See a Different World: Interactive Storytelling for Children to Raise Awareness of Color Blindness

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See a Different World

Interactive Storytelling for Children to Raise Awareness of Color Blindness

Dan Yu

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Masters of Fine Arts in Visual Communication Design

Rochester Institute of Technology
College of Imaging Arts and Sciences
School of Design
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Title
See a Different World: Interactive Storytelling for Children to Raise Awareness of Color Blindness

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Abstract

Children play with interactive applications to gain knowledge in their daily life. There are different kinds of interactive applications that help educate children through visual storytelling. In reviewing the current apps available, few of them were written or designed for children with disabilities, especially children with color blindness. Through research, it was discovered that children lack an awareness of color blindness. This thesis aims to design an effective, interactive visual storytelling application to raise awareness of color blindness for elementary school aged children. The project helps children gain knowledge about color blindness through reading and playing activities within the app. In addition, a short color-blind test for children is included. Based on the research of interactive apps and illustration geared towards children, this project’s visual style helps facilitate the children’s goals of learning about color blindness. The visual storytelling also attracts children through the design of unique characters and colorful elements, such as backgrounds, props, and user interface buttons. Visual design principles are integrated and basic design software is used to produce an effective user interface. Usability testing is conducted to test the visibility issues of this app and address any issues that needed to be modified and improved.

Keywords:
Interactive app
Educational app
Children storytelling
Interactive design
Color blindness
Children illustration
Visual storytelling
Color blind test
Electronic book
A majority of children are not aware of color blindness. Considering children are more sensitive about visual graphics than literal text, an efficient, interactive visual storytelling application needs to be designed to raise awareness of color blindness (color vision deficiency) for elementary children (age 7–12).

Children can be educated through the combination of visual storytelling and playing. A children's research institute, named Common Sense, claims that the time children spent on mobile devices tripled over the past three years. Combining interactive technology with traditional graphic design can provide a more interesting method for children to learn. Vivid visual images not only help children to gain the knowledge but also can raise their awareness about vulnerable groups, especially children with color blindness.

About 2% of the population is color blind all over the world. [1] Based on a number of research results, about 8% of the male and 0.5% female population have some sort of color blindness. [2] Majority of children lacks the awareness of color blindness. For these children who are color blind, they are afraid about it and feel different when compared with other children, so they urgently need a platform so that other children can learn about color blindness and understand its effects. Some children may have color vision deficiency, but they do not notice or recognize it. Faced with these problems, how can visual design and interactivity be used to raise children's awareness of color blindness?

There are lots of good interactive educational applications for children. Few of them relate to the knowledge of color blindness, and most of them have poor visual style and are too literal for elementary children to comprehend. Except the traditional children’s books, a color blindness test is another part of the design that may help children to play and learn. However, testing may be too formal of an approach for children that may be intimidated by taking a test. Therefore, an effective design is needed that solves the concerns of color blindness and avoids a too literal or serious presentation for children to play and learn.

This thesis proposed a study that explores how designing an interactive storytelling application can help to raise awareness of color blindness for elementary children. The research included education design, illustration design, interactive design and color blindness information as related to children, aiming to answer the following questions:

1. What kind of visual storytelling is more suitable for elementary children to learn information about color blindness?
2. How to combine the mini-game and color-blind test into the application that is easy for children to comprehend?
3. How can interactive elements help to convey the story more effectively to children?
4. Considering both color blindness and normal vision children, what color palette will be appropriate for the design?
5. What style of character can be created to make the storytelling easier for children to understand and want to share their feelings for others?

The result of the research is meaningful for both children with color blindness and normal vision. The goal is to raise the awareness of color blindness with empathy.
Review of Literature

Overview

In the design area, existing tools and technologies of interactive education are mature. Lots of educational and adventure applications have beautiful visual style and attractive interactive effects. Developed technology also supports various ways to be interactive.

For subject matter, there are variety methods to access the knowledge of color blindness that help to learn deeply about their situation.

Design Area

Digital Storytelling: A creator’s guide to interactive entertainment
By Carolyn Handler Miller

The book is a guide for designers who need to create interactive entertainment. It is organized into five sections, the first section describes the history of digital storytelling. The second section investigates some of the major concepts and tools of digital storytelling. The third section talks about harnessing digital storytelling for pragmatic goals. The fourth section introduces different types of digital media and models. The last section examines the career issues and discusses how to create one’s showcase.

