Peg + Cat Digital Media Summative Evaluation

Early Childhood Educator Study

Rockman et al
Research & Evaluation

Acknowledgements

Evaluation & Report Credits:

Dr. Camellia Sanford-Dolly, Senior Researcher

Rockman et al

201 Mission Street, Suite 1320

San Francisco, CA 94105

3925 Hagan Street, Suite 301

Bloomington, IN 47401

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About Rockman et al:

Rockman et al is an innovative research, evaluation, and consulting company that specializes in examining critical issues in formal and informal education. The Rockman team includes evaluators with diverse backgrounds and skill sets who help clients answer critical questions in clear, direct, and honest ways. Rockman et al has served as the lead evaluator for numerous projects funded by the National Science Foundation, as well as several other public and private funding agencies. Learn more at www.rockman.com.

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Executive Summary

Peg + Cat is a popular broadcast television series, developed by The Fred Rogers Company and airing on PBS, in which a girl named Peg and her sidekick, Cat, solve everyday problems using mathematics, creativity, persistence, and humor. *Peg + Cat: Developing Preschoolers' Early Math Skills* was a three-year project, funded by the National Science Foundation, that aimed to impact children's interest and engagement with mathematics, as well as their development of positive social-emotional skills. The project supported early math learning via the creation of additional Peg + Cat episodes, online games and digital storybooks, a science center summer camp, and early childhood educator professional development. This evaluation report focuses on the use and impact of three online games (*Don't Go Bananas, Symmetry Painter,* and *Music Maker*) and three digital storybooks (*The Big Dog Problem, The Election Problem*, and *The Perfect Ten Problem*) by early childhood educators.

Rockman et al, an independent educational research and evaluation company, conducted the summative evaluation study of the six Peg + Cat digital media resources with fifteen early childhood educators. Participating preschool teachers were told that one of the goals of the online games and digital storybooks was to support children's social-emotional skill development, and that they should try to talk with the children in their classrooms about these topics, while using the digital media. Otherwise, teachers were instructed to use the six online games and digital storybooks in their classrooms however they wanted to incorporate them over a four-month period. Each month, teachers filled out an online form, indicating which Peg + Cat digital media they used in their classrooms, and how they and their students used them. The teachers then participated in a telephone interview at the end of the study, asking them to provide more in-depth information about how they utilized the six online games and digital storybooks in their classrooms, how they addressed mathematics and social-emotional skills during gameplay, and the extent to which they felt that the Peg + Cat digital media had impacted the children in their classrooms.

Key Findings

- **Teachers tended to use the Peg + Cat digital media in both small groups during "center time," as well as in large groups during "circle time."**
    - Teachers used the online games most often during center time, and the digital storybooks most often during circle time.
    - Teachers used the online games most often on a tablet computer, and the digital storybooks most often on a Hatch Board.

- **The main challenge that teachers encountered was not having an adequate internet connection or appropriate technology in their classrooms to use the Peg + Cat digital media in the ways that they intended.**
- **All participating teachers were able to identify math concepts that they saw within the Peg + Cat digital media.**
    - Teachers were able to link specific online games and digital storybooks to mathematical content.
        - *The Perfect Ten Problem:* Number recognition, size comparisons, the concept of zero, addition, counting on, determining how many more
        - *The Election Problem:* Large numbers, quantity comparisons, more than/less than
        - *The Big Dog Problem:* Size comparisons, counting, sorting, quantity, measurement, division, problem-solving
        - *Don't Go Bananas:* Addition and subtraction, counting, how many more, counting on, number recognition, one-to-one correspondence, subitizing
        - *Symmetry Painter:* Symmetry, novel math vocabulary
        - *Music Maker:* Counting, biggest and tallest, patterns, number recognition
    - Teachers were able to provide examples of math-related conversations and activities that they engaged in which children in their classrooms that directly addressed concepts they encountered within the Peg + Cat digital media.
        - *The Perfect Ten Problem:* Teachers used classroom objects to generate different combinations of ten.
        - *The Election Problem:* Teachers had children vote on different preferences, and sometimes used data representations to make quantity comparisons.
        - *The Big Dog Problem:* Teachers compared the heights of children or objects in the classroom, or asked them to come up with solutions to problems like trying to reach a tall object. Some teachers had children divide objects into equal amounts.
        - *Don't Go Bananas:* Teachers asked children to count different objects arranged in various combinations to make a total amount.
        - *Symmetry Painter:* Teachers encouraged children to make symmetrical artwork or building blocks.

        - *Music Maker:* Teachers linked musical concepts like pitch and volume to math, or compared bar heights during block-building activities.
    - Some teachers observed their students incorporating math concepts they had learned from the online games and digital storybooks into other classroom activities.

- **Most teachers (80%) felt that the Peg + Cat digital media had increased children's interest in math.**
- **Most teachers (87%) thought that the Peg + Cat digital media resources were effective at addressing social-emotional skills.**
    - Teachers were able to link the Peg + Cat digital media to classroom conversations or activities involving positive social-emotional behaviors.
        - Teachers were most likely to discuss taking turns or working collaboratively with children while using the Peg + Cat digital media resources.
        - The online games tended to facilitate discussions about taking turns and working together to solve problems.
            - *Don't Go Bananas:* Taking turns, working together, helping others
            - *Symmetry Painter:* Taking turns, working together
            - *Music Maker:* Working together
        - The digital storybooks supported conversations around a wider range of social-emotional topics.
            - *The Perfect Ten Problem:* Helping others, fairness, expressing emotions
            - *The Election Problem: H*elping others, being a good sport, calming down when upset, it is okay to have different opinions
            - *The Big Dog Problem:* Helping others, sharing, not judging by appearances, taking turns, working together to solve problems, what to do when you are scared
- **A few teachers saw changes in children's positive social-emotional behaviors that they attributed to using the Peg + Cat digital media in class.**
    - Demonstrations of children's positive social-emotional behaviors were observed during gameplay, as well as afterwards during other classroom activities.
- **In general, teachers liked the Peg + Cat digital media because they were fun and engaging learning resources with characters that were familiar to children.**

- Teachers did not have a clear favorite individual Peg + Cat digital media resource. However, they mentioned the digital storybooks most often as either their favorite or least favorite resources.
- Teachers thought that the children in their classroom liked *Don't Go Bananas* the best, and *Music Maker* the least.

