Drawing in Circles

Geometry Playground

Formative Evaluation

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THIS IS NOT A DEFINITIVE FINAL REPORT

FORMATIVE evaluation studies like this one often:

- **are conducted quickly**, which may mean
  - small sample sizes
  - expedited analyses
  - brief reports

- **look at an earlier version** of the exhibit/program, which may mean
  - a focus on problems and solutions, rather than successes
  - a change in form or title of the final exhibit/program
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Background

Drawing in Circles is an artist piece created for the Geometry Playground exhibition by artist Tauba Auerbach, http://taubaauerbach.com/. A make-and-take spirograph drawing activity allows visitors to make art, fostering a connection between math and art. The visitors build art-making competency and have an opportunity for an aesthetic appreciation of geometry.

DRAWING IN CIRCLES (eval 1)

Goals

The goal of this evaluation is to:

- See how visitors use the exhibit and see what support they need from a label.
- Observe and talk to visitors to address usability issues.

Set-up and Methods

On Tuesday, March 2nd, 2010 the team writer and evaluator conducted a floor test with Drawing in Circles from 11 - 1pm in prototype area of the museum.
Findings

Many adult visitors were very excited and shouted out, "a giant spirograph" either as they passed by or used the exhibit. The exhibit seemed to be delightfully nostalgic for adult visitors.

Mostly children were unfamiliar with how to use a spirograph, but when they were with an adult who knew how to use it, the adult served as a good guide to get the gears moving correctly.

The behavior observed felt more process oriented, than results oriented. All of the visitors keep adding colors and lines to their first drawing and did not try to get fresh paper (unless we offered it to them.) Not sure if this will be the same situation when the exhibit is less mediated.

Younger kids had a hard time reaching across the table and putting enough pressure
on the pencils. It takes some coordination to do.

Visitors were telling us that it was easier to get the gear rolling when the pencils were in one of the middle holes. Once they got the hang of it, they were more able to move to the holes on the edge of the gears and successfully role it around.

One visitor helped her child and suggested that he look at the edge of the circle as he drew and to not look at the pencil. This seemed to help and a suggestion we might consider in the label.

No Findings Yet
We didn't get a read on how the paper cutter worked, it was not installed at the time of the evaluation.

We didn't get a sense of how the pencil sharpening worked (there was one available, but it was not used). Visitors would go in search of a pencil that was already sharpened.

We don't have a sense of the text that refers to the gear numbers. No visitor questioned what the numbers were for or seemed to notice them.

Recommendations to consider

Keep the instruction label close to the drawing action. The "to do" text was placed down on the table near the gear rack.

For prototyping, we created two colored drawings and put them on the wall. We would recommend for the next evaluation experimenting with displaying real drawings and/or photos of completed drawings. We will need the artist, Tauba Auerbach's recommendation on the images and arrangement. We would recommend displaying at least one full size drawing that is good, not great, to give visitors a sense of the possibilities.

Try adding a note to the label about trying different holes in the same gear (instead of picking a new gear).

Next Steps for the Label

Based on the first informal evaluation and exhibit team input, we are planning to evaluate the exhibit again with the following text:
DRAWING IN CIRCLES
Create geometric designs you can take with you.

- Choose a gear and fit it into the teeth in the big circle.
- Put a pencil tip into one of the small holes.
- Use your pencil to roll the gear around, pushing toward the outside of the large circle OR. Push the pencil toward the outside of the circle to roll the gear around.

Geometry in your drawing

The shapes in your drawing depend on which gear you choose.

For example, the gear with 40 teeth makes a shape with 3 "corners." That's because the large circle has 120 teeth, 3 times as many as the gear has.

Images of design made with 40-tooth gear
Images of other designs labeled with numbers of gear teeth

Label for paper cutter:
To take home your drawing, pull out the paper and slide the cutter across.

Label for pencil sharpener
SHARPENER

Text for next evaluation
DRAWING IN CIRCLES (eval 2)

Set-up

On March 11th, 2010 the team writer and evaluator and the exhibit developer/artist conducted a rapid evaluation with Drawing in Circles from 2 – 4:30pm in prototype area of the museum.