Flash Cinematic Techniques: Enhancing Animated Shorts and Interactive Storytelling
By Chris Jackson

The book focus on some projects that reader can effectively use Flash to enhance their visual storytelling skills. The first section explains the basic information about story and character. The second section explores the visual elements used in stories. It includes three chapters about how space, line, color, and movement can be framed on the Flash Stage to communicate emotion and meaning.
Chris Crawford on Interactive Storytelling
By Chris Crawford

The book helps designers navigate and open their mind to more creative ways of producing stories. The author firstly lays out the fundamental ideas behind interactive storytelling. Then he details about interactive storytelling into five parts. The first chapter explains the differences between story and interactive storytelling. The second chapter provides different styles of thinking. The third chapter focuses on strategies for interactive storytelling. The fourth chapter points out the core technologies for interactive storytelling. The final chapter introduces the applications relevant to the interactive storytelling.

Applications

Monument Valley
Developed and published by indie studio Ustwo
Ustwo. 2014.

Monument Valley is a puzzle game played on iOS and Android. The player leads the princess Ida through mazes of optical illusions and impossible objects in ten levels. It has beautiful illustration and provides unique user experience for players to control.

LIMBO
Developed by Playdead and Double Eleven
Microsoft Studios, Playdead. 2010.

LIMBO is a puzzle-platform video game. The player guides an unnamed boy through dangerous environments and traps as he searches for his sister. The developer built the game’s puzzles expecting the player to fail before finding the correct solution. The game is presented in black-and-white tones, using lighting, film grain effects and minimal ambient sounds to create an eerie atmosphere often associated with the horror genre.
Dumb Ways To Die
Developed by Julian Frost and Samuel Baird

Dumb Ways to Die is a puzzle-platform video game that comes from the public service announcement campaign by Metro Trains in Melbourne, Victoria, Australia, to promote rail safety. The game invites players to avoid the dangerous activities engaged in by the various characters featured throughout the campaign.

Amelia and Terror of the Night
Developed by OhNoo Studio

Amelia and Terror of the Night is an extraordinary, quirky interactive story book app not only for children. It stands out for its visually stunning presentation and interactivity. Not only in art style but also in unique 3D effect and animations. The book tells a story about little girl Amelia and her three animal friends.

Who Stole The Moon?
By WindyPress

Who Stole The Moon? is an interactive e-book for children. It tells an story that a boy named Join Bertie on his quest to find the moon, with this charming bedtime story that will gently nurture your child’s imagination, and send them off into the magical world of dreams. It includes four games for children to play and eight original songs to listen.
Color Blindness Information and Children Books

What is Color Blindness?: What to Know if You’re Diagnosed With Color Blindness
By Egill Hansen

The book provides basic facts about defects in color vision—how they arise, how they become apparent, how many different types, and which diagnostic methods are used. Part one presents the extent of color blindness and its history. Part two indicates about what causes color vision deficiencies. Part three introduces some tests that examines if you are color blindness. Part four describes ramification of color blindness. The last part indicates how can the influence of color vision among artists be estimated. The content of the book offers me the information of color blindness that I can apply to my thesis.

Storytelling with Children
By Andrew Wright

The book is a resource book for teachers to learn and educate children through storytelling. It includes some popular stories in different culture. The first chapter lays out how to choose, tell, and reads stories aloud. The second chapter presents some common activities that happened before, during or after the story. The third chapter points out the stories and lesson plans through some examples. The last chapter highlights guidelines about writing, visualizing, grammar, music, characters in storytelling. This book provides teachers a outline, helpful and practical structure for storytelling.
Erik the Red Sees Green: A Story About Color Blindness
By Julie Anderson and David Lopez

The children book narrates a story of a boy named Eric who is a color blindness. The book combines the basic information of color blindness and vivid illustrations to convey the knowledge. In the design part, this book uses some examples tell the readers the visual differences between what normal people see and what color blindness see. The content is clear and easy to read and follow, and the layout is simple that can attract the children's attention. It is a cohesive and complete story about color blindness that is a good example for me to learn.