Teachers saw the Peg + Cat digital media as fun and engaging educational resources that they could use to support math and social-emotional learning in their preschool classrooms. Teachers were able to identify specific math content that the online games and digital storybooks addressed, and successfully linked those topics to conversations and activities they engaged in with children. Teachers also saw different affordances in the online games and digital media for supporting children's social-emotional skill development. The online games were mainly used to model taking turns and working together, while the digital storybooks were used to discuss a range of social-emotional skills. Thus, both types of online media had important roles to play in children's social-emotional development and early math learning.

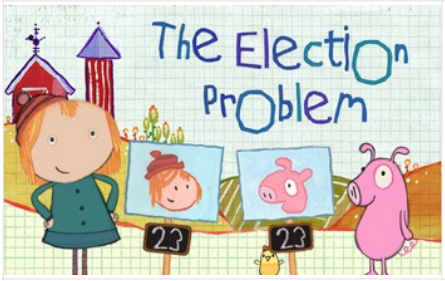
Project Description

Peg + Cat is a popular broadcast television series, developed by The Fred Rogers Company and airing on PBS, in which a girl named Peg and her sidekick, Cat, solve everyday problems using mathematics, creativity, persistence, and humor. *Peg + Cat: Developing Preschoolers' Early Math Skills* was a three-year project, funded by the National Science Foundation, that utilized *Peg + Cat's* media and philosophical approach to ultimately impact children's interest and engagement with mathematics, as well as their development of positive social-emotional skills to support early math learning. The project aimed to do so via several activities: 1.) creation of additional broadcast television episodes of Peg + Cat, 2.) development of three online games and three digital storybooks hosted on the PBS Kids website, 3.) design of a Peg + Cat-themed summer camp for a local science center, and 4.) implementation of a professional development experience for early childhood educators. This evaluation report focuses on the second activity - the use and impact of the six Peg + Cat digital media resources.

Three online games and three digital storybooks were developed as part of the *Peg + Cat: Developing Preschoolers' Early Math Skills* project (see Table 1). These digital materials were designed to highlight positive and helpful interactions among Peg + Cat characters, and to be available for use in classrooms and informal settings. The six online games and digital storybooks also addressed specific social-emotional skills, such as self-regulation, an effort-based mindset, perseverance, help-seeking, and mentoring in some way. For reference, the six digital media are available on the PBS Kids website (https://pbskids.org/peg/games).

Table 1. Description of Peg + Cat Digital Media

Digital Media	Description
	Players can draw freely, or place stickers with characters, numbers, or musical notes on a blank canvas. Whatever players draw on one side of the screen is mirrored on the other side, depending on whether they have turned on the following options: Horizontal symmetry, vertical symmetry, or both.
	Players can select one of three scenes that contain bars of various heights. Players can adjust the height of the bars to change the pitch of the music being played. They can also adjust the tempo, and make Cat run quickly or slowly across the screen.

Digital Media	Description
	Players take turns with Peg, and spin a spinner to determine how many monkeys they need to find in the circus scene. Players try to collect ten monkeys, and can count how many they have and how many more they need. If they land on "bananas," they lose their monkeys, and must start again.
	Peg and Cat need to mail several letters at a mailbox, but are initially scared to do so because Big Dog is in their path. They find out that Big Dog is friendly, and he helps them when they are not tall enough to reach the top of the mailbox. By working together, the group successfully mails the letters.
	Ramone hosts a talent competition with Peg, Cat, and Parrot as judges. The group takes turns rating the various acts, but must always end up with a total of 10 points for each contestant. When Parrot rates Pig's act a 10, Cat helps Peg realize that she can rate it a zero in order to have Pig receive 10 total points.
	The Farmer holds an election to see who will watch over his farm in his absence. Peg runs against the Pig to win the most votes from one hundred chickens. Math concepts include large numbers, and greater than and less than. Peg sings a song about what she knows about math to ultimately win the election.

Evaluation Methodology

Rockman et al, an independent educational research and evaluation company, conducted the summative evaluation of the six Peg + Cat digital media. The evaluation focused on two audiences: Early childhood educators and families with preschool-aged children. This report describes results from the early childhood educator study.

The early childhood educator study took place in Pittsburgh, PA over a four-month period. Fifteen preschool teachers from Head Start and Pre-K Counts were recruited to participate. Almost all (14 out of 15) participating educators were female.

Participating preschool teachers were instructed to use the six online games and digital storybooks in their classrooms however they wanted to incorporate them over a four-month period. They were told that one of the goals of the Peg + Cat digital media was to support children's social-emotional skill development, and that they should try to talk with the children in their classrooms about these topics, while using the online games and digital storybooks. At the end of each month, participating teachers filled out an online form indicating which of the six Peg + Cat digital media they had made available to the children in their classrooms that month, what activities they incorporated the online games and digital storybooks into, with whom children in their classroom used the digital media, and what kinds of math and social-emotional topics came up during conversations around the Peg + Cat digital media. At the end of the four-month period, each teacher participated in a telephone interview, where they were asked to provide more in-depth information about how they had utilized the six online games and digital storybooks in their classrooms, how they addressed mathematics and social-emotional skills during gameplay, what they and their children thought about each of the online games and digital storybooks, and the extent to which they felt that the Peg + Cat digital media had impacted the children in their classrooms.

Findings

Teachers' Use of the Peg + Cat Online Games & Digital Storybooks in Their Classrooms

Teachers tended to use the online games most in small groups during "center time," and the digital storybooks most in large groups during "circle time."

Within preschool teachers' classrooms, "center time" consisted of a small group of children selecting an area or table in the classroom to do an activity, such as art, computers, blocks, etc. Sometimes, these activities were set-up and/or facilitated by the teacher, while other times children could engage in free play. "Circle time" tended to involve the entire class sitting in a circle on the floor, and either talking about a topic together or doing a whole-group activity. Over a four-month period, teachers specified whether they used the Peg + Cat digital media during circle or center time in their journal entries. Within these 47 entries, teachers were most likely to report using the online games during center time, and the digital storybooks during circle time (see Table 2).

