($p<0.01$). Additionally, time spent viewing the 2-D shape appisodes was significantly correlated with performance on the 2-D shape assessment ($p<0.01$). No differences between conditions were found for skip counting. As with Wave 1, both conditions had negative—but not significantly different—trends in math affinity from pre to post. No cumulative effects of engaging in both *UMIGO* conditions in Waves 1 and 2 were found.

Appendix C: Summary of 2010-2015 RTL Summative/Efficacy School Studies¹⁰

(Presented in chronological order)

Study: *Evaluation of The Electric Company Summer Learning Program.* (McCarthy et al, 2011).

Research Questions

RQ1. Are teachers implementing the *TEC Summer Learning Program* as planned? Are there any obstacles to implementation? What variables contribute to fidelity of implementation? (e.g., number of children, children's initial level of knowledge, years of teacher's experience, type of program).

RQ2. Do students who participate in the *TEC Summer Learning Program* increase skills in select mathematical domains?

RQ3. Do students who participate in the *TEC Summer Learning Program* acquire the mathematics vocabulary targeted by the program?

RQ4. Do students who participate in the *TEC Summer Learning Program* increase their comprehension of connected text? Do they learn strategies that good readers use to understand connected text?

RQ5. Do students who participate in the *TEC Summer Learning Program* increase their motivation and confidence to engage in learning activities related to literacy?

RQ6. Do students who participate in the *TEC Summer Learning Program* increase their motivation and confidence to engage in learning activities related to mathematics?

RQ7. Do teachers who participate in the *TEC Summer Learning Program* increase their motivation and confidence leading groups?

RQ8. Do teachers who participate in the *TEC Summer Learning Program* report an increase in morale and enthusiasm in their summer school setting?

RQ9. Do teachers who participate in the *TEC Summer Learning Program* learn new instructional strategies in teaching mathematics and literacy?

RQ10. Which aspects of the *TEC* model do students find the most (and least) appealing, interesting, and educational?

RQ11. Which aspects of the *TEC* model do teachers find the most (and least) appealing, interesting, and valuable, particularly in regard to learning content and increasing motivation?

RQ12. Which aspects, if any, of the *TEC* model (including professional development) do the teachers think might need to be refined, improved, or modified? Would teachers use the summer curriculum again? Would they use all or part of the curriculum in their regular classroom? Why or why not?

¹⁰ The Electric Company Summer Program study (WestEd, 2011), Curious George content study (WestEd, 2014), and the Odd Squad Math content study (WestEd, 2015) were considered “school” studies for the purposes of this report.

Methodology

Design: Pre/post, no comparison.

Intervention: *The Electric Company* Summer Learning Program curriculum composed of 36 hours of content including 12 episodes of *The Electric Company*; small and large group activities, games, and the transmedia online gaming experience *Prankster Planet*; teacher professional development; and teacher curriculum guide.

Comparison: N/A

Math Concepts: Place value, addition, subtraction, measurement, data analysis, and time.

Literacy Concepts: Letter-sound knowledge.

Sample: Sixteen teachers and 152 rising second graders aged 6 to 8 years old in 12 summer programs across the U.S. in rural, urban, and suburban communities.

Dosage: 90 minutes, 4 - 5 days a week for 5 - 6 weeks for a total of 30 - 36 hours.

Results

Child Outcomes: Students made positive and statistically significant gains from pre to post intervention on the full 19-item skills-aligned survey assessment and the specific 17 math items ($p<0.01$). Students also made significant gains in all 20 mathematical vocabulary items from pre to post intervention ($p<0.01$), and they reported positive attitudes toward math and reading on the Estes Attitudinal Scale at post-test. Teachers also reported increases in student motivation and confidence in math and literacy as well as increased morale and enthusiasm for learning in general.

Teacher Outcomes: The majority of teachers reported increased motivation and confidence in leading groups. They also reported learning new instructional strategies, especially for teaching vocabulary, integrating technology, and combining different modes of learning to maintain student engagement. Teachers also reported gains in their computer skills and feeling more comfortable with the idea of using technology in the classroom.