Dr. Seuss’s Horton Collection
By Dr. Seuss

This is a collection of Dr. Seuss’ Books that includes some of its famous and popular children books, such as the bestselling Green Eggs and Ham and The Cat in the Hat. The author good at using simple characters and story to educate the children the basic knowledge. In those books, each character has its unique outlook and personality that can attract the children's attention. Although the contents of the books are not relate to color blindness, it is still relevant and helpful in character design and storytelling to my thesis.

The Sound of Colors: A Journey of Imagination
By Jimmy Liao

The book tells a story about a young girl whose eyesight began slipping away a year ago and then she start using her imagination travel when she stay on a subway. The author applies his imagination and unique visual style on the story. I can learn the composition and the use of color from the book to my thesis, especially for illustration and visual style.
The Black Book of Colors
By Menena Cottin, Rosana Faría and Elisa Amado
Groundwood Books, Toronto, Canada. 2008
This children book creates an atmosphere that allows readers to experience colors the way blind people do by using entirely black and white. It gives young readers the ability to experience the world in a new way. Totally black and white provides readers stronger visual effects that evokes their sympathy for vulnerable groups and raise the awareness of color blindness.

Website and Online Articles

http://wearecolorblind.com
Founded by Tom van Beveren
We are Colorblind.com is dedicated to making the web and beyond a better place for the color blind. It founded by an colorblind (deuteranomally) interaction designer who uses examples to illustrate certain mistakes and pitfalls on this website.

http://www.colourblindawareness.org
Founded by Kathryn Albany-Ward
The Color Blind Awareness site has been founded to raise awareness of color blindness (colour vision deficiency) and aims to be the first point of reference for in the UK for people seeking information on colour blindness. This website provides support for colorblind people, especially color blind children and their families and teachers. It also provides information on the everyday problems experienced by color blind people and offers advice to parents.
http://www.color-blindness.com
By Colblindor

Colblindor is a site exists since 2006 and is all about color vision deficiency. It introduce about color blindness’ tests, tools, facts, news and a lot more information. This website helps me learn more about color blindness and provides me different resources and tools to develop my project.

5 Online Color Blindness Tests
By Colblindor

This article introduces about five popular online tests of color blindness. They are: Ishihara plates color blindness test; Farnsworth Dichotomous Test (D-15); City University Dynamic Colour Vision Test; Color Vision Test at Biyee.net and Multiple Choice Color Vision Test. Those are great samples for my thesis.

Related Technologies

Vischeck
Developed by Bob Dougherty and Alex Wade

Vischeck is an online tool that simulates colorblind vision. It is based on SCIELAB from the Wandell lab at Stanford university. This tool can help my design with correct colors.

Coblis
Support by Colblindor

Coblis is color blindness simulator. You can use the sample pictures or just upload your own images to test the color for color blindness.

Proto.io
Developed and Support by Proto.io Team

Proto.io is an online prototype developer that helps project testing.
Process

The See a Different World is an interactive application for mobile devices, specifically an iPad. The design purpose was to use engaging visual storytelling and interactive elements to raise awareness for elementary school-aged children about color blindness.

The development process included following stages: study and analyze the existing resources; brainstorm visual design principles and the design process; apply interface design and interactivity cues; evaluate and modify the design to improve the application. The elements of design included character design and background layouts to illustrate a narrative story about color blindness. Interaction design allowed children to gain knowledge about color blindness by manipulating the characters and/or situations in the story. A color-blind test was also incorporated and used best practices for the user interface design.

Based on the limitation of the techniques, the final design product was an interactive prototype of the application. It included an interactive storybook that displayed on desktop, which had the entire interface design and 2 main games to test if the children were color-blind. In addition, a reading prototype showed on iPad, which is supported and developed by Proto.io (an iOS app). Children could click and read it, but it had limitation of some interactive effects, such as the games or moving items.