Table 2. Classroom Activities During Which Peg + Cat Digital Media Was Used*

Peg + Cat Digital Media	Circle Time Only	Center Time Only	Both Circle & Center Time	Did Not Specify
The Perfect Ten Problem	36%	29%	29%	7%
The Election Problem	31%	31%	23%	15%
The Big Dog Problem	54%	23%	15%	7%
Don't Go Bananas	20%	47%	27%	8%
Symmetry Painter	14%	43%	21%	21%
Music Maker	8%	38%	31%	23%

* *Blue squares denote the highest percentage of journal entries.*

Teachers were most likely to report using the online games on a tablet computer, and the digital storybooks on a Hatch Board (see Table 3). This is not surprising given that a Hatch Board is a larger device that lends itself to large group viewing, whereas a tablet computer typically has a single user. Although teachers reported using the online games more with large groups and the digital storybooks more with small groups, several teachers shared that they initially introduced all of the Peg + Cat digital media with the whole class first, and then made the resources available during small group time as one of the centers that children could select: "Typically with other games, they just play on their own. With these ones, we were able to play as a group because it was put up on my Hatch Board, or I can do it in small groups or individually. It just seemed like there were endless ways to engage them in the game."

Table 3. Technologies Teachers Used To Play Peg + Cat Digital Media*

Peg + Cat Digital Media	Hatch Board	Tablet Computer	Desktop Computer	Did Not Specify
The Perfect Ten Problem	41%	36%	18%	5%
The Election Problem	42%	37%	11%	11%
The Big Dog Problem	47%	35%	12%	6%
Don't Go Bananas	36%	45%	14%	5%
Symmetry Painter	41%	41%	6%	12%
Music Maker	35%	41%	18%	6%

* *Blue squares denote the highest percentage of journal entries.*

The main challenge that teachers encountered was not having an adequate internet connection or appropriate technology in their classrooms to use the Peg + Cat digital media in the ways that they intended.

Challenges that teachers encountered in using the Peg + Cat digital media in class were long download times or an inability to download the online games or digital storybooks in general, and having the screen freeze up due to slow internet speeds or spotty connections. Several teachers noted that they did not have a Hatch Board in their classrooms, which "inhibited" them from being able to use the Peg + Cat digital media effectively in groups.

One teacher shared that it was difficult to monitor children's use of the Peg + Cat digital media during center time, as children could navigate away from the online games or digital storybooks onto other educational websites or apps. Another teacher indicated that it was hard for some children who lacked fine motor skills to use a mouse during gameplay. A few teachers also mentioned that introducing the Peg + Cat digital media at the end of the school year was difficult, since they had already established classroom routines: "It's hard to find a way to squeeze it in." Several teachers indicated that they planned to incorporate the online games and digital storybooks into their classroom earlier for the next school year.

Teachers' Incorporation of Math Content & Activities Using Peg + Cat Digital Media

All participating teachers were able to identify math concepts that they saw within the Peg + Cat digital media.

In general, teachers felt that the Peg + Cat digital media covered mathematical content:

> "I think they learned a lot that they're doing with math because it's such a fun way, and it's such a creative – you know what I mean? And they're helping Peg out, so I don't think they really realized they were doing math, and I like that about Peg + Cat."

> "I think it addressed math and it helps them to understand what math is all about. It's the understanding or the beginning to understand math skills."

Teachers were able to link specific online games and digital storybooks to mathematical concepts: "I think that *The Perfect Ten Problem* covered addition very well in sets of 10. For older children, *The Election Problem* was really good for greater than/less than once it gets into its higher numbers, and *The Big Dog Problem* was very good for sorting and heights or size comparison." Furthermore, teachers were able to provide examples of math-related conversations or activities that they engaged in with children in their classroom that directly addressed concepts they encountered within the Peg + Cat digital media.

The Perfect Ten Problem

Teachers used *The Perfect Ten Problem* to talk about number recognition, size comparisons, the concept of zero, practice addition with their students, and to help them learn to count on/determine how many more numbers were needed to make ten:

> "We talked about small, smaller, and smallest. We talked about addition facts, and how we can get to the 'perfect 10.'"

> "Okay, if Peg did this, how many more do we need to get this? This plus this will give us 10, and then we introduced zero to them in the last part of the story."

> "To tell how many more numbers we would need to add to reach our perfect 10! Then we would ask, 'How did you know that, or how many more did you need to add to get to ten?'"

> "We used that during our circle time and our story on two different days, using it as just simple addition and figuring out how to make ten in different ways, especially in the story, you know? 'The parrot gave them a 1 star. How do we make 10 stars if we already have 1 star?'"

Teachers also expanded on the concepts introduced in *The Perfect Ten Problem* during classroom activities. For example, some teachers created a similar scenario of judges and contestants:

> "I used *The Perfect Ten Problem* during small group. The students were practicing an end of the year song. I then assigned judges to give a score, and then added the score at the end. I modeled as a judge, and asked the students how many more points they needed to get to ten. Some students were able to grasp, and use resources (fingers) to count up."

Other teachers used classroom objects, such as blocks, stars, and ten-frames to generate different combinations that added up to ten, or to five for younger children:

> "To continue the lesson, we made sets of 10 using our 'set of 10' number line. We added a certain set of numbers, leaving out some numbers for children to take turns."

> "That was a fun way to practice counting without actually knowing you're practicing counting…Seeing how many we needed to get to five. Adding and taking away."

Some teachers noted that children in their classroom internalized concepts from *The Perfect Ten Problem*. For example, when students in one class were playing a dice rolling game during transition time, they would mention the story anytime someone rolled a ten. One teacher observed that her students started counting from zero instead of from one after reading the story. Another teacher saw children combining numbers of objects that they were playing with in different ways. Finally, one teacher overheard her students repeating that five plus five equals ten.

The Election Problem

Teachers utilized *The Election Problem* to introduce larger numbers, compare quantities, and decide who had more or less of something:

> "We used *The Election Problem* during our closing circle as a large group at the end of the day. Children explained who won and why! We talked about how we knew Peg won, and how she had the higher amount, meaning more than the pig. Therefore, she won the election."

> "'Well, which one has more? Which one has less? Who is winning?' I was surprised with that because we don't really do big numbers in our classroom, and those numbers were bigger."

