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EXECUTIVE SUMMARY

Produced by Twin Cities Public Television, St. Paul, MN, and sponsored by the National Science Foundation, *SciGirls* (SG) is a multimedia project for upper grade-school and middle-school tweens. Weekly half-hour episodes are tied in with web and outreach activities in the fields of science, technology and engineering. Multimedia Research, an independent evaluation group implemented a summative evaluation of the SG Season Two multimedia project. Fifth grade girls (N = 87) viewed three shows over three weeks. They could visit the SG website at any time but were required to visit and play a *Pick'm Stick'm* game after viewing the third show.

Viewers were highly engaged with Season Two episodes. Almost all viewers wanted to watch more SG shows. They described them as informative, interesting and fun. They enjoyed the stories of engineering and science inquiry, and seeing failure and persistence as part of the process intrigued them. Viewers were surprised by some of the results and observations of the investigations as well as by the capabilities of the onscreen girls.

The episode/website connection motivated girls to visit the website after viewing and provided them with creative ways to explore further the investigation stories. Each Season Two episode features onscreen clues intended to push viewers to a two-part activity on the SG website called *Pick'm Stick'm*. The web activity presents an I Spy type game (*Pick'm*) to earn stickers for a mashup collage interactive (*Stick'm*) where users can create their own unique SciGirls collages. Almost all viewers noticed the features within the shows that referred to the online activity, and one-third of the girls were motivated to visit the SG website voluntarily. Viewers felt the experience of seeing items in a TV show and then using those items in an online game was cool, fun, or helpful for successful game play. Players liked the challenge of earning stickers in the timed *Pick'm* game, the connection to the *Stick'm* activity, and the freedom to create one's own unique *Stick'm* picture. In their *Stick'm* picture for the episode *Habitat Havoc*, nine of ten girls used stickers representing major components of the investigation. Three-quarters of the girls felt that the show influenced what they chose to put in the picture and could describe how the stickers they used reflected the investigation story of the onscreen girls.

SciGirls episodes motivate viewers to do their own science investigation. Almost nine of ten viewers were interested in carrying out their own science investigation with friends, and all viewers agreed that watching *SciGirls* would help them do so. Viewers felt that the series showed them steps of investigation, inspired them, encouraged them to reach out to adult mentors, and gave them confidence.

SciGirls episodes can aid girls' understanding of the steps of science inquiry. A majority of viewers spontaneously recalled four of five science inquiry steps as they were modeled by SciGirls in the episode *Habitat Havoc*. Three-quarters of viewers could describe details of three or more steps.

INTRODUCTION

Produced by Twin Cities Public Television, St. Paul, MN, and sponsored by the National Science Foundation (NSF), *SciGirls* (SG) is a multimedia project for upper grade-school and middle-school tweens. Weekly half-hour programs with both animated and live action are accompanied by web and outreach activities in the fields of science, technology and engineering (STEM).¹ The overall goals of the multimedia project are to 1) to foster a greater interest and confidence in STEM among girls ages 8 to 13 and their parents; 2) to deepen understanding of the most effective ways to engage girls in STEM activities and encourage them to pursue STEM careers; and 3) to connect girls to existing quality STEM education opportunities in their communities.

Each half-hour episode of the SG television series follows a different group of enthusiastic, *real* middle school SciGirls who collaborate, communicate, investigate, engineer and discover. They are accompanied by two animated characters – a plucky SciGirl named Izzie and her best friend Jake, who tie the series together with their ongoing adventures. Each episode begins with a story in which Izzie and Jake discover they have some problem that science can solve. Reaching out to the SciGirls, Izzie surfs the SG website to find a science or engineering problem related to her own. While the real girls model the science inquiry process or engineering design process to solve their real-life problem, Izzie and Jake solve their problem based on what Izzie learns from observing the SciGirls' experiences. The SG second season introduced an innovative set of clues that were integrated into the broadcast episodes and were intended to push viewers to online activities that extend the episodes' stories.

Supported by NSF grant #1114739, Multimedia Research, an independent evaluation group, implemented a summative evaluation of the SG multimedia project during the fall of 2012. The post-only study focused on (1) girls' engagement with the television series; (2) the appeal and impact of the experimental broadcast/website connection; (3) the strength of the series to motivate viewers to do their own science investigation; and (4) the extent to which viewers recall science inquiry process.

¹ See <http://pbskids.org/scigirls/>

GOALS OF SCIGIRLS' SUMMATIVE EVALUATION

Engagement with Episodes. A post-test only comparison group study of Season One's engineering episodes² revealed that *SG* episodes successfully engaged tween girls with engineering content through a set of evidence-based teaching strategies. One goal of this Season Two summative evaluation is to examine if and how a different set of shows, focused on science inquiry, engages viewers. To that end, the evaluation looks at what in the three shows motivates viewers to want to watch another episode and what in the shows surprises them.

Episode/Website Connection. New to Season Two is an experiment to use new techniques within the broadcast episodes to motivate girls to visit the *SG* website. Every episode of Season Two features onscreen clues that lead girls to a two-part activity called *Pick'm Stick'm (PmSm)*, which presents an I Spy type game (*Pick'm*) and a mashup collage interactive (*Stick'm*) where users can create their own unique SciGirls stories. A second goal of the summative evaluation is to explore five research questions related to the inclusion of clues in the broadcast episodes:

- How effectively do Season Two shows motivate offsite viewers to visit the *SG* website?
- What do those who visit the website do on the site?
- How do users of the site feel about the episode/website connection?
- How do players of *Pick'm Stick'm* feel about the activities?
- How do completed *Stick'm* pictures reflect the science investigation in an episode?

Motivation To Do Science Inquiry. One of the overall goals of the *SG* project is to encourage girls to pursue science inquiries in their own lives. The Season One summative evaluation found that providing vicarious experiences via the onscreen female characters influenced viewers' confidence in their ability to implement some of the engineering design process steps. The summative evaluation of Season Two science inquiry shows looks at the motivational quality of the series in a different way by asking viewers to reflect on if and how watching the *SG* shows help them and their friends do their own science investigation and how interested they are in carrying out an investigation with friends. The third goal of this summative evaluation is to assess the strength of the series to give viewers the knowledge and confidence to do their own science investigation.

Recall of Science Inquiry Process. The television series showcases the *process* of STEM and includes a wide variety of projects, incorporating both scientific inquiry and engineering design. In Season One's summative evaluation about engineering design process, we looked at transfer of tween viewers' engineering learning to new design situations – different from those presented in the shows - providing evidence that television can influence viewers' application of the engineering design process. In Season Two's study, we are looking at the science inquiry process, and instead of using a transfer measure, we examine viewers' open-ended recall of

² <http://www.tpt.org/science/evaluations/> Flagg, B. (2010). *SciGirls Season One Summative Evaluation*.

what they learned from the three shows they viewed and recall of the steps of the inquiry process as it was presented in one of the SG episodes viewed. In SG episodes, the onscreen groups of girls investigate questions, following steps of the science inquiry process:³

1. *Define the question*
2. *Plan by researching online, consulting experts or a mentor, and brainstorming*
3. *Predict what will happen*
4. *Test, collect data*
5. *Analyze the data*
6. *Share results*



The three SG episodes used in this summative evaluation model the science inquiry process to varying degrees. Some steps are presented more completely and explicitly than others depending upon the program. The programs do not treat the steps didactically; instead the process steps are embedded in the actions and dialogue supporting the development and implementation of each science project. Therefore, the fourth and final goal of this summative evaluation was to explore to what extent viewers recall the science inquiry process of *Habitat Havoc*, one of three programs tweens viewed.

³ E.g.: www.pbs.org/teachers/includes/content/scigirls/activities/health/scigirls_health_inquiryprocess.pdf

METHOD

Sample

Girls in fifth grade were recruited around seven national sites, including Miami, FL; rural DE; Baltimore, MD; Austin, TX; Bethlehem, GA; Milwaukee, WI; and Seattle, WA. These sites were chosen because their areas were not broadcasting *SciGirls* Season Two during the same period as the evaluation. Evenly distributed across the sites, the 87 participants had access at home to a DVD player to view the *SG* episodes and a fast (not dialup) Internet connection to go online to the *SG* website. Six girls (7%), spread across four sites, had seen one or more broadcast episodes of Season One.