All the related research, process and documents were uploaded to a thesis blog (danyuthesis.wordpress.com). All the assets were designed in Adobe Illustrator and Adobe Flash.
Step 1:
Design Inspiration/Personal Style

After getting inspiration from great existing applications and illustrations, such as Monument Valley, LIMBO, illustrations of Jimmy Liao and Kiyomi Saitou, various ideas for the interactive application were generated. Considering this was an educational application for children, the story needed to fit for elementary-aged children to read. Based on the research of best apps for kids [3], it was not hard to find that the interactive adventure story was a trend of children storytelling, and children can easier learn knowledge during reading. Based on some of the children storytelling guides, the concept of this application was about an adventure journey of a kid. The addition of a few mini-games into the story also brought more entertainments for children to read and learn.

The visual style of this application should fit for children, and the color pallet needed to be bright to attract children to reading. This thesis incorporated thesis candidate's style (fig.1) into the visual elements to express a unique and childlike atmosphere.

Figure 1: Personal Style

Step 2:  
Color Palette

The subject matter of the thesis is color blindness or color vision deficiency. The definition of color blindness is the inability or decreased the ability to see color, or perceive color differences, under normal lighting conditions. There are two main types of color blindness: red/green color blindness and yellow/blue color blindness.

Based on the research about color blindness, the color palette (fig.2) was chosen to match the two types of color blindness. In addition, to create a user-friendly interface/experience, a darker background was included to offer more contrast between prioritization and secondary elements. In addition, a yellow tone color was used on the main elements because it was easy to identify for both normal vision and color blindness. In this app, the red and green hues represent the red/green color blindness, whereas the green and blue hues depict the yellow/blue color blindness. This color palette was applied to entire story to keep consistency and left strong visual emotion for children that helped them understand the meaning of color blindness.

<table>
<thead>
<tr>
<th>Reds&amp;Greens:</th>
<th>Blue&amp;Greens:</th>
<th>Dark Background vs Yellows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Represent the red/green color blindness</td>
<td>Represent the yellow/blue color blindness</td>
<td>Make more contrast between main elements and background, easy to recognize</td>
</tr>
</tbody>
</table>

Figure 2: Color Palette of See a Different World

Step 3: Mind Map

A mind map diagram (fig.3) visually displayed a thinking process. The goal was to organize design, subject and technology aspects and elements of thesis ideas. The conceptual solutions of preliminary ideas related to this children's interactive application designed to make them aware about color blindness.
An information flowchart (fig. 4) was created based on the concept that helped define the connection between subject matter and design application. The goal was to use effective visual and interactive design to convey the information of color blindness for children.

For the final delivery, it would be a digital application with interactive storytelling application. It also contained an interactive, colorful, unique illustration, color blindness test for children and appropriate look and feel for the subject matter of color blindness.

Figure 4: Information Flowchart
Based on the research of color blindness and children storytelling, a story plot was developed. In order to mix the two types of color blindness into the adventure story, two planets were created to represent two types of color blindness. All the residents living in those planets represented the people who were color-blind. In this way, the basic frame of the story was determined. The main character in the story was selected as a little boy based on the research. It describes that color blindness is expressed in males with a higher probability than in females because of the inherited genetics. In that case, the male character was more reflective of the research.

In order to add more entertainment into the story, two color-blind tests were incorporated into the adventure story on each planet. However, a result from the research indicated that humans are naturally afraid of doing tests, especially for children. Therefore, incorporate tests into the story in the form of games can assist with testing for color blindness. This served the goal of encouraging children easily using the application without fear.

The whole story of this application (fig.5) was about a little boy, Max, who notices that he seemed different than other kids because he saw the world in different colors, so he decided to travel to different planets to find someone similar to him who can help him understand about him.

![Figure 5: Story Plot](image)


A rough user flowchart (fig.6) was designed based on story compositions, assistant functions and the information of color blindness. This diagram displayed a process and receives continual refinements based on user feedback and observations.

Figure 6: Flowchart Sketch
After a full research and analysis, a refined process workflow (fig.7) was designed. This diagram visualized how many parts were included in the application, and how users read the story and play the game step by step. Three main parts in the application:

1. Story: The story was the core of the application. The plot was further developed based on the previous foundation. It included two games at different planets.