> "They were counting to some higher numbers, and they were talking about more and less and how many more and how many less. For my kids that are heading to kindergarten that was adventurous to them, and they were ready for that at that point."

Teachers tended to expand on the concepts within *The Election Problem* by having children in their classroom vote on different preferences, sometimes incorporating different data representations like tally marks and graphs:

> "We talked about counting all the chickens…We had our own little election, and we voted whether kids like winter or summer better, or cats or dogs better just to expand that for them."

> "We watched the video in large group, while children were in circle time. Then we had our own election. We placed two different pictures of fruit on our white board, and children came up to the board and placed a tally under their favorite fruit of choice. After all children finished voting, we tallied the marks and decided which fruit won and why…We talked about terms like, 'more than, less than, equal to,' to show people how to count up and down from a number…We created a bar graph, and showed them on the bar graph."

> "We have been doing a lot of representations of data, so we've been having little mini-elections for things like, 'Do we like pancakes or waffles more?, or 'Which is a better dinosaur? Things like that. So that's been a good connection because they saw it in the story, and we've been practicing it through these last couple weeks of the school year."

Several teachers utilized pre-existing classroom routines, like asking a Question of the Day, to reinforce the math concepts covered in *The Election Problem*:

> "Some of the concepts they already do in the class, but it gave them a different way to look at things. Like an example would be *The Election Problem*. We do a Question of the Day already, where they compare how many people say, 'Yes,' and how many people say, 'No.' But it gave them another way to look at how that works too."

One teacher observed that her students would compare quantities during play time: "They would talk about 'I have more; he has more,' and they would count how many each person has of the blocks or some of the building toys that we have." Another teacher noticed that the children in her classroom compared quantities, in general: "They'll point out numerals, and they talk about maybe who has less than or more than."

The Big Dog Problem

Teachers felt that *The Big Dog Problem* included the following math content: Size comparisons, counting, sorting, quantity, measurement, division, and problem-solving:

> "Before lunch, I had *The Big Dog Problem* pulled up on our classroom Hatch Board. We counted how many letters Peg was holding. We counted how many marks on the doorframe tall Peg and Cat are. Throughout the story, we compared Cat, Peg and the big dog to see who is tallest in each scene."
>
> "We talked about problem solving, and stopping and thinking about how you could solve the problem. We talked about size comparison, and that they needed to be taller to reach the mailbox."
>
> "Measurement, like comparing smaller and bigger."
>
> "We talked about grouping because the white letters and the red letter, and then asked, 'How many did Peg have? How many did Cat have?' We talked about when they lost the red letter, taking that one away. We talked about difference in height, problem-solving when they couldn't reach the mailbox, what they could do."
>
> "'Well, what do I do if I can't reach the mailbox?' Then they had to think about it like, 'Oh, we can use different objects to.' We can incorporate all that into the classroom like, 'Well, what if you had a problem? What do you do? Well, just like Peg, we can think of a problem and a solution to the problem.'"

Teachers expanded on the concepts covered in *The Big Dog Problem* by comparing heights of people in the classroom: "We took the activity a step farther, and we compared the height of the children, 'Who was taller or shorter, and how do we know?'" One teacher shared that she had to explain to the children in her classroom that 'just because someone's taller, doesn't mean that you're older.' Another teacher "did measuring and then some comparing sizes with just other materials in the classroom."

Some teachers asked the children to come up with solutions to problems like trying to reach an alphabet poster on the wall or trying to reach a mailbox:

> "I have this alphabet gathered on the wall that's up higher…I asked the children if they could reach the letters on the wall, which were close to the ceiling. 'Why not?' We had a discussion on why they could not reach, then we talked about ways to solve that problem. 'How could a child reach those letters?' Some children said they could stand on one another's shoulders. Others said, 'Stand on a ladder, and it will make you taller.'"

> "We actually walked to the mailbox, because we were mailing Mother's Day cards. But the problem of it is when we got to the mailbox, some of the children couldn't reach the one we went to. I didn't have anyone who could reach it. But it was very visual to the children that I could reach it. But they thought they were tall enough. I got height and weight measurements out of that. We talked about how else could we have solved the problem, and the children generated a lot of other ideas."

A few teachers also picked up on the concept of dividing amounts up equally: "I made different sets of pizzas. So we had to figure out how we would divide the pizza slices up among evenly with the children."

Don't Go Bananas

In terms of the online games, teachers felt that *Don't Go Bananas* included the following math content: Addition and subtraction, counting, how many more, counting on, number recognition, one-to-one correspondence, and subitizing:

> "I felt like it had so many concepts. We took turns, we counted, we added, we took away, and then they were recognizing how many bananas were there at the time."

> "I would have them take a turn. When it wasn't their turn, they would watch Peg and then I'd say, 'Well, Peg got this [many]. What do we need to do?', and then they would answer."

> "I would let them know that, 'Oh, no! I got a banana. So now one monkey has to get taken away,' and then they'd be like, 'We have three left. One, two, three.'"

> "We had the kids come up and find you know however it's spun, however many monkeys they needed to find. You'd have them come up, find that many monkeys, and then while they were watching, the rest of the group would count how many do we have and how many do we still need to find."

Teachers linked the math concepts in *Don't Go Bananas* to other classroom activities, usually around counting objects or the number of children in a group to make ten:

> "They practiced finding sets with 10, you know, with sea creatures, with blocks, whatever it may be, and then we had a small group, where we rolled a dice and they would have to add the blocks up to 10."

A few teachers modified counting activities with smaller numbers for their younger students:

> "We did a game with a parachute, where we got five bean bags and we would bounce the bean bags off of the parachute and then see how many were left. Sort of like a similar idea of adding and taking the bean bags away."

One teacher observed that her students would discuss how many more pieces of food they needed to reach a certain amount during mealtime: "When we do lunch, they get a certain amount. So they would talk about… 'We need to get this many. You already have this many. How many more do you need?'" Another teacher noticed that children in her classroom did this, in general: "They talk about adding. They talk about subtracting, and taking things way."

Symmetry Painter

Teachers felt that *Symmetry Painter* focused on the concept of symmetry and introduced novel math vocabulary:

> "I kind of just explained that you have the same on both sides, and showed them the different ways. I showed them the different buttons…horizontal, vertical, with stickers – I kind of just showed them what they could do."