Study: *Preschool pilot study of PBS KIDS transmedia mathematics content.* (Pasnik & Llorente, 2012).

Research Questions

RQ1. What features of the *PBS KIDS* transmedia-rich mathematics curriculum supplement and comparison supplement (activities, technology, and coaching) worked well?

RQ2. How can the *PBS KIDS* transmedia-rich mathematics curriculum supplement be improved to make it stronger for the full RCT?

RQ3. Do preschool teachers implementing the *PBS KIDS* transmedia-rich mathematics curriculum supplement change their views about teaching mathematics, and how does this change compare to that of teachers who implement the comparison supplement?

RQ4. Do children in classrooms implementing the *PBS KIDS* transmedia-rich mathematics curriculum supplement make significantly more gains in math relative to children in classrooms that enact the comparison supplement, which does not use technology or *PBS KIDS* transmedia content?

Methodology

Design: Pre/post with comparison group, condition assigned by center on a rolling basis.

Intervention: *PBS KIDS* transmedia supplement (*The Cat in the Hat Knows A Lot About That*, *Curious George*, *Dinosaur Train*, and *Sid the Science Kid*) with digital videos and interactive games accessed on interactive whiteboards and laptops; hands-on materials (e.g., books, paper-based games and classroom materials, manipulatives, children's math detective journals); curriculum supplements guides; in-person professional development; ongoing coaching.

Comparison: Hands-on math curriculum supplement covering same math concepts as the transmedia condition; hands-on materials (e.g., books, paper-based games and classroom materials, manipulatives); curriculum supplements guides; in-person professional development; ongoing coaching.

Math Concepts: Shapes, patterns, counting, number recognition, and subitizing.

Additional Measures: Behavioral self-regulation as measured by the Head-Toes-Knees-Shoulders (HTKS) assessment.

Sample: Two hundred and ninety six children (126 intervention, 170 comparison) and 24 teachers from 16 Head Start or early childhood preschool programs serving low-income children in New York City and San Francisco, CA (8 intervention, 8 comparison). Only children ages 4 to 5 years of age were included in the study.

Dosage: 25 - 35 minutes a day, 3 - 5 days a week (no more than 2.5 hours a week) for 10 weeks for both conditions.

Results

Child Outcomes: Students in both conditions made gains in target math skills and self-regulation from pre to post-intervention. There were no significant differences between conditions.

Teacher Outcomes: A larger proportion of teachers in the *PBS KIDS* transmedia intervention condition reported feeling like a "math person" and being as good at teaching math as any other subject compared to teachers in the hands-on comparison condition.

Study: Preschool teachers can use a PBS KIDS transmedia curriculum supplement to support young children's mathematics learning: Results of a randomized controlled trial. (Pasnik & Llorente, 2013).

Research Questions

RQ1. What is the impact of the *PBS KIDS* Transmedia Math Supplement and Technology & Media experience on young children's mathematics learning?

RQ2. What is the impact of the *PBS KIDS* Transmedia Math Supplement and Technology & Media experience on young children's self-regulation?

RQ3. What is the impact of the *PBS KIDS* Transmedia Math Supplement and Technology & Media experience on teachers' attitudes and beliefs about early mathematics education, and using technology and media to support mathematics learning?

RQ4. To what extent do teachers in the *PBS KIDS* Transmedia Math Supplement group implement the curriculum supplement with fidelity?

RQ5. What are the successes and barriers, if any, that teachers in the *PBS KIDS* Transmedia Math Supplement group encounter while implementing the curriculum supplement?

Methodology

Design: Randomized controlled trial with random assignment by center.

Intervention: *PBS KIDS* transmedia supplement (*The Cat in the Hat Knows A Lot About That*, *Curious George*, *Dinosaur Train*, and *Sid the Science Kid*) with digital videos and interactive games accessed on interactive whiteboards and Chromebook laptops; Internet access; hands-on materials; printed transmedia supplement guide; professional development on math, technology, and transmedia supplement; ongoing coaching for technology integration and transmedia supplement; ongoing technology support.