The written permission letter inviting parents and children to participate asked questions relative to the girls' demographics and interest and ability in science. Any girls who were "not" interested in science or had "ever visited the *SciGirls* website" previously were not included in the evaluation sample. Minorities comprised 36% of the sample, which approaches the 40% level that reflects 5th grade census statistics.⁴ The girls rated their interest in science as "a lot" (55%), "somewhat" (43%) or "a little" (2%).⁵ The girls also self-rated how well they performed in science in school as "really well" (44%), "pretty good" (46%), or "okay" (9%).

Procedure

Upon collection of parent and child signed consent forms, field researchers delivered DVDs of the three episode, labeled individually with their episode title and the calendar period during which the participant should view the show. The episodes were viewed, one a week, for three weeks.

Each girl was given an individual username and password to use when they went online. Going online was voluntary for the first two episodes. With the third episode, *Habitat Havoc*, participants were asked to go to *SG* website and make a *Stick'm* associated with that episode.

After the third viewing period, each girl was interviewed individually in a one-hour session. The interviews include quantitative rating questions and open-ended questions related to each of the four major research goals (See pgs. 2-3).

⁴ <http://www.census.gov/population/www/socdemo/school/cps2008.html>

⁵ For statistical analysis, the two girls in the "a little" category are combined with the "somewhat" category.

Shows

Participants viewed the first three *SG* episodes in Season Two, one a week for three weeks, in the order that follows:



Aquabots. The oyster population in the Chesapeake Bay is shrinking; and that’s a problem for the SciGirls. New restored reefs have been created to help revive the oyster population. The girls investigate if the oysters in the new reefs are making the bay healthier. Diving into underwater robotics at the US Naval Academy, the girls build a “SeaPerch” ROV to investigate artificial oyster reefs in Chesapeake Bay. Learning about

underwater robot building and the importance of buoyancy from the SciGirls, Izzie builds her own ROV to help Jake recover his grandfather’s prized football championship ring from the bottom of the aquarium. ⁶



Mother Nature’s Shoes. The SciGirls set out to design more effective winter non-slip footwear geared toward senior citizens. They look at the pros and cons of current winter shoe cover designs, and research on the web to see how animals- like polar bears- walk on ice. They stumble on the word biomimicry: using nature to solve a human problem. They contact a biologist and invite her to join their team as they design, build, and test their prototypes. Seeing how the

SciGirls found inspiration from polar bears for their shoe cover designs, Izzie and Jake apply the tricks of lizard camouflage to Jake’s hide and seek costume. ⁶

⁶ <http://www.pbs.org/teachers/scigirls/episodes/>

Habitat Havoc. Jake fears that his pet mouse, Fang, is depressed in his spacious new ultra-luxury mouse cage. Izzie and Jake watch as the SciGirls meet an ecologist who studies the effects of introduced plants to the environment by looking at the insect population. The girls learn that the familiar palm trees that cover the landscape of San Diego and Southern California are not native to the area but were brought by immigrants from the Canary Islands. The girls dive into investigating the impact of the Canary Island Palm on the ecosystem. Guided by the SciGirls’ habitat research, Izzie and Jake determine that Fang prefers a cozy place to curl up- inside Jake’s fuzzy bunny slippers.⁷



Episode/Website Connection



After the initial Izzie and Jake story is introduced in each episode, Izzie runs across the screen, as shown to the left, saying, “Watch for the arrows. They’re clues for the *Pick’m Stick’m* game on the website.” Then four times in the episode, the animated arrow appears on its own, clicks on an important investigative object in the science inquiry process and moves a copy of it to a list that pops



up in the right-hand bottom corner of the screen. To the right is shown the arrow adding a third clue (a vial) to the first two clues (pitfall trap; bug sucker) for the episode, *Habitat Havoc*. At the end of the Izzie and Jake story, Izzie encourages viewers to visit the SG website: “Got some clues? Head on over to the Web and play *Pick’m Stick’m* at pbskidsgo.org.”

On the SG website, users can choose from a number of activities but the evaluation is particularly interested in interaction with the *PmSm* activity associated with the clues presented in the episodes (*PmSm* homepage to the right).



⁷ <http://www.pbs.org/teachers/scigirls/episodes/>
Multimedia Research

Shown below is the *Pick'm* part of the *Habitat Havoc* episode game. *Pick'm* is an I Spy type game in which users click on items from the show in timed trials. When the user finds all items listed at the bottom of the screen, she unlocks a set of stickers with which she can make a collage in the *Stick'm* part of the activity. Repeated play of *Pick'm*, in which the list and number of items changes, unlocks more stickers and an occasional bonus sticker.



Below is an example of the *Stick'm* part of the *Habitat Havoc* episode game. *Stick'm* is a collage activity in which users click and drag items from several possible categories (SciStuff; SciGirls; Text; Pretties) onto one of three possible backgrounds. Items are available in the right hand menu of the screen. In this example the bug buster has not been unlocked yet; users can return to the *Pick'm* part of the activity and continue to unlock items to use in *Stick'm*. Users can send their *Stick'm* picture to others or save it as a jpeg on their desktop.



ENGAGEMENT WITH SHOWS

It was so awesome! I don't like science in class, but it was interesting on the show.

Almost all viewers voiced a desire to watch more shows, because they felt the *SciGirls* series is informative, interesting, and fun; and they like watching the science inquiry and engineering stories. Viewers were surprised by parts of the inquiry process, by some of the results, by the combination of cartoon and live action, and by the capabilities of the onscreen girls.

Interest in Seeing Another Show

To assess engagement with the series, interviewers asked the girls how interested they were in seeing another *SG* show and why or why not. Almost all (97%) of the participants were interested in seeing another show, as illustrated in the chart to the right, with 60% “very” interested. These data reconfirm the appeal of the series found in Season One’s summative evaluation.

Girls gave the following reasons in support of their interest to watch more shows:

- 21% were interested in seeing another show because they liked **learning** from the series; for example:

They helped me learn about, like, I had no idea that palm trees were not native to – where was it, California? It was really cool to learn about that stuff.

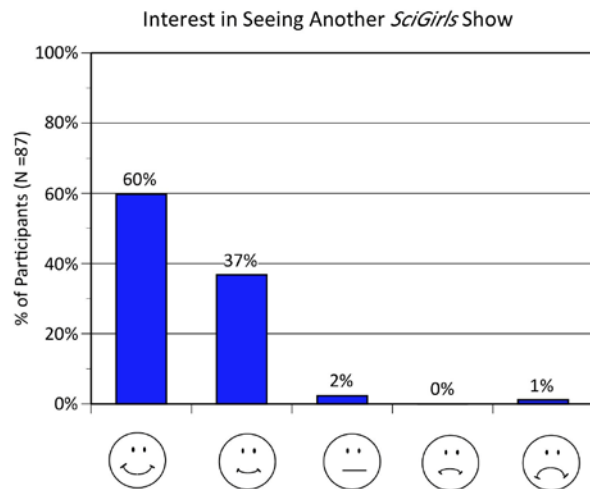
We learned cool stuff, and it teaches you good things about science.

I learned a lot. I didn't know what oysters are, and it really explained what they were and what they do. It was kind of like a little journey.

I really liked the three shows because they were giving me information that I never knew about.

I can learn about a lot of things. I learned a little bit about buoyancy.

All of them teach you something new.



- 29% felt the series was **interesting**; for example:
Oh, definitely, they were really interesting. I was like 'wait!' I was really pulled in. They were interesting, not boring.
They were really cool. They were interesting.
I think it is interesting. I really like science so I would watch it a lot.
I really like science and they were very interesting.
It made me feel interested in science.
- 23% enjoyed the **inquiry and engineering process**; for example:
I think it's cool how they do the experiments.
The part about all the data they record and all the experiments, it's really cool.
I like how it's all set up, and how they do experiments and find out their conclusions.
I liked seeing the girls do the projects, and it was kind of cool seeing the results.
I think it's cool how they make things like they take a science project and they make it into something cool.
I like when they build stuff, like the little boat thing that they used to go for shells and stuff.
- 21% described the series as **fun**; for example:
It's fun to watch.
They are fun and they are exciting.
They're fun.
It was fun to learn and it wasn't boring.
I really liked the fun ways they showed you how to learn about science.
I really liked how it's fun at the same time you do stuff and you figure out new things in the shows.
- 7% were interested in viewing another show because the series **motivated** them; for example:
It inspires me to do something like that and gives me some ideas.
I can also try new things too.
I was interested in how they learned about it, and how they went on the different places and did different things and how older people worked with them and like found solutions, and I'd like to do that someday. I think that was really cool.
They give you cool things to do.
It was very relatable because it was talking about real girls trying to make a difference, and it showed that anyone can help do stuff.