2. Game: User could select to play games directly in this section.

3. Info and Help: The information about how to use this application and the basic information about color blindness.

Figure 7: Process workflow: How users read and play application
**Game Flowchart**

The test used the story elements of traveling to different planets as the metaphor. Tests were structured more as games for the thesis’ target audience who may be frightened of taking tests. The game flowchart (fig.8) shown the feedback when user plays the game:

1. **The color dots game**
   
   This game based on the traditional Ishihara plates color blindness test. There would be five buildings hide in the sky. Player needed to choose the numbers that they can see the dots’ image.

2. **The Matching Game**
   
   The player needed to find the correct color palette to match the sample.

There were two types of feedbacks of the game. If the children were the normal vision and could identify the colors, it meant that the children passed the color-blind test and they did not belong to this type of color blindness. If they had trouble to identify the colors, it meant they might had some color deficiency problem. The expression of the feedbacks was fit for the story, which not too harsh for children to accept.

![Game Flowchart](image-url)

Figure 8: Game Feedback
Target Audience

The specific target audience for the thesis was elementary children who lack the knowledge of color blindness and were interested in reading and playing interactive application on the iPad.

The specific target audience for the questionnaires and surveys were both color – blind and normal – vision children. The users surveyed were 7–12 years of age.

<table>
<thead>
<tr>
<th>Persona One</th>
<th>Name</th>
<th>Alice Jones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>8 years old</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td>Second-year Elementary School, she born and grow in New York City and she live with her parents</td>
<td></td>
</tr>
<tr>
<td>Personality</td>
<td>Outgoing, kind, smart, curious about new things, sensitive</td>
<td></td>
</tr>
<tr>
<td>Interests</td>
<td>She prefer learning about things from reading books and playing games on iPad.</td>
<td></td>
</tr>
<tr>
<td>Goals</td>
<td>One of her friend is color blindness, but she not familiar with color blindness, and she want to learn about it.</td>
<td></td>
</tr>
<tr>
<td>Challenges</td>
<td>She needs an easy and attractive way to learn the information about color blindness</td>
<td></td>
</tr>
<tr>
<td><strong>Persona Two</strong></td>
<td><strong>Name</strong></td>
<td>Eric Tipton</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>10 years old</td>
<td></td>
</tr>
<tr>
<td><strong>Background</strong></td>
<td>Fourth-year Elementary School, he born and grow in Rochester and he live with his mother</td>
<td></td>
</tr>
<tr>
<td><strong>Personality</strong></td>
<td>Sensitive, quiet, kind, playful</td>
<td></td>
</tr>
<tr>
<td><strong>Interests</strong></td>
<td>He prefer learning about things from reading books and playing games on iPad.</td>
<td></td>
</tr>
<tr>
<td><strong>Goals</strong></td>
<td>He knows that he is color blind, and he is sensitive about to be a color blindness. So he needs a way to learn about it easily.</td>
<td></td>
</tr>
<tr>
<td><strong>Challenges</strong></td>
<td>He does not like doing the color blindness test because he is afraid of taking tests.</td>
<td></td>
</tr>
</tbody>
</table>
**Storyboard**

The most significant part of this interactive application was the visual storytelling of color blindness. The initial ideas evolved through lots of rough sketches, and they represented a basic visual style and visual storytelling.

The sketches of home and content pages (fig.9) laid a visual foundation of the whole story and expressed the concept of See A Different World by using the galaxy and child elements. The galaxy and planets drew on the storyboard matched the plot of traveling through different planets and the shapes of planets were combined with the designer’s visual style.

![Figure 9: Home and Contents Pages Sketches](image-url)
The first part of the storyboard (fig. 10) was the beginning of the story. It described why a little boy named Max who wanted to begin his adventure journey. The intention of taking a big proportion of the main character’s face on the page was emphasized the primary visual concentration point during reading. Besides, different perspectives were illustrated through every page, which intended to bring more visual diversity.
The second part of sketches (fig. 11) was the traveling section. It told about the two planets that Max traveled through and residents he met on each of the planets. From the previous research of color blindness, each of the planets represented one main type of color blindness. The user can learn the information about each type of color blindness and play a mini game to test if they had those vision deficiencies when they read in this section.
The last part of storyboard (fig. 12) was the ending of the story. It described how Max left two planets and went back to home.