> "How on each side – just what symmetry is, and how if you draw something on one side, it comes up on the other side, so it's a mirror image."

> "I was like, 'Hey, look! What did you do on this side?' And they were like, 'Oh, it's the same.' And I'm like, 'Yeah, that's symmetry.' It took them a minute to realize it's coloring on the other side of the paper."

Several teachers thought that their students were so enamored with drawing that they ignored the math content: "They really loved the rainbow painting with that, and they really just wanted to make a picture. So I don't think they grasped the symmetrical process quite as much as I'd hoped."

Teachers expanded upon the game's content through additional classroom activities, where children created symmetrical artwork or via block building:

> "We did a craft and we painted one side of something, and then we folded the paper in half to show that the paint would on the other side [have] the same kind of pattern that they had done on the one side."

> "We created the butterflies, cut it out, and then they painted one half of the butterfly and then they closed it and spread the paint out to show symmetry… Then we showed how we split our face down the center, 'Look! We're symmetrical.' You know, where one arm, the other arm, eye, half a nose, half a mouth."

> "We talked about symmetry, and then the way we connected that was if they were building something in the classroom, like in blocks, we would talk about how they were building things that were symmetrical and sometimes in art, it would come up as well."

One teacher had previously done a craft with children and their families around symmetry, and referenced that activity when she introduced the game to children: "We had a family engagement where basically we had a parent or family members come in for about 15 to 20 minutes…We actually had the parents teach their child about symmetry, and they had a butterfly that they painted one side and they folded it and opened it up, and saw how it was symmetric. So when I brought out the *Symmetry Painter* I said, 'Hey, you know, this is when we talked about the butterfly. Whatever you do on one side, it happens exactly on the other side.'" Another teacher noticed that a few children in her classroom used the term, "symmetry," after playing the game: "Every now and then after using it, a kid would actually use the word, 'symmetrical' when they were building things. I had one or two that actually picked up on the word."

Music Maker

Teachers felt that *Music Maker* included the following math content: Counting, biggest or tallest, patterns, and number recognition:

> "I counted the numbers on the side with the student, and then had her count every time we changed the number of bamboo tree segments and tin cans."

> "Some of the kids were trying to actually use the mouse to raise and lower the cans and the bamboo, and we talked about the different numbers and just how it was different-sounding if you made it taller or shorter."

> "What type of patterns they could use. How making a pattern would make one sound, and could you use a different pattern with the different sounds and volumes?"

> "To me, being familiar with music and math and the relationship between those, I felt like how the height correlated to the pitch, again that comparing and measuring, I thought was really good."

One teacher applied the concepts covered in Music Maker around size comparisons to a block-building and graphing activity: "We set up groups of three using the stacking blocks. We talked about, 'Which block was tall, taller or tallest? Why? How you know which one is taller? How many more blocks is this one? How many less in this stack? What makes this the smallest?' Then we pulled a small group of children, and we actually created bar graphs."

Other teachers were able to link music and math concepts together, especially around pitch and volume:

> "We had [previously] talked about pitch and sound [during our Music Unit]…They just put the pipes up and down like, 'Oh, you're making it bigger,' you know, 'Making it longer, then it has a lower sound, and smaller. It has a higher sound.'"

> "Different levels of sound. We got to about how we use inside voices and outside voices, and which number it went up to would be an outside voice and how low it went to be an inside voice."

One teacher observed her students emulating the connection between tall and short heights, and volume: "They would make a taller tower of blocks, and then say something about it being like a louder noise, and a lower thing of blocks making a smaller noise, even though there was no actual noise associated with it when they were doing it." This teacher also saw her students do this in their drawings of pictures of blocks of different sizes at the art station during center time.

Teachers felt that the Peg + Cat digital media had increased children's interest in math.

Most teachers (80%) answered affirmatively when asked if the online games and digital storybooks had increased their students' interest in math: "It made them smile, learning to count because they're fun. It gave them something different too, rather than just, you know, like counting the blocks and things in the room." Those who did not say so either thought that the children in their classroom were already interested in math beforehand, or had not made the connection that the fun activities they were doing involved math.

A few teachers observed their students incorporating the math concepts that they had learned into their playtime: "They'd mimic what they learned…If we did *The Election Problem*, then they would go into a small group and I can see them getting objects like, 'Okay, well, which one has more? How many more do I need?', or 'Which one has less?'" One teacher shared that after using *The Perfect Ten Problem* in class, parents had told her that their children tried to make a 'perfect 10' at home using cereal or toy cars. She also reported that when her seventeen students lined up to go outside, one girl noticed, "We don't have a perfect 10." Similarly, another teacher observed students creating their own sets of ten out of markers during center time, as well as making lines of markers that were small, smaller, and smallest.

Teachers' Incorporation of Social-Emotional Skills Using Peg + Cat Digital Media

Most teachers thought that the Peg + Cat digital media resources were effective at addressing social-emotional skills.

The majority of teachers (87%) answered affirmatively when asked if they thought that the Peg + Cat digital media had been successful at addressing social-emotional skills. Participating teachers identified various social-emotional skills that they saw within each of the online games and digital storybooks:

> "I would play the story or the game with them, and then we would talk about what the problem was. Our biggest thing is like, if one of us gets upset, we'll say, 'Okay. We're going to count backwards like Peg did because that's what we learned before.' That way, they can relate to the thing: to the game, to real life, what's going on in the classroom."

> "It was a lot of just talking about taking turns and staying calm, and managing your emotions. Peg would do the counting down, so we did that all together. We'd count down."

> "The biggest focus about it is Peg always had a problem. So I'm big on problem-solving. So it fit right into what we normally would do as far as solving a problem."

One teacher indicated that she gave students in her classroom individual time with technology and the Peg + Cat digital media as a way to help them calm down: "If anybody got upset or irritated during a specific time and maybe needed time alone…We have this sort of little safe place that they go to, and then they'd come back and be ready to join the group."

Teachers were able to link the Peg + Cat digital media to classroom conversations or activities involving positive social-emotional behaviors. Overall, they tended to discuss taking turns or working collaboratively with children while using the Peg + Cat digital media resources.

