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

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Executive Summary

WestEd conducted a classroom-based study for the CPB-PBS Ready To Learn initiative during the summer of 2014 in order to investigate children’s relatively unmediated use of the Curious George’s Busy Day transmedia suite in supporting preschool students’ mathematics learning in the classroom environment. The Curious George’s Busy Day transmedia suite includes digital games, hands-on learning activities, and video episodes, all featuring Curious George. The suite uses a narrative arc throughout all aspects of its educational products and media platforms to engage children and support learning around the mathematics concept of numeracy. The current study explored the effectiveness of the Curious George’s Busy Day transmedia suite in supporting preschool students’ mathematics learning in the preschool classroom environment. In addition, the study examined the affordances (features and advantages) of transmedia-based learning in the preschool classroom. The study included an intervention developed by teachers and researchers that included all aspects of the suite (digital games, hands-on learning activities, and video episodes) and allowed for a relatively unmediated blended learning experience that was integrated into a typical preschool curriculum. The research questions guiding this study were:

1) 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”?

2) What are the affordances of the use of the Curious George’s Busy Day transmedia suite and related educational materials in the preschool classroom?

The Study Intervention

The study intervention included 16 digital learning games selected from the Curious George’s Busy Day transmedia suite, Curious George’s Busy Day hands-on materials from the PBS KIDS Lab website, three Curious George video episodes, and books and other common classroom materials available at the participating intervention preschool. In general, students participating in the study used the selected content with minimal teacher, parent, or researcher mediation. The structure of the intervention built upon the school’s current classroom practice of arranging educational content into “learning stations,” with students moving from learning station to learning station throughout a typical morning in their classroom. In addition, parents were asked to play the Curious George video episodes for their children at home during a time when they normally would allow their children to watch television, a DVD, or other video content. Parents were asked to encourage their students to watch the videos at least once over the four-week study period and students were free to watch the videos as many times as they liked. The intervention, dubbed Curious George Math for the purposes of this study, allows for students to interact with Curious George’s Busy Day mathematics content in the classroom for at least 30 minutes a day twice a week over a four-week period. Students spend at least 60 minutes viewing Curious George episodes over the course of the intervention. The intervention lasted for four weeks and focused on two specific mathematics concepts each week. Concepts included cardinality, counting, identifying digits, comparing numbers, identifying the number after, and simple addition.

Classroom activities for Curious George Math took place at learning activity stations implemented in three classrooms at the intervention preschool. Before the intervention took place, it was determined that the use of learning activity stations, where students move from station to station during unstructured learning time, are a daily activity at the intervention preschool. During the Curious George Math intervention,
participating students rotated through three learning activity stations:

- Learning Station 1: A bank of computers where *Curious George’s Busy Day* digital learning games were available for exploration
- Learning Station 2: A table with hands-on activities from the *Curious George’s Busy Day* section of PBS KIDS Lab and adapted from *Curious George’s Busy Day* games
- Learning Station 3: A free play area with a variety of indoor and outdoor classroom activities that changed daily, such as painting, sand table, and imaginative play

During the intervention, teachers moved about the stations and observed student activities. Learning Stations 1 and 2 were specifically designed to allow students to interact with and learn from *Curious George’s Busy Day* mathematics content.

### Study Methodology

#### Participants

The target age population of the *Curious George Math* preschool study was preschoolers aged three to five years old. Sixty-eight children were recruited from a preschool serving low-income communities in the San Francisco Bay Area and took part in the intervention. Classroom teachers from the preschool were also recruited to participate in the study. Complete pre- and post-assessment data were successfully obtained from 51 students. Participating children’s average age was 4.3 years old.

#### Instruments

**Test of Early Mathematics Ability (TEMA-3).** The Test of Early Mathematics Ability, third edition, is a test of children’s informal and formal mathematics knowledge, and was developed by Western Psychological Services (Ginsburg & Baroody, 2003). The test is designed for use with children ages 3 years, 0 months through 8 years, 11 months. A total of 26 items were selected to measure numbering (e.g., children learning to recognize collections of one or two items and labeling them “one” and “two”), informal concepts (e.g., children demonstrating understanding of informal cardinality rules), number comparisons (e.g., children choosing the larger number), reading and writing numerals (e.g., children reading single-digit numbers), and calculation (e.g., children’s mental addition: sums 5 to 9). These items measure the skills that are supported by the 16 *Curious George’s Busy Day* games and materials used in this study.

For the purpose of this study, the TEMA-3 experimental score was used to analyze children’s mathematics ability. The experimental score is based on selected TEMA-3 items, though each item may contain multiple sub-problems. The total number of selected TEMA-3 items was 26, while the total number of sub-problems was 53. The experimental score is defined as the number of sub-problems scored correct on the selected TEMA-3 items (one point per correct response). Therefore, the experimental score ranged from 0 to 53. The overall reliability of the selected TEMA-3 items was high (KR20 = .94 for pre-assessment and KR20 = .95 for post-assessment).

