Executive Summary

In spring 2015, WestEd conducted a study for the CPB-PBS Ready to Learn Initiative of a school- and home-based transmedia mathematics intervention based on the resources in the PBS KIDS Odd Squad transmedia suite. The transmedia mathematics intervention, called “Odd Squad Math” for purposes of the study, included a wide variety of Odd Squad transmedia assets, including episodes from the television series, educational online games, interstitials (short video clips), and hands-on activities. The current study addresses how children use and learn in transmedia learning environments. A primary feature of the intervention is a transmedia learning environment that includes high-quality video episodes, digital games, and hands-on activities for classroom and home. All learning materials are connected by a strong narrative domain and carefully curated mathematics content. During the intervention, students are invited to enter the world of the narrative domain’s storylines and to work with the domain’s appealing characters to solve mathematics problems in a fun, engaging learning milieu.

The purpose of the study was to test the promise of using Odd Squad Math to enhance first grade students’ mathematics learning. During the study, participating students used a school- and home-based intervention that included videos, online games, interstitials, and hands-on activities from the Odd Squad transmedia suite. The research questions that guided the study were:

1. 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)?

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

The Study Intervention

The Odd Squad Math (OSM) intervention featured two primary components – an in-class component and an at-home component. The resources included in both the in-class and at-home components were drawn from the Odd Squad transmedia suite, including seven episodes from the television series, two educational online games, three interstitials (short video clips), and five hands-on activities. OSM was designed for use in the first grade classroom and in participants’ homes, and focused on the mathematics domains of Algebraic Thinking and Numbers and Operations.

OSM featured two “cases” consisting of content from the Odd Squad transmedia suite focused on the mathematical domains of Algebraic Thinking and Number and Operations. Each case included 4-6 days of classroom activities, with each day of activities taking between 15-30 minutes to complete. Teachers were provided with a recommended sequence and pacing of activities for each case, though they were free to use the resources in the order and timeframe that worked best for their classrooms (e.g., moving an activity that involved technology to a day when the school laptop cart was available). The OSM activities did not need to be conducted on consecutive days in the classroom, and could be used by teachers over the course of 2-4 weeks in their classrooms.
On the first day of each case, teachers showed a ten-minute, full-length *Odd Squad* episode during class time. The purpose of viewing the episode was to introduce the mathematics content of the case and to introduce the narrative storyline that would be explored. On the second day of each case, students were encouraged to play an interactive, educational online game from the PBS KIDS *Odd Squad* website. The online games were related to the storyline that was presented in the full-length episode, but instead allowed students to take an active role as an “agent” in the case. The remaining days of each case included a mix of interstitial videos and hands-on activities that allowed students to further reinforce and practice the skills that were explored in the first two days of the case.

The at-home component included five at-home *Odd Squad* episodes and accompanying activities. The at-home activities were aligned and sequenced with the in-class activities, such that a concept would first be introduced in the classroom and then be reinforced and further practiced at home. For each at-home episode and activity, parents were encouraged to co-view an *Odd Squad* episode with their child. After watching the *Odd Squad* episode together, parents were encouraged to follow a detailed activity guide that was related to the episode. The activity guide included a description and explanation of the mathematics content and vocabulary that was used in the episode. The activity guide also included a list of suggested questions that parents could ask their child about the mathematics content in the episode, along with accompanying answers. Lastly, the activity guide provided a short mathematics activity that parents could complete with their child in order to further practice the mathematics content. Each at-home episode and activity took approximately 30 minutes to complete: 15 minutes to co-view the *Odd Squad* episode, and 15 minutes to complete the questions and suggested activities in the activity guide.

**Study Methodology**

**Participants**

Four first grade teachers from the San Francisco Bay Area and their classrooms (n=83 first grade students and their families) participated in the study. All participants were recruited from elementary schools serving low-income communities, and all participants in the study received the *Odd Squad Math* intervention.