Comparison A: Technology and Media condition, including interactive whiteboards Chromebook laptops, and Internet access; printed guide with pointers to transmedia resources available on *PBS KIDS* Lab and *PBS KIDS* websites; professional development on math and technology; ongoing coaching for technology integration; ongoing technology support.

Comparison B: Business as Usual (received professional development on math instruction *after* the study implementation).

Math Concepts: Shapes, patterns, counting, number recognition, and subitizing.

Additional Measures: Behavioral self-regulation as measured by the Head-Toes-Knees-Shoulders (HTKS) assessment.

Sample: Teachers (157) and children (966: 307 intervention, 321 comparison A, 338 comparison B) from 86 preschool classrooms (26 intervention, 30 comparison A, 29 comparison B) serving primarily low-income children in the New York City and San Francisco Bay areas. The average age of children was M=4.55.

Dosage: 25 - 50 minutes a day, 4 days a week (no more than 2.5 hours a week) for 10 weeks.

Results

Child Outcomes: Children in the *PBS KIDS* transmedia supplement condition experienced significantly greater gains from pre to post-intervention on the researcher-designed assessment compared to students in the Business as Usual condition ($p<0.01$) but not on the standardized REMA assessment. Children in the Technology & Media comparison condition did not significantly improve from pre to post-intervention compared to children in the Business as Usual condition. There were no differences in self-regulation as measured by the Head-Toes-Knees-Shoulders assessment for children in any condition.

Teacher Outcomes: Significantly more teachers in the *PBS KIDS* transmedia supplement condition addressed the target math skills of numeracy and patterns and spent more time on math compared to teachers in the Business as Usual condition ($p<0.05$). A significantly larger proportion of teachers in both the *PBS KIDS* transmedia and Technology and Media conditions reported using technology to teach math concepts, compared to teachers in the Business as Usual condition ($p<0.05$). Additionally, teachers in the *PBS KIDS* transmedia condition significantly increased in their beliefs about their own math knowledge and developed a more positive disposition towards the value of technology for preschool education ($p<0.05$).

Implementation Outcomes: Teachers in the *PBS KIDS* transmedia supplement condition implemented and addressed target math skills more than teachers in both comparison conditions. While teachers in both technology conditions encountered challenges integrating technology into their daily lessons, those in the Technology & Media condition required more on-site coaching support compared to teachers in the *PBS KIDS* transmedia supplement condition.

Study: *Effects of Interaction with Pocoyo Playsets on Preschool (Spanish) ELL Children's English Language Learning: A Randomized Controlled Trial.* (Michael Cohen Group, 2013a).

Research Hypotheses

H1. Preschool children who play with *Pocoyo PlaySets* in a non-mediated learning environment will experience greater gains in learning of target vocabulary and English language fluency compared to children who play with commercially available Spanish-English apps.

Methodology

Design: Randomized controlled trial with random assignment by classroom.

Intervention: *Pocoyo PlaySets*, composed of and accessed on tablet computers (1:4 tablet to child ratio per classroom) used during free play without instructional guidance; printed teacher guide to materials.

Comparison: Commercially available Spanish-English apps *BilingualChild* and *LinguPenguin*, which focus on learning similar words/content as *Pocoyo PlaySets*, accessed on tablet computers (1:4 tablet to child ratio per classroom) used during free play without instructional guidance; printed teacher guide to materials.

Literacy Content: Target vocabulary of colors, vehicles, and animals; English language fluency; attitudes toward learning English.

Sample: Five hundred and eighty ELL Spanish-speaking children (286 intervention, 294 comparison) from 53 classrooms (26 intervention, 27 comparison) in 15 low-income preschool centers in New York, NY, Bridgeport, CT, Miami, FL, and Los Angeles, CA. The majority (77%) of children had used a tablet computer before, and 62% were familiar with *Pocoyo Playsets*.

Dosage: 3 days a week for 3 weeks during free play time.