What surprised viewers

Viewers were asked what surprised them in the shows they watched. Open-ended responses were sorted into the following categories:

- 25% were surprised by **parts of the inquiry process**, particularly the failures that were shown; for example:
When they were learning about it, and when they did adjustments in one of them. They had to figure out and plan and use tools. They had to make sure. The experiments are the best part.
Like how it worked. Like how they made the aquabots really go underwater.
They got to go to different places and explore things. They got really involved in it, and got to create things that helped solved the problem. They got to test them out to see if they worked and edit them. People other than them got to try them out.
How they tested things – their methods.
In the second episode, everything started to fall apart because of the glue. Sometimes in science experiments, it doesn't always work. You learn from mistakes.
Sometimes I remember they had problems. I was expecting that things were going to be fine – it's a TV show! But I remember in the last episode, the bug sucker wasn't working. And in the second one, things were falling off, the little grippers.
- 21% were surprised by the **combination of cartoon and live action**; for example:
At first, I thought it was going to be all cartoon, but then after the cartoon part, I realized it was going to be both cartoon and real life people, and I liked both of those.
It surprised me that, I thought it was just going to be real people, but it was half cartoon and half with real people. I thought it was really funny.
I didn't think it would be actual people in it. I thought it would be cartoons, and I liked how it was.
The cartoon part. I liked how it jumped back and forth from the two.
That it was cartoon and regular people.
- 20% were surprised by **some of the observations, results and conclusions**; for example:
For some of them, I didn't expect the data they got.
I didn't know that oysters were running out in the ocean.
That the clams help the reefs. The snakes have scales on the bottom of them that are longer and bigger than on top.
I really like the last one when they experimented with the bugs because, I thought that was cool, learning about the different bugs, knowing which one was not poisonous and which one was really rare.
Palm trees didn't attract the most bugs.
You see a lot of palm trees, and I thought they were native, but they came over from some other country on a ship, and they weren't native. So that surprised me.

- 14% were surprised by **the capabilities of the onscreen girls**; for example:
 - It surprised me that there were so many different people that did different projects, and they did it, not with the help of a lot of people, but they did it by themselves.*
 - It was surprising that girls could do this. I didn't know that we could do so many things at such a young age, so it inspired me.*
 - I was surprised at what girls could do.*
 - How much kids can do, like make the robot and stuff and do all the experiments.*
 - I was really surprised that the girls could do as much research as they did, and they spent that much time on it, and I really liked that.*
 - It surprised me that the girls could actually make a submarine and that it shows me that most people are really capable of things.*
- 8% were surprised that **the girls worked with experts**; for example:
 - They all involved somebody who was professional in the stuff.*
 - I was surprised how they could get together with the marine biologist.*
 - That they got to meet marines and a biologist. They got to meet experts.*
 - How they talked to scientists.*

EPISODE/WEBSITE CONNECTION

I thought it was really cool, cause then you know there's that game that corresponds with the TV show. You had to think really fast [in Pick'm] and whatever you had to find was blending in with the background....while you were playing the Pick'm game, you wanted to play it again, because you wanted to get more things to create your own picture [in Stick'm]. And then I thought it was fun because I could create my own thing [in Stick'm], and it wouldn't be like I had to follow instructions to do it.

One-third of the girls reported going spontaneously to the website as a direct result of television production features intended to push viewers to the site. Those who did not visit the website spontaneously said they were too busy or forgot about it. The girls thought the experience of seeing items in a television show and then using those items in an online game and activity was cool, fun, or helpful for successful game play. Almost all girls eventually played the *Pick'm Stick'm* activity and highly rated its appeal. Three-quarters of girls whose Episode 3 *Stick'm* picture was available for their interview felt the show influenced what they chose to put in the picture and could describe how the stickers they used reflected the investigation story of the onscreen girls.

Motivational Value of Episode/Website Connection

The episodes included production features intended to motivate viewers to go to the website. In post-interviews, almost all (94%) of the participants reported noticing the character Izzie announcing and showing clues to the *PmSm* game on the website, so these production features were apparent to viewers. The evaluation was designed to discover if those features themselves were sufficient to push viewers to the website.

At the beginning of the evaluation period, participants were given post-it notes with individual usernames and passwords to log into the website. Going to the website was optional after girls watched the first two episodes and required after the third episode. In the interviews, a majority of the girls (59%) recalled visiting SG website after watching either or both of the first two episodes. Those 41% who did not spontaneously visit the website reported being too busy or forgot about it. Of those who recalled visiting the site, 61% reported being motivated by features in the first two episodes, including Izzie's announcement of the *PmSm* game and suggestion to go to the website; or the arrow animations of clues; or the website itself shown within the video.

Thus, of our full sample of 87 girls, one-third (31%) reported going spontaneously to the website and linked that visit to intentionally motivating production features in the episodes they viewed.

- 33% of those who went to the website after Episodes 1 and/or 2 responded to **Izzie's announcement of visiting the web to play PmSm**; for example:
*After the show it talked about the website and I logged on after that.
I thought the Pick'm Stick'm game sounded fun- she said head over to the website and that made me want to go.
On the show it was showing a lot of things about Pick'm and Stick'm and at the end it said to go, and I thought maybe I should try that! So I did.
I liked the game where you matched up everything. A bunch of utilities you could match up to in the video and watch out for the clues that tell you what you might see in Pick'm Stick'm.
I wanted to see more about it- see how maybe I can do something and try something new, and I also wanted to make a picture of the things they do.
I wanted to try it out and I ended up having a lot of fun playing the Pick'm part and making my own scene in the Stick'm part
Well, I wanted to do the Pick'm Stick'm.*
- 16% reported that the **arrows made them curious about the website and game**; for example:
*The arrow on the Pick'm Stick'm thing. I wanted to know what that was.
When the little arrows would pop up I didn't really know what that was or how it would relate to it at all, so I was like I might as well find out.
I wanted to see what the girl [meant], she said to watch out for the little arrow. I wanted to see if they were actually on the game to get some points.
When I was watching they had the little arrow that came up and like clicked on the thing, and I was like "Oh, Pick'm Stick'm, that's a funny name, what is that?"
I wanted to see the games on the site to represent the show. Like Pick'm Stick'm - all the red arrows.*
- 12% suggested that **seeing the website in the episodes** motivated their web visit; e.g.:
*I wanted to see the different things - how the girl goes into the SciGirls website and looks for different girls to help her situation. So I could see all the other ones.
On the video, it showed there was a website and it looked interesting. It had colors in it, but not too much colors that drove me out, so it was just the right amount of colors and it had science in it. So it looked interesting.
When I watched the first two I was interested to go to the website, because they, the people in it, they were going to the website in parts of it, and I was just a bit curious, so yeah.
I kinda saw the website on the show. And it looked cool and it looked interesting. I could find more information on the show.*

- 20% visited the site **to play games**; for example:
I just thought it would be fun to play the games.
Yes, playing the games. I wanted to see what the games were like.
Well I wanted to see how the games were, and if they were going to be fun or not.
There were games, and just looking at the games. It's a kids' website, so I wanted to know what kind of games there were, and all kinds of cool stuff.
- 8% who visited the site were **simply curious**; for example:
I wanted to see what it was and what you could do.
I went to the website just to see what it was like about and to see what there was and stuff.
I wanted to see what was on the website.

Attraction Value of Website Activities

During the weeks of viewing Episodes 1 and 2 when site visitation was optional, 23 girls were tracked on the website as clicking for the *PmSm* activity. One-quarter (26%) of the full viewing sample of 87 girls were motivated by their viewing of Episode 1 and/or 2 to locate and play the *PmSm* game announced by Izzie.

Online tracking was not available for other parts of the *SG* website, so girls who recalled visiting the site after viewing Episode 1 and/or 2, were asked what other activities they remembered doing. Of the 51 girls who spontaneously visited the site:

- 45% were tracked online playing *Pick'm* or *Stick'm*
- 41% reported playing Aquabots
- 29% said they looked at Projects
- 24% watched other Videos
- 22% made a Profile
- 10% made new Friends
- 10% read about the girls in the episodes
- 10% visited their Secret Box (a collection spot for points earned on different PBS sites)

Appeal of Episode/Website Connection

By the end of the evaluation period, 91% of the girls had visited the site and played *Pick'm* and/or *Stick'm*. Those who never visited the website were too busy, forgot, or could not figure out how to log on.