**Instruments**

**Student Verbal Mathematics Assessment.** Students were assessed using a one-on-one verbal mathematics assessment. The items included in this assessment were selected or adapted from the TEMA-3. The TEMA-3, or the Test of Early Mathematics Ability, third edition, is a test of children’s informal and formal mathematics knowledge, developed by Western Psychological Services. The TEMA-3 is a standardized, nationally normed achievement test (Ginsburg & Baroody, 2003). The test is designed for use with children ages 3 years, 0 months through 8 years, 11 months. It measures four categories of informal mathematics: Numbering, Number Comparisons, Calculation, and Concepts. It also measures four categories of formal mathematics: Numeral Literacy, Number Facts, Calculation, and Basic 10 Concepts. Researchers selected and adapted a subset of items from the TEMA-3 that are aligned to the domains of Numbers and Operations and the skill of skip counting that were focused on in the intervention. Students
were assessed using this verbal mathematics assessment both before and after participating in the intervention.

**Student Written Mathematics Assessment.** Students were assessed using a researcher-developed mathematics proximal assessment both before and after participating in the intervention. The pencil-and-paper assessment was administered to students either at the class level or in small groups, with the test administrator (the teacher or a teaching assistant) reading assessment instructions aloud to students. The proximal assessment addressed the domains of Number and Operations and Algebraic Thinking. The assessment was not a timed test, and no precise time limits were imposed on students being tested.

**Mathematics Assessment Resource Service (MARS) Assessment.** The Mathematics Assessment Resource Service (MARS) assessments are performance-based tasks that require extended open responses from students. The tasks assess math concepts and skills that correspond to the core ideas taught at each grade level. The tasks also assess the mathematical processes of problem solving, reasoning, and communication. The MARS tasks are scored using a detailed, point-scoring rubric. Each task is assigned a point total that corresponds to the complexity of the task and the proportional amount of time that the average student would spend on the task in relation to the entire exam. The combination of open tasks and weighted rubrics provides a rich picture of student performance, including their problem solving approaches, strategies to find solutions, explanation of student thinking, and justification of their findings. A subset of tasks related to the domains of Number and Operations and Algebraic Thinking was selected for use in the study. Students were assessed using this subset of MARS tasks both before and after participating in the intervention.

**Student Mathematics Vocabulary Assessment.** Students were assessed using a researcher-developed mathematics vocabulary assessment both before and after participating in the intervention. The one-on-one assessment was administered to individual students to assess students’ mathematics vocabulary. Students were required to verbally provide definitions of mathematics-related words (e.g., pattern, conjecture) that were emphasized in *Odd Squad Math* intervention. Researchers used a detailed rubric to evaluate the quality of the students’ definitions and scored the items correct, incorrect, or partially correct.

**Teacher Interviews.** After participating in the intervention, classroom teachers participated in a teacher interview. Teachers were asked to elaborate on how the *Odd Squad Math* intervention was incorporated into their regular classroom environment, how their students responded to the content, whether they felt the content helped to support their students’ learning in mathematics, and whether they felt the content helped to develop their students’ mathematical practices.

**Parent Survey.** Before and after participation in the intervention, parents of participating students were asked to complete a short parent survey. The survey included items related to parent awareness of children’s mathematical development and to parent support of their child’s mathematics learning in their home environment. The survey also collected demographic information from parents, and was available for parents to complete in both English and Spanish.
Parent Focus Groups. After participating in the intervention, parents were invited to participate in a brief focus group at their child’s school. During the focus group, parents were asked to elaborate on how the Odd Squad Math episodes, activities, and online games were used in the home environment, how their child responded to the content, and whether they felt the intervention helped them to support their child’s learning in mathematics and increased their awareness of their child’s learning in mathematics. Focus groups were conducted in either English or Spanish, depending on parents’ language preference, and were facilitated by a WestEd researcher. Each focus group lasted 20-30 minutes.

Results
Successful Implementation

• Four first grade teachers and their classrooms (n=83 first grade students) participated in the study. With the exception of one teacher who skipped one hands-on activity, the teachers used all episodes, games, and activities as recommended in the OSM intervention. Pre- and post-assessment data was collected for all 83 students who participated in the study.
• Approximately 80% of participating families used OSM during the intervention. About 80% of families watched all of the episodes included in the home component of the intervention, and about half of these families used the other components along with the episodes.