Results

Child Outcomes: Children's who engaged with *Pocoyo PlaySets* made significantly greater gains in target vocabulary from pre to post intervention compared to children in the comparison condition ($p<0.01$). Results held for target vocabulary in both *PlaySets*. Moderation analyses revealed children whose parents did not speak to them in English (i.e., only spoke Spanish) made the least improvement, but among this Spanish-only group, those in the *Pocoyo* intervention made significantly greater gains in vocabulary compared to those in the comparison condition ($p<0.05$). There were no differences in overall English fluency or attitudes toward learning English between the two conditions.

Study: *Effect of the UMIGO transmedia property on first and second grade students' math ability: A randomized controlled trial (RCT) study.* (Michael Cohen Group, 2013b).

Research Hypotheses

H1. Children who use *UMIGO* in addition to regular classroom instruction (*UMIGO intervention condition*) will show significant increases in math knowledge and skills taught in *UMIGO* relative to children in classes randomly assigned to regular classroom instruction plus use of a comparator transmedia property.

Methodology

Design: Cluster-randomized controlled trial with randomization stratified by school and grade.

Intervention: Independent use of *UMIGO* transmedia property, composed of online games, apps, e-books, workbooks, music videos, and a board game.

Comparison: *Math Blaster* transmedia property, composed of online games, apps, and printed worksheets.

Math Concepts: Inequalities, early arithmetic, height and length, and measures of capacity.

Sample: 484 first and second graders (245 intervention/239 control) in 31 classrooms (16 intervention/15 comparison) from five Title 1 schools in Bridgeport, CT; Memphis, TN; and Sedro-Woolley, WA.

Dosage: 25 minutes a day (approximately 8 total hours) across 19 days.

Results

Child Outcomes: Children in both the intervention and control group had positive gains in overall assessment scores from pre to post intervention. Children who used *UMIGO* made significantly greater gains on the specific math concepts of inequalities and capacity ($p<0.01$).

Study: *Learning Math with Curious George: PBS KIDS Transmedia and Digital Learning Games in the Preschool Classroom.* (McCarthy et al, 2014).

Research Questions

RQ1. Does children's self-directed use of the *Curious George's Busy Day* transmedia suite in the preschool classroom lead to gains in preschool students' early mathematical knowledge in the domains of "numbers and counting" and "operations"?

RQ2. What are the affordances of the use of the *Curious George's Busy Day* transmedia suite and related educational materials in the preschool classroom?

Methodology

Design: Pre/post, no comparison.

Intervention: Learning stations for self-directed use of *Curious George's Busy Day* transmedia suite components, including 16 digital games, hands-on materials from PBS KIDS Lab website, three *Curious George* video episodes, books, and additional common materials available in classrooms; at-home viewing of *Curious George* videos.

Comparison: N/A.

Math content: Numbers and counting, and operations.

Sample: Fifty-one preschool children ($M=4.3$ years old) in three preschool classrooms from the same preschool center serving low-income children in the San Francisco Bay area.

Dosage at School: 30 minutes, twice a week for 4 weeks.

Dosage at Home: View three full-length *Curious George* episodes (15 minutes each) at least once over 4 weeks.

Results

Child Outcomes: Children made significant gains in number comparison and informal concepts on the TEMA-3 from pre to post intervention ($p<0.05$). Sub-group analyses showed that children with lower pre-assessment scores gained significantly in number comparison ($p<0.05$) while those with higher pre-assessment scores gained significantly on number comparison ($p<0.05$) and informal concepts ($p<0.01$). Teacher interviews and researcher classroom observations revealed that self-directed and free play use of *Curious George's Busy Day* transmedia suite increased math discourse in the classroom and collaborative learning, which provided opportunities for children to develop social-emotional skills (sharing, cooperating, listening, communicating) and digital literacy skills.

Teacher Outcomes: Teachers reported that observing students' game play increased their own knowledge about students' learning and math development.

Study: *Children's learning through transmedia materials: A clustered randomized controlled trial of two Pocoyo PlayGrounds.* (Michael Cohen Group, 2015b).

Research Hypotheses

H1. Preschool children who play with *Pocoyo PlayGrounds* in a non-mediated learning environment will experience greater gains in literacy development and target vocabulary, compared to children who use similar materials that cover the same educational content.