Teachers were most likely to use the six digital media resources with children to discuss taking turns or working collaboratively (see Table 4). The online games tended to facilitate discussions about taking turns and working together to solve problems (see Table 5). For example, one teacher used *Symmetry Painter* to practice group collaboration: "With *Symmetry Painter*, we pick a scene to paint, for example, a house, and each child contributes a different part to the painting." Teachers utilized *Don't Go Bananas* to help the children practice taking turns with Peg and with each other (in the case of larger groups):

> "I liked *Don't Go Bananas* too because Peg got a turn. And they were just so used to always being the one in control that I had to remind them that it was Peg's turn to spin the wheel."
>
> "The *Don't Go Bananas* game, it really helped with the turn taking, and things like that because kids nowadays are now on the power trip. They're used to being able to do everything and be in charge of it. I think that was really nice that they have to slow down and think, 'Okay, it's Peg's turn, so I'm not spinning. Peg needs to spin now.'"
>
> "You had to take turns in the game with Peg, and then if we were doing it as a group, we also had that added level of, 'Who takes turns? Now it's one child's turn. Now it's Peg's turn. Now it's a different child's turn.'"

A few teachers also used *Don't Go Bananas* to support their students in helping others and working together to play the game:

> "We talked about friendship. It was their Buddy Day. We talked about how to be a good friend, and how to take turns and share that day….working together…Some of them would stand there the whole time and just help them click and everything like that, and they were helping each other because some of the younger ones couldn't figure out where to find [the monkeys], so the older ones would kind of help bring them out."
>
> "This is teamwork when we work together to try to solve the problem or try to get all the monkeys."

Teachers had a hard time finding social-emotional content within *Music Maker* beyond students collaborating to make songs. Similarly, some teachers had trouble fostering social-emotional skills around *Symmetry Painter*: "*Symmetry Painter* was the hardest one for me to really come up with a social and emotional skill. Mostly, with that one, I would just talk about taking turns."

The digital storybooks supported conversations around a wider range of social-emotional topics (see Table 5): "In terms of the stories, whenever Peg would say, 'I'm freaking out,' we would just, you know, talk about how can she calm down or how can she change that. Even in the classroom a few times with some of the children, when they would have issues or get emotional or angry or upset, we would bring that up and try counting back like Peg and Cat do." In terms of specific digital storybooks, teachers utilized *The Election Problem* to talk about helping others, being a good sport, calming down when upset, and that it is okay to have different opinions:

> "Doing different Questions of the Day, and why certain people like certain things and don't like the other things, and how everybody in class is different and has different opinions."

"*The Election Problem* was staying calm, even when you're not getting what you want."

"We talked about a lotta feelings with that, with the losing and the winning. How they went to their friends for help with stuff, and how we feel to help, and what kind of person helps."

"They both wanted to win, and in the end, they were both happy for one another even though I think it was Peg who ends up winning."

"We also got to talk about managing feelings. Even if you didn't win, it's still okay, and we had to observe how Peg was still calm, even when she wasn't winning."

Teachers used *The Big Dog Problem* to talk about sharing, helping others, not judging by appearances, taking turns, working together to solve problems, and what to do when you are scared:

"That one was lot: The sharing, taking turns, and then giving people a chance and some problem-solving and helping each other out."

"That they had a problem, and how they both worked together to be able to fit that mail in the mailbox."

"We even talked a little bit about what to do if you were scared in that situation, since [Peg and Cat] were scared of the dog."

"I just figured it as a method of they're working together, and also I made sure to do that on Community Helpers' Day because that kind of talks about the mail and the mailman."

"They were talking about the mailbox, and the dog being big, and then sharing and taking turns when they carrying the letters down. Being friendly, and we heard some other stories about them not to be judging."

Teachers used *The Perfect Ten Problem* to talk about helping others, fairness, and expressing emotions:

"How to be a good friend, and how Cat helped solve problems.

"It has to be fair. Everyone has to get the same amount…It said the parrot was upset because they didn't let him in their show, so we talked about that, 'Would that make you angry if you couldn't go?'"

Table 4. Number of Teachers Who Referenced Specific Social-Emotional Skills During Children's Math-Related Digital Media Use (N=15)

Social-Emotional Skill	Number of Teachers Who Mentioned
Taking turns	11
Working collaboratively	11
Talking about feelings	6
Strategies for calming down when upset	5
Problem-solving	4
Helping others	2
Asking for help	2

** Some teachers mentioned more than one social-emotional skill.*

Table 5. Comparison of the Number of Teachers Who Referenced Specific Social-Emotional Skills During Children's Use of Digital Storybooks Versus Online Games (N=15)

Social-Emotional Skill	Number of Teachers Who Mentioned Regarding Digital Storybooks	Number of Teachers Who Mentioned Regarding Online Games
Taking turns	3	11
Working collaboratively	4	10
Talking about feelings	4	0
Strategies for calming down when upset	6	0
Problem-solving	4	1
Helping others	2	0
Asking for help	2	0

** Some teachers mentioned more than one social-emotional skill.*

A few teachers saw changes in children's positive social-emotional behaviors that they attributed to using the Peg + Cat digital media in class.

While most teachers did not notice any differences in how their students interacted in class, a few teachers provided examples of instances where children demonstrated positive social-emotional behaviors during or after using the Peg + Cat digital media. For instance, one teacher described a student who liked to direct other children's actions and had been trying to help him interact more collaboratively with others. She was surprised that this child worked well together with his classmates while playing *Don't Go Bananas*. Another teacher saw older children in her classroom helping the younger students with the various online games and digital storybooks. One teacher observed her students taking turns, helping others, and asking for help during gameplay:

> "I think definitely with the taking turns because we did a lot, like I said, in the large groups, and they knew to do that, to take turns to play the game, and also they did go to helping their friends when one of them didn't know what to do. They were so supportive in helping them when I asked. I let them try to figure it out on their own, and if they can't figure it out, I'll ask if they want their friend's help and they said, 'Yes.'"

A few teachers concluded that the nature of the technology students were using to play the Peg + Cat digital media influenced their interactions: "I think the games gave another opportunity for students to take turns in a different way, because I think taking turns with technology is very different than taking turns with a physical toy in front of them." For example, one teacher reported that children in her classroom had to share one iPad between them, which "encouraged us to talk to each other and take turns." Similarly, another teacher noticed that pairing up students to take turns using a game supported positive social-emotional behaviors: "We had one student who had trouble interacting with other kids just because he doesn't get a lot of socialization outside of school. So it was cool to see his social engagement with other students using the games."