Summary of evaluation methods and goals

7 visitor groups were asked to read the instructions, use the exhibit, and speak with us afterward. 6/7 groups were children because the last evaluation indicated that adults could draw upon their past experience with Spirographs. Together we watched visitors use the exhibit paying particular attention to any confusion or struggles, and spoke to the visitors following their experience about the wording of the directions and the “Geometry in Your Drawing” section. Below is a list of things that worked well and changes recommended to address the issues that arose.

What worked well

• Including an Exploratorium stool at the exhibit to ease reach for kids.
• Keeping the pencil box as close to, and just to the right of, the big circle (otherwise, too far of a reach for kids)
• The life-sized, finished, full-color drawing example directly above the big circle.
• Keeping the ‘Ring Gears’ in an explainer box for mediated use (too difficult to explain in the label).
• The “Geometry in Your Drawing” label: All visitors were asked to read the explanation and were able to re-iterate in their own words the meaning of the explanation label. The three adults (who were asked after their children used the exhibit) felt that the images alongside the number of teeth were more useful than the wording.

**Changes under consideration**

• Removing the middle hole from the gears (a couple of kids just tried the middle hole on a few different gears, which leads to uninteresting circles for all gears). This would require us to make new gears.
• Some gears are much harder than others, and can be frustrating when they are the first gear a kid uses. We are considering removing the harder ones and keeping them in an explainer box for mediation use, or etching Hard/Medium/Difficult into the edge of the gears.

**Next iterations for labels**

The exhibit writer (KB), exhibit developer/artist (TA) and evaluator (TD) made the following recommendations for the next draft of the label.

**Wording of directions:**

• “One” not “a” (from TA, KB, & TD)
• Put your pencil into a small hole in the gear (from KB)
• Push (toward the edge/ big circle) with your pencil to roll the gear around (the edge of the big circle) (from KB)
• Try different colored pencils in different holes (from TA)

**Wording of “take it home” with you:**

![Image of the label with text: take your drawing home! pull the paper toward you, then slide the cutter across.]

www.exploratorium.edu
Placement:

- Consider placing the text, "Take it home with you" label to underneath the life-sized example of a finished example.

Use Drawing:

- We observed that kids instinctively grab and go, rather than reading the directions. Because many are unfamiliar with Spirographs, they easily get confused and frustrated. We are hoping to try a use drawing of the big circle, a gear inside, a hand holding a pencil in a small hole, and an arrow indicating motion. We imagine this would be life-sized (gear and big circle), and directly to the left of the example drawing.

Label elements to be formatted by graphics dept:
**Set-up and Methods**

On Saturday April 10th, 2010 the evaluator conducted an evaluation with Drawing in Circles in prototype area of the museum. 12 visitor groups participated and the focal kids were: 7 boys aged 4-13, and 5 girls aged 6-16. Parents, siblings and friends also participated.

**Findings**

**Summary**

- The use drawing and arrows around the big circle really helped visitors know what to do. The Easy/Hard titles on the gears are clear and helpful.
- Visitors know they can take their drawings home, but they do not know how to get their drawing out or how to align the cutter.
- The gear rack on the right of the table seems like the best layout.
- Kids and adults are naturally talking all kinds of geometry (shapes, teeth numbers, predictions).
1. Do the focal kids know what to do at the exhibit (now that the arrows and use drawing have been added)?

- 5 kids needed directing from their adults, while 7 were able to do it without any help. All were eventually successful in using the exhibit.
  - One (1) saw others use it and so he knew what to do.
  - Five (5) said that they used the “use drawing” to figure out what to do (a few had also used a Spirograph before).
  - Two (2) used the directions to figure out what to do (one of these kids used both).

2. Do visitors understand the Easy/Hard labels (prototype of etch) on the gears?

- Nearly every focal kid understood the reason for the Easy and Hard labels/etchings (didn’t ask the 4 year old). Most thought that it was useful to have them labeled as such.
- Most did not see/read the hint suggesting that the smaller gears are easier. The two who read it found it useful, but also read the gears.
3. Do visitors know they can take their drawing home with them?

- All of the visitor groups knew they could take their drawing home with them.
  - Visitors either read the “take your drawing” label below the large example drawing or deduced that they could take it home because they read the “cut” label on the cutter.
  - None of the visitors learned they could take their drawing home by reading the tagline.

- None of the visitors were able to figure out how to get their drawing out of the exhibit.
  - Once I showed them where to pull the paper, many of them did not pull the paper out far enough to avoid cutting their drawings.
  - A few tried to lift up the plexiglass surrounding the outer circle, which could be damaging as well as frustrating.