Methodology

Design: Randomized controlled trial with random assignment by classroom.

Intervention: *Pocoyo Colors* and *Community Helpers Playgrounds*, composed of bilingual apps, puzzles, vocabulary cards, match and tell cards, books, activity journals, color paddles, and board games, used during free choice time without instructional guidance; mini iPads (1:5 ratio of iPads to students); printed teacher guide for materials.

Comparison: Commercially available products similar to those included in the *Playgrounds* (e.g., puzzles, books, flash cards, apps) covering similar content but not themed or a unified education intervention; mini iPads (1:5 ratio of iPads to students); printed teacher guide for materials.

Literacy Content: Vocabulary related to colors and community helpers.

Sample: Four hundred and twenty six preschool children (227 intervention, 199 comparison) in 37 classrooms (19 intervention, 18 comparison) from 10 preschool centers in New York City and Philadelphia, PA. The majority of children (57%) were Hispanic, and 38% were African American, with over half (58.69%) speaking a language other than English at home.

Dosage: 3 days a week for 3 weeks during free play time.

Results

Child Outcomes: Children in both the *Pocoyo PlayGrounds* and comparison conditions made modest gains on all measures from pre to post intervention. No differences were found between conditions on the *Get Ready to Read!* early literacy assessment or on community helper vocabulary. On the overall color vocabulary assessment, children in the *Pocoyo* condition with higher pre-test scores made significantly greater gains compared to children in the comparison condition with high pre-test scores ($p<0.05$). No differences were found for children with low pre-test scores. Additionally, children in the *Pocoyo* intervention made significantly greater gains in knowledge of uncommon colors (i.e., turquoise and lavender; $p<0.01$) and color shades ($p<0.02$) from pre to post intervention compared to children in the comparison condition.

Study: *Odd Squad: Learning math with PBS KIDS transmedia math content at school and home. A report to the CPB-PBS Ready To Learn Initiative.* (Tiu et al, 2015).

Research Questions

RQ1. Does the use of *Odd Squad Math* lead to gains in students' mathematics knowledge in the domains of Algebraic Thinking (specifically, the topic of patterns) and Numbers and Operations (specifically, the topic of skip counting)?

RQ2. What are the affordances of using the *Odd Squad Math* intervention in the elementary school classroom?

Methodology

Design: Pre/post, no comparison.

Intervention: *Odd Squad Math* transmedia suite with classroom and home components.

- *Classroom components:* *Odd Squad* episodes, online games, interstitials, and hands-on activities with recommended sequence for classroom teachers.
- *Home components:* Five *Odd Squad* episodes, co-viewing guide, and accompanying activities sequentially aligned to the classroom component.

Comparison: N/A

Math Content: Algebraic thinking and numbers and operations.

Sample: Four teachers and 83 first-graders and their parents from low-income elementary schools in the San Francisco Bay area.

Dosage at school: 15 - 30 minutes a day, 4 - 6 days over 2 - 4 weeks.

Dosage at home: 30 minutes a day (15 co-viewing, 15 activity), 4 - 6 days over 2 - 4 weeks.

Results

Child Outcomes: Students experienced significant increases in overall math knowledge from pre to post intervention ($p<0.01$), but differences were driven by significant gains in three sub-skills, namely skip counting, pattern recognition, and simple addition and subtraction ($p<0.01$).

Parent Outcomes: Parents reported that their children improved on target math content and some parents took ideas from *Odd Squad Math* to extend learning opportunities to support their children's math learning. Parents also reported positive experiences with *Odd Squad Math* and a realization that play could be an effective learning strategy for their children.

Teacher Outcomes: Teachers felt that *Odd Squad Math* supported the learning that occurred in their normal teaching practice and reported that the combination of digital media and hands-on activities enabled students to make more connections in their learning and reinforced math concepts through different media. They also thought the home component of the intervention provided a cohesive math learning environment that traversed the home-school divide, and in doing so, increased student involvement in their math learning.