The girls who visited the website and experienced *Pick'm* and/or *Stick'm* activities were asked what they thought of the experience of seeing items in a television show and then using those items in an online game and activity. They liked the connection of the show and website. They thought it was helpful to see the items in the show to prep you for the web activity or that it was cool because you have to recall the show items to play *PmSm* and also the items in *PmSm* remind you of the show.

- 24% felt the connection between the show and game was **simply cool, fun, or good**; e.g.,
I think that's pretty cool - I like the idea of that.
I thought that was really cool.
It was cool.
It was fun.
I thought that was fun.
That was pretty fun.
I think it was good.
It was good.
- 24% thought it was **cool, good, fun or helpful to see the items in the show that prep you for the website activity**; for example:
It's cool kinda because you get a hint about what would be on the game.
I thought it was fun because if you do it right after, you'll be like "oh there it is, there it is" and you'll just get right through it.
I found it very fun, that you would watch and then you got to actually do it.
It was fun to see what was on the TV and I can go onto a website and use them to play games.
I think it was easier to find the pictures in the Pick'm Stick'm game, because I watched the videos and it showed me kind of like clues.
I saw them in real life and they were easier to spot in the game.
- 13% responded that the episode/web connection was **cool because you have to remember the show items for the website activity and the items in the activity remind you of the show**; for example:
I thought it was cool because you have to remember, you have to be actually paying attention to the show, and not just have it on and be doing something else. You have to actually pay attention to play the game. And it helps you learn new words and stuff.
I thought that was really cool to refresh your brain of what was going on in the show
I thought it was cool because you have to remember what you saw instead of just forgetting it.
It was kinda cool --- cuz like, "Oh, I remember that from so and so, and I remember that from so and so, and that one was from so and so scene, and that's when they did that!"
I thought that was pretty cool because you could see the stuff in the show and then you're like, "Oh my gosh, I remember that!" when you see the stickers.
It was pretty fun. And like when I look at it in the game I remember watching the show, and it being on there.
- 7% reported that the connection was **cool because in the web activities you get to use items from the show**; for example:
It was cool how it went along with the show and how you can take things from the show and put it in a picture.

I thought that was really cool that online you could get the little pictures that you see on the episodes.

I thought it was pretty cool to see how they use the exact same things.

I think that's very creative, using the items from the video, I like that part, they weren't just random items, you didn't know what an object was. They weren't just mixed together.

- 6% were **more negative or confused about the episode/web connection:**

I couldn't really remember the objects so I didn't think it helped really that much that they pointed them out in the show.

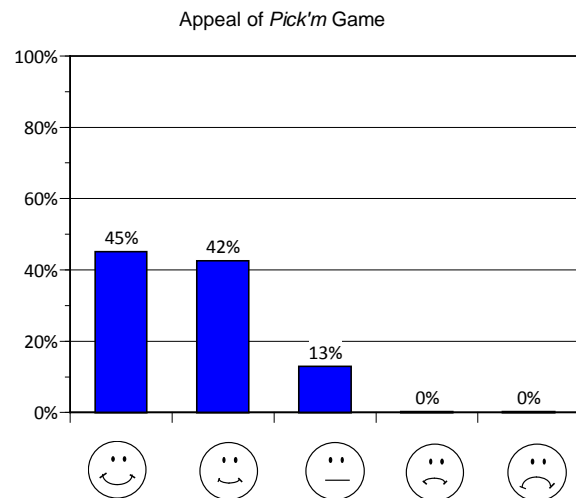
I thought that it was a little bit weird how they did it. I don't really know how else they would do it though; maybe put all the stickers at the end of the show, so that it wasn't kind of distracting.

I just thought that Izzie was getting ideas from those--I didn't think they were really like clues or anything. And she said follow the arrows; they're clues for the Pick'm Stick'm game on our website, and I'm like, "I don't see how those are clues, honestly. How are the arrows part of the Pick'm Stick'm game?"

On the online game, it was just a teensy bit weird since you never really see those objects in the game before really. Like I never really seen, like Jeffrey, in a game.

Appeal of Pick'm

Pick'm is an I Spy type game in which items from an episode appear on a camouflaged background (see p. 7), and players must click on listed items within a certain time limit. When correct choices are clicked, the items turn white. Players can click on a video hint that plays a brief clip from the episode about one of the four clue items that the arrow cursor clicked on in the show. When all listed items are located correctly, the player unlocks stickers to use in the Stick'm activity. Playing more Pick'm games unlocks more stickers and sometimes bonus stickers.



Almost all (90%) of the participating girls played the Pick'm game, and 87% of those players liked the game, as shown in the chart. Players described what was fun and not fun about the game.

- **Having a timer was both a positive and negative feature,** which means the times were likely set appropriately for the average player: 32% said they liked being timed and 24% said they wanted more time to win; for example:

I liked how it was timed so you actually had some action in the game.

I love games that you get timed on because when you do it a lot, you get faster and you know where the pictures are. It's cool, and sometimes you get bonus pictures.

I liked it because it was timed, and I could challenge myself.
I liked that one. It was like challenging and you had to click it in a certain amount of time. It was fun.
I liked how you had to be fast enough to find the pictures, so you can actually get stickers.
It was sort of fun to find the stickers, but sometimes I felt a little pressured while I was playing it, because you only get 30 seconds to find a bunch of stickers.
It was stressful to have only 15 seconds to find things. I panicked!
I like challenges but sometimes it was too much of a challenge. The time was a little short.
There's not that much time to find everything.
You had to go really fast.

- The **camouflage was both a positive and slight negative feature**: 21% said they liked the objects hidden in the camouflage background but 6% were frustrated by that aspect; for example:

I really liked trying to find all of the things, and some of them were really hidden. I like having a challenge and puzzles and things.
It was kind of challenging to look for all the stuff because some of it was small and blended in. So that was fun.
They are camouflaged so sometimes you can't find it. That was the fun part, also to achieve it.
I liked how some of the things were so camouflaged. I was hunting around for the grasshoppers.
I got frustrated when I couldn't find the grasshoppers.
It was camouflaged in with all the other designs, so I would have liked a white background.

- 17% liked searching for **items that they saw in the episodes**, whereas 10% found some items difficult to recall or identify; for example:

It was fun that you had to find what you learned about.
I liked how they used the information you learned in it.
It was fun because I could see the things that related to the show and then pick them.
It's like a word search. You get to find everything that you saw on there [episode], and you really have to remember what they said, what they are, like when they say "oyster bag," you have to remember what the oyster bag looks like.
I didn't know what some of the things I was supposed to find looked like, and when I went to the video hint, it would show me the things I already found.
Sometimes I got frustrated because it would show something and I had no idea what that is, and I was clicking on random things.

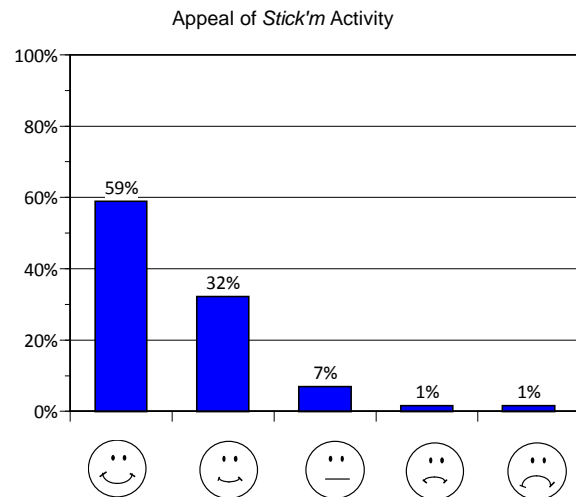
- 14% liked **the reward of stickers for the Stick'm activity**:

As I did it, it showed me the stickers I won. That was really creative.
After you would get the reward to make your own picture, so I found it very interesting that you get a reward after learning something.
I liked how you got to win the stickers. It was really fun.

It was fun because when you beat it, you got to make your own wallpaper thing, and that was really cool.

Appeal of *Stick'm*

In the *Stick'm* activity, players can create their own collage of episode-related backgrounds and objects (see p. 7). Categories of episode-related objects that players can drag, drop, and resize in a picture space include Backgrounds, SciStuff, SciGirls, and Text. Pretties is a category of objects not related to the episodes. Many objects – stickers - are always unlocked for use, and some objects are unlocked through one's playing the associated *Pick'm* game.



Most (86%) of the girls experienced the *Stick'm* activity, and 91% of those players liked the activity (see chart). Players identified what was fun and not fun about the *Stick'm* activity:

- 100% of the players liked the **creative value of *Stick'm*, being free to make a unique picture of their own**; for example:

I thought it was fun because I could create my own thing, and it wouldn't be like I had to follow instructions to do it.