Those residents encouraged him and he started to open his heart and became happier than ever. Different perspectives were used from page to page. It efficiently conveyed the plot of the story and brought more imagination to children.
Based on the storyboard, a refined story layout (fig. 13) was designed. It displayed an overall visual connection from page to page, which provided a reliable layout for the next design step.

Figure 13: Modified Story Layout Sketches
Typography and Characters Design

Typography and character design were essential components of the interface design. Children are the target audience for my application, so the typeface needed to be bold and easy to read. For the characters, they needed to be cute and friendly for children.

The home page sketches (fig.14) illustrated an idea with an adorable typeface and character. It was a detailed design of the home page with selected typeface. This design provided a playful and joyful atmosphere for children to read.

Figure 14: Home Page Sketches
Century Gothic and Rockwell (fig.15) were the selected typefaces of the interface. Century Gothic works well for both title and content text, especially in bold weight, while Rockwell only for the title. These typefaces are clean, friendly, and well suited for this application.

The final typography of the home page (fig.16) used a contrasting color palette between front elements and background. The reversed letter D and eyeballs emphasize a childlike tone for the home page that engaged the children to read.
The protagonist Max, a little boy, was the most important character in the story. The sketches of Max (fig. 17) illustrated different positions during the whole story: standing, sitting, reading, and walking. And the variety of expression: said, lonely, anxiety, peace, happy. Those different emotions and positions afforded the character more practical personality and it might shorten the distance between the children and characters.

Figure 17: Main Characters Sketches: Max
The secondary characters were the two planets and its residents. Those sketches (fig.18) displayed a design process of planets and residents. All the shapes were unique but had consistent elements. The figures of residents were inspired by the buildings on the planets. Those figures kept some visual element from the building, but more looked like the aliens.

Figure 18: Main Characters Sketches: Planets and Residents
Another important character was the starship, which flew Max to two different planets. The shape of the starship was not so harsh for young children, but still maintained the sense of the future to match the theme of traveling through the galaxy. Those sketches (fig. 19) illustrated the structure of the starship and how it flies through space.

Figure 19: Main Characters Sketches: Starship
The final characters illustration (fig. 20) represented a full-color graphics. Based on the research of color blindness, the color selection of Max was yellowed, which more stood out compared with the dark background and easily to recognize.

The colors of residents represented the two types of color blindness. It had a strong and delightful personality that drew the children's attention to read and play.

Figure 20: Characters Illustration
An icon needed to be designed for this application that showing on the iPad screen and representing the spirit of See A Different World. These icon sketches (fig.21) implemented the ideas of the main character Max and the planet views. The final logo design (fig.22) emphasized the concept of “see a different world”, only using the face of Max to express the feeling of being different and looking for hope. It had strong emotion and represented in a perfect way compared to other applications.

Figure 21: Logo Icon Sketches

Figure 22: Final Logo Icon
For the purpose of being consistent, a template wireframe (fig. 23) was designed for all interfaces. Because this application was designed for children to read, the final product was designed for the landscape mode on an iPad.

This wireframe created a maximum guideline to put text and buttons on each page. By following those rules, a cohesive system was created for the interface design.

Figure 23: Interface Margin (Landscape)
The final interface design included three parts: Read Story, Play Game, Help & Information. They were visualized based on the storyboards and the wireframes.

The home page design was important to represent the entire visual style before reading the story. The first version (fig.24) demonstrated the original concept of the home page design. The revised version (fig.25) used contrast color palette to engage the children and left a strong visual feeling about the whole story. Both of the typeface and planets were improved compared to the previous design.

Figure 24: First Version of Home Pages

Figure 25: Refined Home Page
Part 2: Content Page Implementation

Using three different planets as the selection button in the content page made it more fun for children to tap and play. The first version (fig.26) of content page used a light orange color, which did not provide enough contrast between the three buttons and the background. The refined design (fig.27) kept a dark background to bring more visual impact to the users.

Figure 26: First Version of Content Page

Figure 27: Refined Content Page
Part 3:  
Game & Feedback Pages 
Implementation

The game was an important component in the application. It was divided into two sections:

1. The games and feedback in the Story: children could play the game when they read the story.

2. The Play Game section on the content page: children could play the game directly before or after reading the story.

Both of the sections shared the same games and received similar feedback.