Findings Around Students’ Knowledge and Skills in Mathematics

• Over the course of the Odd Squad intervention, students’ overall knowledge of mathematics in the domains of Number and Operations and Algebraic Thinking increased significantly (Pre M = 42.80, Post M = 48.70, p<0.001).
• In sub-categories of mathematical knowledge, students showed significant and positive pre- and post-changes on their knowledge of skip counting (Pre M = 10.92, Post M = 13.61, p<0.001), pattern recognition (Pre M = 9.49, Post M = 10.12, p<0.01), and simple addition and subtraction (Pre M = 18.72, Post M = 20.95, p<0.01).

Affordances of Using the OSM Transmedia Intervention in the Classroom and Home

• Odd Squad Math Supported Students’ Learning of Mathematics
Analyses of the qualitative data—teacher interviews and parent focus group—suggest that OSM supported student’s mathematics learning. In particular, teachers mentioned that OSM supported mathematics learning for their grade level, especially in the areas of patterns and skip counting. Approximately one third of the parents who took part in OSM home activities mentioned that OSM supported their children’s learning of patterns, skip counting, addition, subtraction, and mathematics vocabulary.

• Potential of Odd Squad Math to Support the Standards of Mathematical Practice
Analysis of teacher interview data showed that three of the four participating teachers reported that the OSM’s narrative-based structure supported learning in specific areas of the Standards of Mathematical Practice. These teachers mentioned that Odd Squad’s plot device of showing children constructing and testing arguments, listening and responding to the theories and perspectives of others, and persevering to solve complex problems could be framed to support teaching around the Standards of Mathematical Practice.
• **Parents Noticed Their Children Improving on Target Mathematics Content**

The majority of parents participating in focus groups at the end of the study mentioned they noticed their child practicing and improving in mathematics during the study. Domains of mathematics most often mentioned by parents were addition, subtraction and mathematics vocabulary. A subgroup of parents mentioned additional mathematics topics, including pattern recognition and skip counting.

• **Parents Created Other Learning Activities to Support the OSM Content**

Qualitative data analysis suggests that a subset of parents who used OSM materials took ideas from the *Odd Squad* materials to create their own ways to support their child’s learning.

• **Exciting Storyline in Odd Squad Math Spurred Engagement in Mathematics**

OSM involves episodes, games and activities that include a fast-paced, playful narrative domain that draws students into storylines. OSM invites students to be a part of the *Odd Squad* team and to help solve “cases” that involve using mathematics. In interviews and focus groups, teachers and parents often mentioned that these engaging aspects of OSM boosted students’ interest in mathematics and in solving mathematics problems. All of the teachers mentioned that the *Odd Squad* plot device of making viewers and players part of the *Odd Squad* problem-solving team brought a strong motivational factor to mathematics learning during the intervention.

• **Transmedia Content in Odd Squad Math Adds Educational Value**

Qualitative data analysis suggests that the intervention’s transmedia content, including a storyline with academic content that are connected across multiple platforms and environments, added educational value to the OSM learning environment. Teachers reported that the combination of episodes, digital games, and hands-on activities allowed their students to make useful connections and reinforce their mathematics learning through different media.

• **Parents Appreciated Odd Squad Math**

Parents reported they had positive experiences with their children when engaging with the OSM activities at home. Parents said that they were impressed with the mathematics content and felt that it was teaching meaningful mathematics concepts to their children. Parents reported that engaging in the OSM episodes and activities together with their children inspired meaningful dialogue and that they were able to learn from OSM alongside their children. Several parents mentioned that while using OSM with their children, they saw their children successfully learning through play. These parents reported realizing that learning through play was an effective way for their children to gain an understanding of and solidify new math concepts.

• **Teachers Felt the Home Components of Odd Squad Math Were Useful**

All teachers mentioned that they liked the idea of having families involved in the intervention. Teachers commented that by including families in OSM, students became more involved in the *Odd Squad* narrative and the mathematics content.