Teachers also saw these behaviors transfer outside of gameplay: "I think just the skill of practicing negotiating with each other, was the way I was using *Music Maker* and *Symmetry Painter*, and having them work together to create something cohesive definitely translated into other parts of our day because they were better able to use those skills in other places." A few teachers observed children using Peg's calming down strategy: "I do think that all of the Peg + Cat stuff that we have does address [social-emotional skills] very well. My kids will actually stop and count backwards from five to calm down. I've had them actually say, 'We have a problem,' and then they stop and think about it." One teacher said that *The Election Problem* helped students in her class netter manage their feelings: "We also played Candyland a lot this month, so they got to kind of link that in, and think about how Peg would handle the not winning the game." Another teacher saw children engaging in more teamwork and turn taking while playing board games after using *Don't Go Bananas*.

Teachers' Opinions of the Peg + Cat Digital Media

Teachers thought that the Peg + Cat digital media resources were fun, engaging, and educational.

In general, teachers liked the Peg + Cat digital media because they were fun and engaging learning resources that leveraged technology:

> "[I liked] the specific math skills that they're trying to teach the children (or at least introduce them to), and the fun, interactive music and the bright colors."

> "It was a good way to kind of build on things because my kids love technology, and like the computer and stuff, so it's kind of a way to grab their attention about math."

Teachers also appreciated being able to reference characters that were familiar to children:

> "They're familiar characters, so they could get excited about reading the books and playing the games…It was really nice that we weren't just playing random games. We were learning about math and social emotional, and everything else too."

> "I really didn't have like a math curriculum or anything to go off of, so it was definitely a great starting point, and it made me try to be more creative and figure out how I can tie it together…. and [Peg + Cat] was something that they can relate to, something that they've already seen at home."

> "They're now used to Peg + Cat. They start singing the song, even before I get it booted up."

Since the study took place towards the end of the school year, several teachers were excited to introduce the Peg + Cat digital media in the fall: "I'm really happy I get to use them in the classroom. I think they're really beneficial to the students and to our overall learning, so I'll definitely use those again next year and maybe look at PBS for more games and storybooks too."

Teachers did not have a clear favorite individual Peg + Cat digital media resource. However, they mentioned the digital storybooks most often as either their favorite or least favorite resources.

Teachers tended to list one or all of the digital storybooks as their favorite out of the six Peg + Cat digital media resources (see Table 6):

> "The storybooks I loved because they had songs, and they were really engaging for the kids."

> "I love the Peg + Cat stories. They incorporate so many ideas between the math ideas and the social-emotional with how Peg has to figure problems out."

Teachers liked that children could go through the digital storybooks at their own pace, and could return to missed content: "They liked the fact that they could click the stories, and if the children missed something, we could go back and forth." They also appreciated having this feature for themselves: "I think overall the way that they told the story, and I liked how you had to stop. I had control over it…I could take that time to explain things to the kids who didn't understand."

Over half of the teachers did not have one online game or digital storybook that they liked less than the others. One teacher felt that the directions in all of the digital media resources were a bit long. Some teachers did not like the digital storybooks as much because they felt that those resources had been less interesting to children, and that children did not want to return to the digital storybooks later: "So I think just because the stories were a little bit longer and it was different than a regular story, they didn't quite know how to process it. So they weren't super-attentive or engaged with it." One teacher had "a hard time listening to the voice that was reading them [aloud]."

Table 6. Teachers' Favorite Peg + Cat Digital Media (N=15)

Digital Media	Number of Teachers Who Liked Best	Number of Teachers Who Liked Least
Don't Go Bananas	3	0
Symmetry Painter	2	1
Music Maker	0	1
The Big Dog Problem	3	0
The Perfect Ten Problem	3	1
The Election Problem	2	1
All Digital Storybooks	1	3
None Specified	1	8

Teachers thought that the children in their classroom liked *Don't Go Bananas* the best, and *Music Maker* the least (see Table 7). One teacher observed that children in her classroom did not choose to play *Music Maker* again, when given the chance to do so during center time. The Appendix contains teachers' specific feedback regarding what they and children in their classrooms liked and disliked about each online game and digital storybook.

Table 7. Children's Favorite Peg + Cat Digital Media, According to Teachers (N=15)*

Digital Media	Number of Teachers Who Said Children Liked Best	Number of Teachers Who Said Children Liked Least
Don't Go Bananas	8	1
Symmetry Painter	2	0
Music Maker	1	5
The Big Dog Problem	1	1
The Perfect Ten Problem	1	1
The Election Problem	2	1
All	1	0
None	0	6

** One teacher listed two favorite resources.*

Conclusions

Teachers saw the Peg + Cat digital media as fun and engaging educational resources that they could use to support math and social-emotional learning in their preschool classrooms. Teachers were able to identify specific math content that the online games and digital storybooks addressed, and successfully linked those topics to conversations and activities they engaged in with children. Teachers also found the Peg + Cat digital media to be effective at highlighting positive social-emotional skills. Yet they saw different affordances in the online games and digital media for doing so.

The online games were more open-ended, and required interactive participation, which teachers were able to leverage towards social-emotional skills that children could physically demonstrate like taking turns and working together. In contrast, the narrative format of the

digital storybooks lent themselves to more cognitive social emotional skills that could be discussed with children, such as talking about one's feelings, and various strategies for self-regulation, help-seeking, and problem-solving. Although the digital storybooks included images that moved when readers clicked on them, they were linear stories with one path from beginning to end. Yet they also allowed the reader to pause and think, whereas gameplay required action. Thus, both types of online media had important roles to play in children's social-emotional development. These results have implications for the intentional design of children's digital media to support educators in discussing math content and modeling positive social-emotional behaviors with children.

Appendix: Teachers' Opinions of Specific Peg + Cat Digital Media

The Election Problem

Likes

Teachers liked the characters in the story, especially the chickens. They thought the narrative was fun, and a good opportunity for children to practice counting. Teachers shared that their students found the story engaging, as well:

> **"**They just were so excited, clapping over different things, and it got me excited about the actual program also. I think that one just was so cute, the way that the cartoon showed the chickens and Peg and then the Cat and then the reactions."