You got to use your own thoughts and there was nobody telling you, "Pick that one! Pick that one!"

You got to pick your own stickers and like nobody could copy off of yours, and you have your own unique one.

You get to design it your own way, the way you wanted it to be, not anybody else's way. It was cool making the designs.

You weren't given a certain thing you had to do. You could do whatever you wanted. And that was a lot of fun, because on some websites, they say 'ok, make this.' And it's lot more fun when you can just create.

You get to think even more, and you get to make it into this really cool picture. You can even explain how the show went. It was really fun sticking them down.

You could make it like silly and not natural, and you could just make it exactly like the show.

- 12% noted the **freedom to make weird, unreal or funny pictures**; for example:

I liked being able to make really weird things, like I made a hamster house for the animals and different bugs and stuff. I liked that a lot.

I made kind of weird scenes, though, like ladybugs everywhere. I like art.

I liked putting random things that don't go there in the picture. I had like a forest scene, and then I put a pink chair in there. It was fun.

I had this forest background and two pairs of scissors fighting with each other, and "What would nature do?" I had a lot of fun with that.

You get to just make it funny, cause you could make like a giant bug in the yard.

I liked making it disordered, making the people tiny and the lizards giant. I thought that was pretty fun.

- **Having to unlock stickers in *Pick'm* was both a positive and negative feature:** 15% pointed out that they liked playing *Pick'm* repeatedly to unlock stickers but 23% were frustrated by the locked items; for example:

It was fun that we got to create our own picture using what we earned from a different game.

*You play the *Pick'm* game and you get a lot of selection. I played it like a million times so I got a bunch of stickers.*

Earning the stuff was really fun! The items were really cool, and we get to earn SciGirls [stickers] too.

*I like making pictures a lot and when you did the *Pick'm*, you unlock stickers, and I tried to unlock as many stickers as I could.*

*After you play *Pick'm*, you would get cool stickers and do it however you wanted.*

You had to unlock the certain things that you wanted to put on the picture.

*I couldn't choose that much of a selection because I couldn't really figure out any more of the *Pick'm*s.*

You had to unlock some of the animals or things and it was really hard.

*It's not fun that if you see something that you really, really want, you have to go back to the *Pick'm* game.*

*If you saw a sticker that you really liked, and you kept doing *Pick'm* and doing it and doing it, sometimes you wouldn't get it, and it was a little annoying.*

I didn't have some of the stickers I wanted, and I had to change what I wanted.

Relation of *Stick'm* Pictures to *SciGirls* Episode

When participants had completed viewing of the first two episodes, they were asked to play *PmSm* and to make a *Stick'm* picture after viewing their third episode, *Habitat Havoc* (see p. 6 for picture and photo of this episode). The third episode *Stick'm* picture (*Stick'm3*) was shown in the post-interview to address the research question of how completed pictures reflect the science investigation in an episode.

Of the 87 girls, 64 (74%) made a *Habitat Havoc Stick'm3*; those who did not were too busy, forgot or their Internet was unavailable in that period. Of the 64 pictures made, we could obtain 48 pictures to show to participants for their interview and to code later. The remaining pictures were not available due to website programming and usability problems and thus are not part of the evaluation analysis that follows. The group whose pictures were available ($n = 48$) did not differ from the rest of the sample ($n = 39$) in any demographic or background variables or in any of the post-viewing show and activity appeal ratings.

There were no instructions to participants about creating their picture, yet a majority (75%) of *Stick'm3* makers felt that what they saw in *Habitat Havoc* about the science investigation influenced what they chose to put in their picture. For example, the creator of the *Stick'm3* below described how her picture relates to the girls' investigation in the episode as follows:

I liked to use this background because it had a bunch of the bushes around it, and that's why I put all of the bugs around there... I think I can see a palm back there. I didn't put any bugs on those leaves, because like they said in the show, there weren't as many bugs on the palm as the willow. And I tried to pick a tree that sort of looked like a willow even though it is shorter and I tried to put as many bugs as I could on there.

[Why did you choose to include these phrases in your picture? Researcher points to each phrase] [Sorting bugs is pretty fun] *Even though I don't like certain types of bugs, I thought it was really cool how they sorted them under the microscope and how they listed them down and how they recorded it and how they did that. I did [what lives in the trees] because of the different types of bugs that live in different types of trees and plants, and I put it by the different types of trees so you could see the bug standing out a little bit on there. I chose the chair to make it look like Jeffrey is a little king, and I put the "Finding Jeffrey" there to show him there.*

[Why did you choose to include the episode clues of the vial and Jeffrey in your picture?] *I tried to make it [palm vial] as small as I could, but I put that there because it kind of goes into the habitat with the sorting and what lives in the trees.... I just put [Jeffrey] there because I thought it was cute and funny. I just thought it was creative and funny.*



Another participant presented the pitfall trap in the ground as the SciGirls used it:

It shows the ground and it shows the bucket where the animals fell in, and some animals crawling around it and the hamster.... I thought what they did was kind of interesting, and I wanted to make it look like that.



A more minimalist *Stick'm3* and the creator's investigation interpretation follow:

The bugs would fall into the middle of the cylinder thingy, and it kind of has two bugs falling into the bucket. They used the bucket thingy to catch the bugs.



One-quarter (25%) of the *Stick'm3* pictures were reported by the girls as not relating to the *Habitat Havoc* investigation. Instead of reflecting the bug and native/non-native tree investigation, these pictures were either creative artworks or presented the Izzie & Jake story, as shown in the two examples that follow:

Some of these animals go on, like land, or like to sit on the flowers, and whatever they do on the flowers, just lay there. And then, I just put the ants there because they looked cool. I chose the flowers cause they were pretty colors, and they kind of went with the background, and I liked the blue of the butterfly, and then I just kind of circled around them with the other things.



It doesn't relate [to the girls' investigation]. I chose a phrase in my picture because the guy was talking to the mouse.



To quantify how completed *Stick'm3s* reflect the science investigation in the *Habitat Havoc* episode, each picture was coded for the appearance of various categories of objects that related to the show.

Makers of a *Stick'm* could choose from five categories of objects, shown to the right: Backgrounds, SciStuff (shown open here with unlocked and locked objects), SciGirls, Text and Pretties. The objects most related to an episode investigation are in SciStuff, SciGirls and Text. Each of these categories has subcategories of objects for each episode.

Listed below are categories and subcategories for *Habitat Havoc*:

1. SciStuff category contains subcategories of
 - a. Arrow clues that were shown in the episode including pitfall trap; bug sucker; vial; and Jeffrey the lizard.
 - b. Investigation objects of various bugs
 - c. Izzie and Jake story objects include bunny slipper, mouse house, tree stump, and flower
2. SciGirls category contains subcategories of
 - a. SciGirls with pictures individually and as a trio
 - b. Mentor Theresa
 - c. Izzie & Jake story characters of Izzie, Jake and Fang the mouse
3. Text category contains subcategories of phrases for
 - a. Process: Sorting bugs is pretty fun; You have to expect challenges; What lives in the trees?
 - b. Findings: Native or Non-native; Insects have six legs; These palm trees aren't from here!
 - c. Technology: Check the pitfall trap; Use the Bug Sucker!
 - d. Fun: Finding Jeffrey; Witness the natural habitat!



Each of the 48 *Stick'm3* pictures was coded for the presence or absence of each category and subcategory of sticker objects. For example, the *Stick'm3* below shows the presence of nine of ten of the sticker subcategories. It's only missing the SciGirls category/Izzie & Jake Story Characters subcategory.



The creator of this *Stick'm3* described how her picture relates to the girls' investigation in *Habitat Havoc* as follows:

It's telling what they did. They used the trap to catch bugs that crawl on the ground. They found a lizard. His name is Jeffrey, so I put him there. I put that [trap] next to him because they liked him, and that's what they found. I wanted to make sure to get all the girls in it because they were part of the movie and the lady that helped them. I put the bug catcher in there because they used it as a tool to help them catch the bugs, and the bugs were part of their project. I had some bugs in there.