**Classroom Observations.** Each day of the study, researchers filled out activity logs to track each student’s use of digital learning games, hands-on activities and other interactions with the intervention content. Researchers verified that children received the appropriate dosage of the intervention. In addition, researchers recorded their observations of children’s behaviors while interacting with *Curious George Math* materials and activities.
Teacher Interviews. At the end of the intervention, each classroom teacher participated in a teacher interview. Teachers were asked to reflect on how the intervention content was incorporated into their regular classroom environment, how their children responded to the content, and whether they felt the content helped to support their students’ mathematics learning.

Results

Successful Implementation

- Over the course of the intervention, participation was robust with 49 children (96%) playing at least 15 of the 16 Curious George’s Busy Day digital games, and 45 children (88%) participating in five or more of the hands-on mini-lessons.
- Parents reported that they watched the Curious George videos at least once with their children at home.

Findings Around Children’s Knowledge and Skills in Mathematics

- Over the course of the Curious George Math intervention, children’s knowledge of mathematics significantly increased, as measured by the selected TEMA-3 items (Pre $M = 21.04$, Post $M = 23.75$, $p<0.01$).
- In particular, children showed significant and positive pre- and post-changes on mathematical skills related to number comparison (Pre $M = 5.98$, Post $M = 7.06$, $p<0.05$) and informal concepts (Pre $M = 0.86$, Post $M = 1.12$, $p<0.05$).
- Researchers further analyzed the data to explore whether the Curious George Math intervention helped children with different pre-assessment mathematical skill levels in different ways. The results indicated that children with lower pre-assessment TEMA-3 scores gained significantly on numbering (Pre $M = 6.24$, Post $M = 18.20$, $p<0.05$); whereas children with higher pre-assessment TEMA-3 scores gained significantly on mathematical skills related to number comparison (Pre $M = 7.65$, Post $M = 9.12$, $p<0.05$) and informal concepts (Pre $M = 1.38$, Post $M = 1.77$, $p<0.01$).

Affordances of Using Curious George Math in the Preschool Classroom

- A Playful Transmedia Environment Contributed to Student Engagement
  Analysis of classroom observation and teacher interview data produced findings that suggest the playful and engaging structure and narrative of the transmedia suite was highly motivating for the students. Observations and teacher report suggest that students were highly engaged in all aspects of the suite, including watching the video episodes at home. Teachers felt that the engaging aspects of the materials contributed to students’ persistence and positive engagement with the mathematics content in the intervention.

- Children’s Self-Directed Use of Curious George Math Led to Collaborative Learning and Classroom Academic Discourse
  A major affordance of children’s self-directed use of the Curious George’s Busy Day digital learning games and related educational materials in the preschool classroom was the emergence of children’s collaborative learning and academic discourse in the classroom. For the current study, children had agency in every aspect of their learning, from choosing what content to interact with, how they engaged with that content, and how long they wanted to play. Researchers and teachers observed that this free choice often led to increased collaborative learning and discourse around mathematics within the classroom. Researchers and teachers observed daily student discussions
and positive interactions around mathematics while at the computer and hands-on learning stations.

- **Collaborative Learning Interactions Supported Children’s Socio-Emotional Learning**
  The collaborative play fostered by use of the intervention also led to additional opportunities for developing children’s socio-emotional skills, such as listening and communication, respecting others, and cooperation and sharing. Socio-emotional learning is a significant component of the preschool curriculum and teachers reported that children’s self-directed use of the *Curious George’s Busy Day* activities helped to support this learning.

- **Collaborative Learning Interactions Supported Children’s Digital Literacy Skills**
  By working together on the *Curious George’s Busy Day* digital learning games, students also had the opportunity to learn technological literacy skills from one another. Teachers mentioned that they appreciated this affordance of the intervention; while technological literacy is not part of the kindergarten readiness curriculum, they felt these were important skills for their students to learn.

- **Curious George Math Allows for Self-Paced Learning and an Engaging Environment to Practice Skills Repeatedly**
  One powerful affordance of game-based learning is the ability of digital games to provide hints and scaffolds for struggling students, and the ability of adaptive leveling to adjust gameplay to easier or more difficult levels of academic content based on students’ mastery of that content. Teachers reported that this affordance supported students’ self-paced learning and allowed students to practice skills until they had mastered them. Teachers reported they particularly appreciated the aspect of free choice provided to children as they interacted with the digital learning games, and said children very often chose games that challenged them.

- **Curious George Math Provides Support for Teachers’ Instructional Practice**
  One unexpected, but positive, affordance of the *Curious George Math* intervention was the increase in teachers’ knowledge around student learning. Teachers found that, like other high-quality lessons they have implemented, by observing their students interacting independently with the *Curious George’s Busy Day* digital learning games, they were able to increase their knowledge about their students’ learning and mathematical development.

Many of the affordances of *Curious George Math* align with the recommendations for best practices in the use of technology and interactive media in the classroom identified in past research and in a policy statement produced by the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center (NAEYC, 2012). The findings of the current study support the NAEYC and Fred Rogers Center’s assertion that, when implemented appropriately, early child educators may “improve program quality by intentionally leveraging the potential of technology and media for the benefit of every child.”
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