> "They thought the chickens dancing were hilarious."

Teachers appreciated being able to use *The Election Problem* to incorporate additional content around elections, voting, and running for president:

> "We talked about making choices. That one it was helpful because a lot of times I'll give the kids a choice and they want to vote for everything, so it was a good way to talk about if you can pick this or that, you can only have one choice... So the next time we had to choose something, I physically had them get up and move to where their choice was, so they could only make one choice."

> "We connected it with our Question of the Day, and how people have different opinions on different things. We actually connected it to voting for presidents and things like that, and how that works."

Dislikes

Several teachers mentioned that they felt like the math content in *The Election Problem* was too complex for the children in their classrooms, especially younger ones.

The Big Dog Problem

Likes

Teachers appreciated being able to use *The Big Dog Problem* to incorporate additional content around approaching strange animals and mailing letters:

> "It went into talking about, if you saw a dog on the street, what would you do? It wasn't just about problem-solving how to get to the mailbox, but it went into other issues that I could deal with with my kids."

> "We talked about the fact that there was a dog there and what they should do if they see a dog, if they've ever mailed letters before. So we took our writing area, where we have envelopes and things for them to write on."

For the most part, they thought that students in their classroom were highly engaged with the story: "The children really enjoyed that one too, I think, because of the interactiveness of the characters, and it was funny and they were laughing. That was one of their favorites."

Dislikes

A few teachers felt like children in their classroom had trouble answering questions about the story: "I think that one was a little bit too much for the kids to grasp." One teacher indicated that the students in her class were confused about why Big Dog (an animal) was taller than Peg (a human).

The Perfect Ten Problem

Likes

Teachers appreciated being able to use *The Perfect Ten Problem* to incorporate additional content, like talking about different children's individual talents.

One teacher felt that her students "were just super engaged and they wanted to read it again and again." Other teachers observed their students singing and dancing along with the different acts. Specifically, children seemed to like any humorous animals in the story: "They liked the dancing. They were fans of the pig with that one, so I guess they kind of just like when the animals are being silly in the stories. That kind of gets their attention."

Dislikes

One teacher thought that having only three combinations of ten was limiting, and wanted to see more variations.

Don’t Go Bananas

Likes

Teachers felt that *Don’t Go Bananas* was fun, interactive, and engaging for children:

> “We used that usually in a large group, and it was fun for us all to count them. They would support each other. They would get excited about spinning the wheel, and they'd be like, ‘Don't get a monkey. Don't get a monkey.’”
>
> “They were super engaged. They always wanted to do those ones. They loved the game. They would request that at the end of the day because they just really seemed to be enjoying themselves.”
>
> “They really enjoyed that one. Finding the monkey and then, they were like, ‘Oh, no!’ with the bananas when they picked the bananas.”
>
> “They got so excited when they got ten monkeys, or their facial expressions when they got the bananas and they had to take some monkeys away.”

One teacher shared how a boy in her class came up to her to let her know when he got his first ten monkeys. Another teacher appreciated that even children who had behavioral problems enjoyed the game: “It was just very nice to see certain students that have troubles in other areas of the classroom actually take the time doing the *Don't Go Bananas* activity.”

A few teachers used the game to cover other concepts like zoo animals and animal sounds.

Dislikes

Teachers noted that some children had trouble waiting their turn, either within the game with Peg or waiting for their classmates, if the game was used as a group activity: “I think that the game though, whenever it was her turn, they always wanted to go. So we want her to go with Peg to teach them how to take turns. But they wanted to go back and forth, and keep touching it.” One teacher shared that there was too much talking within the game itself in-between the actions taking place on-screen. Another teacher had a girl in her class tell her that it took too long to get all ten monkeys, so she did not want to play anymore.

Music Maker

Likes

Most teachers liked the music, and a few observed children in their classes dancing to the beat. One teacher shared that a student in her class had fun composing songs: “One of my kids, she loved doing it and using that. I was really surprised, the little songs that she made had a natural rhythm to it.” Teachers thought that the children also liked watching Cat walk across the screen at various speeds.

One teacher appreciated being able to address additional content with her students, such as sound preferences, and cause and effect, while using *Music Maker*: "I would say, what happens when you make this taller? What happens when you make it shorter? What sounds do you like more? So like we would use it showing about the cause and effect. We talked about…how the different high notes and low notes sounded to our ears**…** We did some different musical instruments and experimented with different musical instruments."

Dislikes

Teachers reported that some children had trouble with fine motor control, using the mouse to change the heights of the bars. Some teachers felt that this game wasn't as interesting or interactive as the other Peg + Cat digital media resources, and that it was confusing for their students: "I don't think they really understood what they were supposed to do, and I'd gone on it and I didn't really even enjoy it. So I didn't take the time to really focus on it either." Some teachers did not feel that the game had very much math or social-emotional content: "For my age group, they just didn't really connect it to math, even though *Music Maker* has the numbers popping off the top and the heights."

Symmetry Painter

Likes

Teachers enjoyed the symmetry mechanic in the game: "Even though I know about symmetry - obviously, I know how it works - I just thought it was so cool the way when you drew on the one side, it would show up on the other. It was just neat to me."

Teachers felt that their students who liked art or drawing really liked this game. Even some children who did not normally like art during center time seemed to enjoy the game. One teacher shared that children in her class were excited to show her what they had made. Several teachers reported that children in their class liked the rainbow colors and stickers.

Dislikes

Several teachers felt like the concept of symmetry was too complex for their students:

> "The symmetry thing, I think was really cool. I think it was just a little bit over my kids' heads."
>
> "They weren't trying to play what symmetry was, and picking the different ways that the vertical line and the horizontal line or both…They would try to figure the pattern out, but they were kind of losing interest quicker."

One teacher shared that it was difficult for her to discuss the concept of symmetry with her class because her preschool curriculum did not include any information about how to teach about it: “It doesn't align to the standards that we use, like there isn't a symmetry standard, so it wasn't something there was instruction with. So it was more just something that we did for fun…It was more just free exploration about artwork.” Another teacher felt that the children in her class just wanted to draw: “I expected them to be as intrigued by that as I was, and they really weren't. So they really just took it at face value, and just created - like made art with it or painted.”