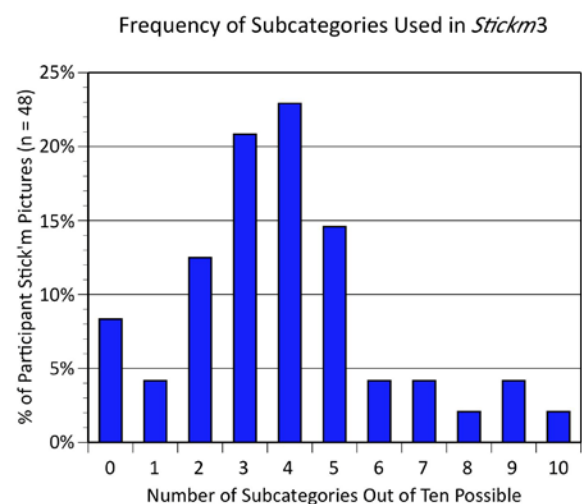
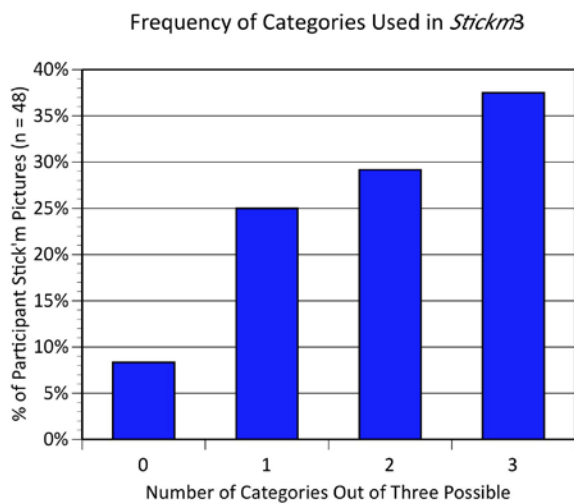
[Why did you choose to include these phrases in your picture?] *Bugs live in trees. Because bugs in trees goes together with using a bug sucker because a bug sucker finds what lives in the trees.*

[Why did you choose to include the episode clues in your picture?] *Because it was tools they used. That [Jeffrey the lizard] was something they liked and the other two were tools they used to help them do their project, so I put them in there to explain what they used for tools. I put Jeffrey in there because he was part of what they found.*

At the other end of the spectrum were *Stick'm3s* that used no objects from the episode and included only Pretties on their Background, as shown below. Despite the absence of episode objects, this participant felt that her *Stick'm3* related to the episode investigation because *It goes with California and in California, there is palm trees and water.*

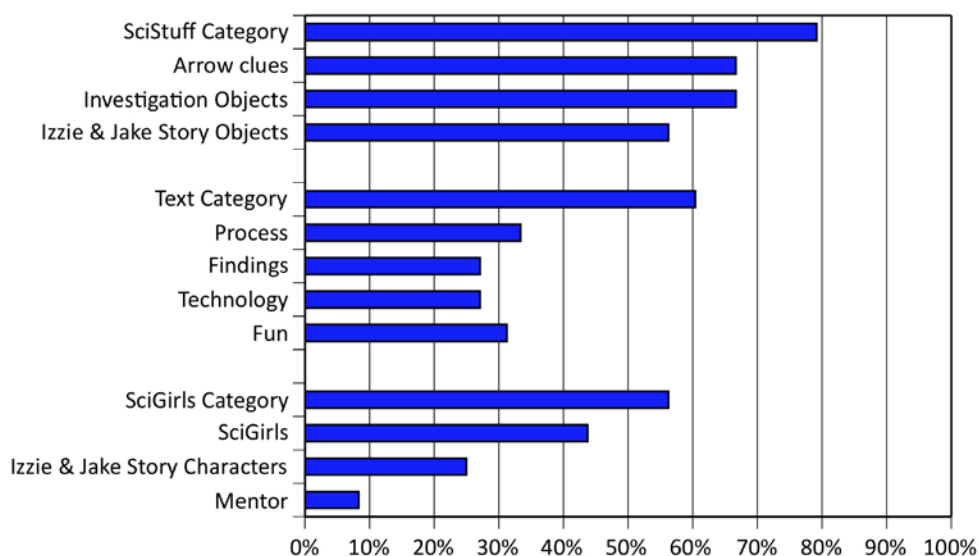


The left-hand chart below shows that 92% of girls chose stickers from at least one investigation category, and the right-hand chart shows that most girls chose stickers from three or four different subcategories.



For more detail about the 48 pictures, the chart below presents the frequency distribution of each of the three main categories and each subcategory. The majority of pictures included at least one object from each of the three main episode categories: SciStuff (79%); Text (60%); and SciGirls (56%). A majority of pictures also showed the SciStuff subcategories of arrow clues (67%), investigation objects (67%) and Izzie & Jake story objects (56%). These stickers represent major components of the episode's investigation story.

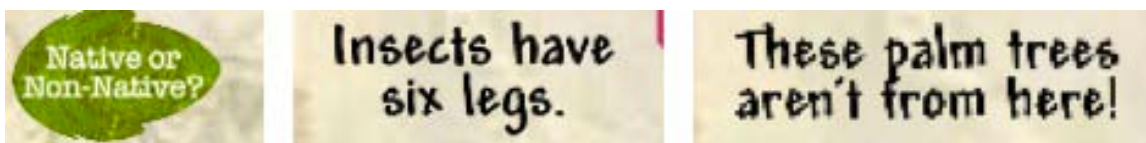
Frequency Distribution for *Stick'm3* Objects Category and Subcategory



Choices of SciStuff and SciGirls stickers were not significantly influenced by the independent variables of participant science interest or performance in science variables. In other words, these categories of stickers were used by girls regardless of their interest in science or their self-reported performance in school science.

However, choices related to the Text category were influenced by science interest and performance. Girls with higher self-reported interest in science were significantly more likely to include one of the ten possible Text category stickers in their *Stick'm3* picture compared with girls with lower interest in science (78% vs. 44%).⁸ On the other hand, those who felt their performance in school science is “okay” were much more likely to include a Text: Findings subcategory sticker (n = 6; 83%) compared with those who felt they perform “pretty good” (n = 19; 21%) or “really well” (n = 23; 17%).⁹

Text: Findings subcategory stickers included:



⁸ $p = 0.02$, two-tailed Fisher's exact test

⁹ $\chi^2 (2, N = 48) = 11.06, p = 0.004$.

Below is a *Stick'm3* picture from a girl who felt her performance in science in school was “okay.” She describes how her picture, which includes one Text: Findings sticker and one Text: Process sticker, relates to the episode:

If you didn't put that text, you wouldn't really get the topic if you just looked at the picture. If you saw that [text phrase], you'd probably get what they were doing, and it might interest you. It might give you a good idea what it's about.



MOTIVATION TO DO SCIENCE INQUIRY

After each episode, I was thinking how much fun it seems, so yes it shows you that you can do it, and how much fun you would have, and I was thinking about who it would be fun to do an experiment with of my friends.

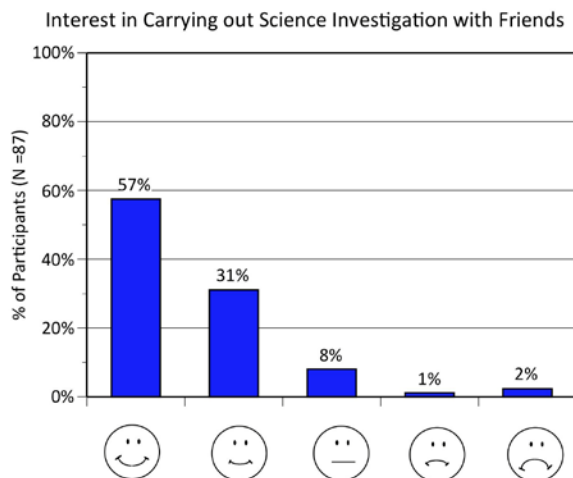
Almost nine of ten viewers were interested in carrying out their own science investigation with friends, and all viewers agreed that watching *SciGirls* would help them do so. Viewers felt that the series showed them steps of investigation, inspired them, encouraged them to reach out to adult mentors, and gave them confidence.

Interest in Doing an Investigation

As illustrated in the chart, 88% of viewers declared an interest in carrying out their own science investigation with friends, and more than half (57%) were very interested.

How Watching *SciGirls* Supports Investigations

All (100%) of the viewers felt that watching *SG* shows would help them and their friends do their own science investigation. When asked how watching the series helps them, one-quarter responded by describing some steps of investigation that the onscreen projects presented and one-fifth suggested that the shows gave them ideas or inspiration.



- 26% felt that *SG* episodes showed them **steps of investigation**; for example:
You learn all the steps you need to do a science investigation. At first they wrote down plans and ideas, and then they tried to make it, and then they tested it, and that's how I would do it.
I think just the way they planned out their experiments and took the time to figure out exactly what they were going to do and figure out the materials, and then afterwards how they did their experiments. Kind of step by step.
It would show me how to do a graph and basically how to do a project, because I am sort of good at science but not as much as I want to be, so it would be sort of a guide.