Exhibit changes to consider

Gear Rack placement

- Consider placing the rack to the right of the table because:
  - It keeps the gears near the explanation of teeth numbers.
  - It places the directions/use drawing before the pieces, which seems to work for visitors.
  - If kids do not put the gears back but leave them strewn on the table, the gears will not interfere with exhibit use when placed to the left, but will interfere if placed on the right (due to space).
    - However, nearly all kids put the gears back. The only time this did not happen, the gear rack was on the left side of the exhibit.

Teeth

- A few kids don’t know the term “teeth.” I asked a lot of kids what they called them, but nothing we could use came up. Maybe we should consider mentioning teeth on the Use Drawing?

Pencils

- Many kids push too lightly on the pencils, and the lead runs down really quickly. If there are pencils with thicker lead, we may want to try them to see if it helps.
Label Changes to consider

Tagline
- We may want to use the tagline to explain “what to do” not “take it home.” Visitors are getting the “take it home” message elsewhere. I tried: “Use a pencil to roll the gear around, pushing toward the outside of the big circle” because this line included all of the important pieces necessary to using the exhibit (pencil, gear, roll, push, big circle).
  - A couple of kids thought that “edge of the big circle” made more sense than “outside of the big circle.”
  - Per our last evaluation, “the” should be “a,” as in “roll a gear around.”
  - Consider keeping the words “Make Geometric Designs You Can Take With You” atop the directions only if we remove it from the tagline. They are pretty close together, so it might be redundant.

Take Your Drawing Home
- Consider making this portion of the label bigger for better readability.
- Consider keeping it located under the large example drawing.

Gear Teeth
- These photos and the wording could be enlarged. A couple of visitors suggested that we consider this.
On Sunday April 25th, 2010 the evaluator conducted an evaluation with Drawing in Circles in prototype area of the museum. Observations and informal interviews were conducted. The exhibit was unmediated.

Goals

The goal of this evaluation is to:

- See if visitors can use the exhibit without mediation.
- See if visitors know to pull the paper.
- See if visitors can cut the drawing without slicing their picture.
- Observe where visitors need more support to be successful
Findings

Summary
This is looking really great – visitors were using the exhibit, cutting the paper, taking the drawing with them, talking about which design they wanted to make, “I am going to do this one”, talking patterns, boys and girls into it, adults too, it is social with visitors helping each other.

Paper
1. Initial feed - Very hard to initially feed the paper into the table. Teeth eat the paper. No feed guide in the back.
2. Paper holder – Where is the final placement for the paper holder? Is visible an option?
3. Paper – if the paper wasn’t white, there would be a visual cue when the paper is correctly in place. Newsprint perhaps? (It is still light, but not bright white.)
4. Paper feed – Based on how it is rolled, the tail either flips up or down slightly. Today I had it flipping up and it was a nice cue for pulling it.
5. Paper tension – It is too hard. I was loosening for visitors.
6. Tail push back – Sometimes (especially when someone was helping someone roll the gear around) the paper gets pushed back. It is very hard to get it re-threaded through, it gets caught in the teeth. Any way to help this issue?

Moving the gears
Visitors still had a hard time getting the gear to roll around. They often use a “helping hand” which doesn’t have a good result. Revisiting our instructions, it felt like the hint was too embedded in the instructions (step #3) and so I pulled it out and called it a hint. This seemed to help, but our numbers were too low to know for sure, one visitor did say, “You have to push down on the pencil and roll around the edges.” It doesn’t seem like it can hurt. To discuss. (This is just one idea, there might be better ideas.)
Cutting and taking home

The visitors seem to know that they can take their drawings home, and perhaps they don’t need 4 steps to figure out how to pull the paper, but really just need to know where the cut line is. I tried a shorter version of the text and it seemed to work fine. We can change the final text, but I would propose we don’t need the 4-step label. I added two small labels on the left and the right since visitors cut from both directions.

Visitors naturally just start to roll-up their drawings so I put out a bin of rubber bands. Every visitor used one. The rubber bands also cue the visitors to the fact that something might need a rubber band (such as a piece of paper you take home). I strongly recommend that we make a small bin for rubber bands. I know, I know, more supplies.
To consider

1. A (pretty) recycle bin
2. Rubber bands
3. The paper holder
4. The paper
5. Finalize text
6. Check sharpener

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