- 23% thought that watching SG gave them **ideas and inspiration**; for example:
Actually me and my friends are trying to do a global warming thing, to like save polar bears. I was thinking about SciGirls actually, and I came up with the idea, and it was based on SciGirls. I didn't see any global warming ones [online], maybe there are, but it inspired me a little bit.
You can do something to make something new in the world, that can change it and add something or help people.
It gives you some ideas you could do, but not just to copy them, but just figure out something to do.
- 15% felt they had to **reach out to adults to help them or were encouraged to reach out** as the SciGirls did; for example:
They went online and they found people in their area like older scientists that could help them, and I think if we tried to do that, it would be pretty easy for us to do an investigation.
Me and my friends probably wouldn't ask a scientist, but they did, and I thought that might help.
I'd also need to find someone who would, who could help us out, because usually you want someone to help, like an expert to help you learn.
- 15% were more concrete and thought the shows would help them only if they were **interested in the same or similar investigations**; for example:
If you were learning about the same thing the show is on, it could be really helpful because you could get their advice on that thing.
It could help if I wanted to do the same experiment.
If it was something that was really similar, then it would be better. It would help quite a bit.
- 9% suggested that the shows **gave them confidence to investigate and to persist**; for example:
It shows you that you can do these things. I've always thought like it'd be hard to make a float – a mechanical float- but the three girls did it.
I did the buoyancy thing in the pool. I got a water bottle and made it actually buoyant.
In one it shows not to be scared to show our things to other people. They didn't think their skate things would work, but they had all their friends come to the skating rink to try it out.
It kinda showed me how it was set up and what to do, and how to make your inventions better, and how not to give up.

RECALL OF SCIENCE INQUIRY PROCESS

They found a palm tree and a willow tree, and they wanted to see which one could present better life on it, and how healthy they both are, and what the differences are. So the first test they did is how many bugs are in it? And they used a sucker to suck up the bugs, and they looked at it with these guides that told them what bugs they are. And the second step is they checked its surroundings with these tubes, and they made a graph with what's on it. It was mostly like leaves and twigs and stuff. And the third test they did was leaf puncture, and they tested which leaf is better for animals to eat. And then they presented in front of the class, so they could do a butterfly garden.

A majority of viewers spontaneously recalled four of five science inquiry steps as they were modeled by SciGirls in the episode *Habitat Havoc*. Three-quarters of viewers could describe details of three or more steps as presented in *Habitat Havoc*. When asked what they learned more generally from the three episodes, viewers remembered facts and results, became aware of measuring technologies and the identification of bugs.

Recall of Steps of Science Inquiry

In *Habitat Havoc*, the SciGirls model five steps of science inquiry through their actions and dialogue:

1. *Define the question:* The SciGirls learn that the Canary Island palm tree is not native to the area so they want to look at the impact of the palm on the ecosystem by comparing it to the native willow tree in terms of number and kind of bugs.
2. *Plan by researching online, consulting experts or a mentor, and brainstorming:* The SciGirls brainstorm and work with Theresa, an ecologist, to produce specific tests: what kind of bugs and insects live in the willow tree and in the palm; what is the leaf toughness of the two trees; and what kind of plants live underneath the trees.
3. *Test, collect data:* The SciGirls use a bug sucker for the creature count, a penetrometer for leaf strength, and a quadrat to assess ground cover. They collect data for two willows and two palms.
4. *Analyze the data:* The SciGirls reference a field guide and microscope to sort, identify and count bugs for each tree. They make graphs comparing diversity and abundance of bugs on the two trees and conclude the willow is a better tree for animals and plants than the palm because the willow has softer leaves to eat.

5. *Share results*: The SciGirls present their results and conclusions to their class, and they convince the class to work together to make a butterfly garden in a Native Plant Garden where non-native invasive palm trees have been removed.

To explore the extent to which the science inquiry process above was assimilated by viewers, the interview asked participants an open-ended question to “tell about the investigation the girls did in *Habitat Havoc* – what did they do from the very first step to the final step” with a follow-up probe for “any steps you haven’t told me about.” Note that the question did not specifically identify the steps of inquiry but did refer to “steps,” and this question was only asked about one episode, the most recent that the girls had viewed. The responses were coded for the presence and absence of language reflecting the five steps described above. For example, the participant in the table below recalled all five steps, some in more detail than others:

Define the question	<i>They want to find out what animals were on the palm trees and why. I guess palms trees weren't native to there but they were so popular, and then how did that influence the bugs that lived on that tree versus a native plant.</i>
Plan, research, consult expert	<i>Then they went to a lady,</i>
Test, collect data	<i>and they looked at a willow tree and a palm tree, and they sucked the bugs off each tree, and they had three tests but the bug sucker ran out of batteries so they couldn't suck some of the last trees.</i>
Analyze data	<i>Then they went into a lab and they put all of the bugs under a microscope and they compared all of the bugs that lived on the palm tree versus the willow tree. They found out that they willow tree had a lot more bugs than the palm tree because it was native to San Diego and the palm tree was not.</i>
Share results	<i>And then presented the information that they found out to their class, and they asked if the whole class wanted to help make a butterfly garden in an area where the trees were cut down.</i>

And then some viewers could not recall much in the way of steps of science inquiry, as in the example below:

Define the question	
Plan, research, consult expert	<i>The first day they talked to the woman.</i>
Test, collect data	<i>Then they went to find insects. Then they used this bug sucker and said it was very cool. Then used this other little teeny something. It looked like a level. That is all I remember.</i>
Analyze data	
Share results	

The top right-hand chart reveals that a majority of viewers spontaneously recalled four of the five steps of science inquiry, and the fifth – “defining the question” – was described by 44% of the sample. Most memorable were the action steps of collecting data with the bug sucker and other tools in *Habitat Havoc*.

The bottom right-hand chart shows that almost all (98%) viewers could describe one of the five steps, and three-quarters recalled details of three or more steps.

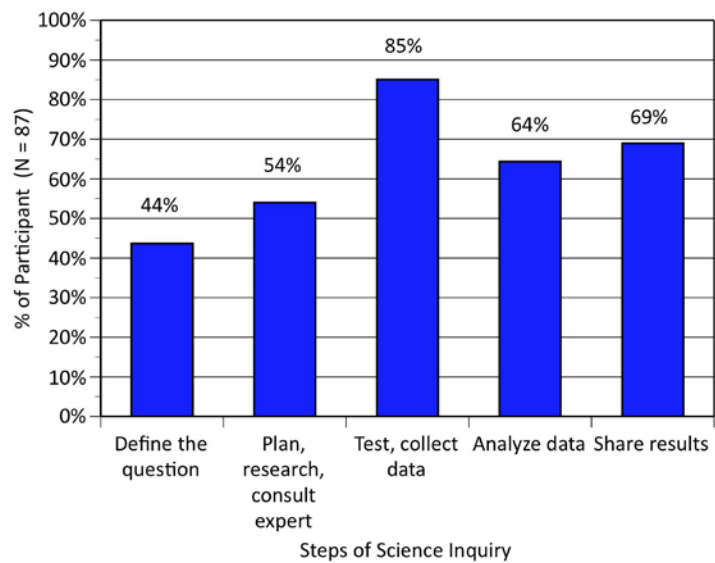
Neither individual steps nor number of total steps recalled were significantly associated with any of the independent or dependent variables in the evaluation. So girls’ interest in science and their self-rated performance in science were not related to their recall of steps of science inquiry.

Learning

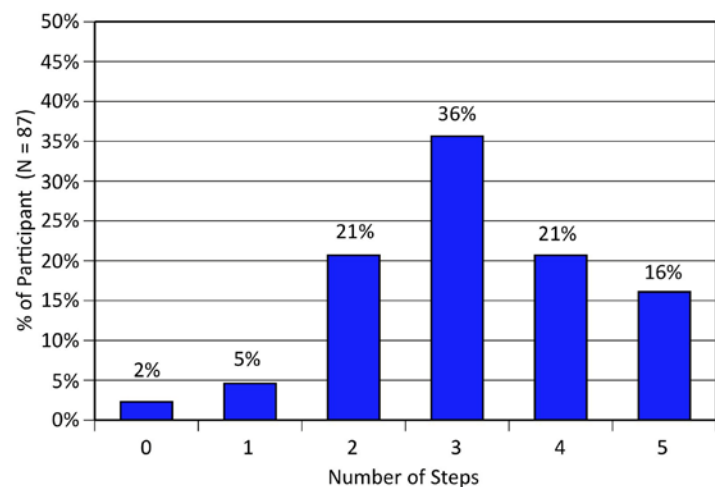
When girls were recruited for the evaluation, they were told that the interview would focus on their “enjoyment” and “opinions” of the series in order to encourage participants to view the episodes as they would any other home television series. Having framed the viewing this way, however, we were interested in what viewers recalled from the series when they weren’t watching for the purpose of learning.

All but one participant was able to describe something that they learned from the shows in response to the open-ended question of “what if anything did you learn from watching the three shows.” A majority of participants recalled something from each of the shows and no show was particularly favored in terms of recall: *Aquabots* (67%); *Mother Nature’s Shoes* (53%); *Habitat Havoc* (70%). Viewers remembered facts and results from the three shows, became aware of measuring technologies from two shows, and enjoyed the identification of bugs in one show.

Steps of Science Inquiry Recalled



Number of Science Inquiry Steps Recalled



- Facts** were most frequently recalled from the three shows: *Aquabots* (13% of viewers), *Mother Nature's Shoes* (22%) and *Habitat Havoc* (34%). Respectively, viewers remembered most often that oysters are in trouble; that animals have different adaptations for walking on ice; and that palm trees are not native to San Diego. For example:

I learned that the oyster populations were dropping, and they were going to help bring back the oysters.

I always thought that if you had something fuzzy, it would slide, but the animals that they researched, they had fur on the bottom, and the fur was like bristles to make it not slide.

I originally thought that palms were native, but it turned out they weren't so that was really surprising. I thought it was really cool to find out. That is one of the plants that California is known for, their beautiful palm trees.
- Results** were also frequently recalled from the three shows: *Aquabots* (25%), *Mother Nature's Shoes* (8%) and *Habitat Havoc* (24%). For *Aquabots*, viewers reported on the influence of weights and floats on the buoyancy of the aquabot and effects of current and pressure. For *Mother Nature's Shoes*, they observed that some materials work better for walking than others; and in recalling *Habitat Havoc*, viewers noted that native plants have more bugs than non-native plants. For example:

I learned that when you are building something, and you are putting it under water, you have to have weights, and foam to make it lift. I thought you just had to have weights that pull them down. I also learned that the current in the water has an effect on things underneath it.

There are certain materials that can prevent you from slipping on ice.

How there were more bugs in the native than the non-native tree. There were more bugs in the native tree. I think it was because of the leaves.
- New awareness of measuring technology** was declared by viewers, including the existence of an aquabot in *Aquabots* (11%) and a bug sucker, pitfall trap and/or quadrat in *Habitat Havoc* (21%). For example:

You could build a robot that could go in the water and have a camera in it and see the bottom.

That a bug sucker is just a leaf blower turned the other way. There is a thing you can put in the ground. It was a bucket, and you can catch bugs in it.
- Identification** of bugs was specifically recalled for *Habitat Havoc* (21%). For example:

I thought it was cool how they looked at all of the bugs underneath the microscope and to see how many bugs were in each of the two, the native and the nonnative one.

I learned that from far away bugs can all look the same but up close they look completely different.

I learned about bugs and poisonous or non-poisonous and whether they were rare or extinct.

Viewers also reported learning more abstract lessons about the nature of science and one's own possible impact on the world:

- 11% noted that **failure is part of science and persistence is important**; for example:
You learn that you're gonna have to try again and again. It's not gonna be perfect the first time.
To be a scientist, you got to do a lot of re-making and inventing stuff you have to do over and over.
Definitely even if you don't get it the first time, you need to still try it the next time.
- 11% observed that **with science, girls can make a difference**; for example:
I learned that science can make everything better or a lot of things easier in life. You can create something new in the world that actually helps somebody and protects the planet. I learned a lot about how girls can make a difference. I learned about how young girls could do a lot of scientific stuff.
That we can build things at a young age with a lot of electronics. That we can investigate by ourselves with a little bit of help. And we can have a big influence on the world...that girls are equal to boys and that we were able to do a lot.

DISCUSSION

The summative evaluation of *SciGirls* Season Two focuses on four areas of impact:

- (1) engagement with the shows;
- (2) the episode/website connection through features integrated into the episodes;
- (3) motivation to do science inquiry; and
- (4) recall of science inquiry process.

Girls in fifth grade (N = 87) were recruited around seven national sites to view three *SciGirls* episodes, one a week for three weeks. For the first two episodes, girls could go to the *SciGirls* website voluntarily; then they were asked to go to the website after viewing the third episode. After the third viewing period, each girl was interviewed individually in a one-hour session.

Engagement with Episodes

Viewers were highly engaged with the Season Two episodes, and almost all viewers wanted to watch more shows. They liked learning from the shows and described the series as interesting and fun. They enjoyed the investigative stories of science inquiry and engineering stories, and they were particularly intrigued by the recognition that failure and persistence is part of the process. They were surprised by some of the results and observations of the investigations.

And intriguingly, a group of our viewers were surprised by the capabilities of the onscreen girls, inspiring viewers to think that they too could do science and engineering projects. Season Two's findings reinforce the findings of Season One's summative evaluation that providing positive vicarious experiences via female onscreen characters can significantly influence viewers' confidence in their own abilities – as in “if they can do it, so can I.”

Episode/Website Connection

Within the broadcast episodes, almost all viewers noticed the appearance of Izzie on the home page at the beginning of the show, the arrow that highlighted the clues, and Izzie's invitation to play the *Pick'm Stick'm* game at the end of the show. These features motivated one-third of our girls to visit the SG website voluntarily. Our findings correlate with higher web traffic recorded in Season Two than in Season One, which only had a single web tag at the end of each episode. According to TPT's research, Season One web traffic during the premiere airing in February-March of 2010 averaged approximately 75,000 visits per month. In 2011, with the addition of new games – but no new broadcasts – web traffic grew to an average of approximately 100,000 visits per month. When Season Two episodes began airing in the fall of 2012, web traffic jumped to nearly 250,000 visits - a 150% increase over the monthly average.

The girls liked the episode/website connection. They thought the experience of seeing items in a television show and then using those items in an online game and activity was cool, fun, or helpful for successful game play. Players of *PmSm* highly rated its appeal. They liked the challenge of the timed *Pick'm I Spy* type game, the connection to the *Stick'm* activity, and the freedom of creating one's own unique *Stick'm* picture.

Our evaluation was also interested in how much the girls' *Stick'm* creations were influenced by the science investigation in an episode. Coding available *Stick'm* pictures for just the episode *Habitat Havoc*, we found that nine in ten girls (92%) included stickers that represented major components of the episode's investigation. Three-quarters of girls felt that the show influenced what they chose to put in the picture and could describe how the stickers they used reflected the investigation story of the onscreen girls. The *PmSm* activity allowed girls to explore the episode content beyond just viewing the video.

Two categories of stickers (SciStuff, SciGirls) that related to the investigative story were used by girls regardless of their interest in science or their self-reported performance in school science. A majority of girls (79%) chose to include SciStuff stickers, which include investigative objects, and a majority (56%) also used SciGirls stickers, which include the characters in the show.

Overall, 60% of girls included Text stickers that reflect process, findings, technology and just fun. Choices related to the Text category were influenced by science interest and performance in different ways. Girls with higher self-reported interest in science were significantly more likely to drag a Text category sticker into their picture than those with lower science interest. On the other hand, those who felt their performance in school science is "okay" were significantly more likely to include a specific kind of Text sticker (one related to investigation findings) compared with those who felt they perform "pretty good" or "really well" in science.

Motivation To Do Science Inquiry

The third goal of this summative evaluation was to assess the strength of the series to give viewers the knowledge and confidence to do their own science investigation. Almost nine of ten viewers were interested in carrying out their own science investigation with friends, and all viewers agreed that watching *SciGirls* would help them do so. Viewers felt that the series showed them steps of investigation, inspired them, encouraged them to reach out to adult mentors, and gave them confidence.

Recall of Science Inquiry Process

A majority of viewers spontaneously recalled four of five science inquiry steps as *SciGirls* modeled them in the episode *Habitat Havoc*. Three-quarters of viewers could describe details of three or more steps. Thus, just as the summative evaluation of Season One's engineering episodes found that television can influence viewers' application of the engineering design process, this summative evaluation of a Season Two science inquiry episode reveals that viewing *SciGirls* can aid girls' understanding of the process of science inquiry.