Section 1  
The Games & Feedback in the Story

The first section was designed as a part of the story. While reading, children had an opportunity to take a simple color-blind test. The red/green color-blind test (fig.28) was designed based on the traditional Ishihara plates color blindness test. The graphics consisted of red and green dots. The red dots were design as the form of the building of that planet, which had a visual connection between the story and the test. Through the online color blindness simulator Coblis and Vischeck, this testing way was detected to be effective.

Figure 28: Story Game1: Red/Green Color-Blind Test
The feedback (fig.29) page would appear after the red/green color-blind test. Users with normal vision would get the left feedback. It meant that they might not have a problem distinguishing the colors. There were two selections that the user could choose: continue reading or learn more information. If the user had an issue recognizing the colors, they would receive the feedback on right screen. The visual structure for both feedback was similar and used the same elements from the first red/green planet.

Figure 29: Feedback of Story Game1

The similar visual style and layout were applied into the second game (fig.30). However, the color palette was changed in order to fit the yellow/blue planet.

Figure 30: Game 2 and Feedback Design
Section 2
The Play Games Section

Another part of the content page was called Play Game (fig. 31). It provided a different choice for the user that they could play the game directly before or after reading the story.

In this page, the user could choose red/green color-blind test by clicking circle button on left, or choose yellow/blue color-blind test by clicking the circle button on right. The buttons were clear and easy to find. The color choice of the buttons was selected from the story.

Figure 31: Play Game Section
The information about color blindness appeared in two forms at the different places. One of them introduced different aspects of color blindness at the Help & Information section. It had more detailed explanation through infographics. The other one only focused on introducing different types of color blindness. This form was included in the story.

When selecting the Help & Information section at the content page, it would jump to the Help and Information Content Page (fig.32). It had two clickable buttons. They were About Color Blindness and Character Guide. The buttons were designed as the same planet displayed on the content page. It kept consistency between visual and structure. Besides, a short guide was offered in this page to explain how to use this application. The round shape of the graphics brought a friendly user experience.

After clicking the About Color Blindness button, a detailed information page appeared. This page described basic information that answered three questions:

1. What is Color Blindness?
2. What cause Color Blindness?
3. What type of Color Blindness?
The information included the name of main types, the causes, the simulative color vision and the population. The first version (fig.33) had two pages. It had too much text and visually crowded. The refined version (fig.34) improved by the following aspects:

1. Separated the two pages into four. It offered an empty space to emphasize the infographics.

2. Changed the color of the title. The visual hierarchy was emphasized during reading. Therefore, the information was clearly conveyed.

Figure 33: About Color Blindness Previous Version

Figure 34: Improved Version of About Color Blindness
The character guide in the help and info section offered a choice that the user could see all the characters in one page (fig. 35). They could learn the detailed profile of every character by tapping on it. Then the messages would pop up. For example, when tapping Max, the profile of Max would appear (fig. 36), and it could be closed by clicking the exit button. The dark background was continually used to keep the consistency of the galaxy theme and made the characters stand out.
Section 2
The Information in the Story

After the users selected learn more information at the feedback page, they would jump to the information page. This page introduced the users to information about green and red color blindness.

The previous design (fig.37) was hard for children to read because of the overwhelming amount of text. The refined version (fig.38) used a clean and illustrative animation to help children easily understand the information.

Figure 37: First Version of Color Blindness Info on Story

Figure 38: Improved Version of Color Blindness Info on Story
Part 5: Storybook Implementation

The first page (fig.39) introduced a little boy, Max, who saw the world differently. The second page (fig.40) illustrated Max at home in his room and that he felt lonely because no one understood him. The first scene used a closeup of Max to show his expression. On the contrary, the second page illustrated a wider shot of the character to show what his room looked like. Both of the pages had hidden animations that users needed to find. It engaged the user through entertainment of playing the application.
The third page (fig. 41) described how Max got an idea that he needed to go outside to find someone liked him. The forth page (fig. 42) showed Max standing in front of his house and deciding to go out and begin his journey. Different perspectives were used in those pages. Page three only showed the head of Max, which put the focus point on the light bulb. The scene on page four illustrates Max preparing to leave his home. Therefore, the idea was only illustrated with the bottom part of Max. The shadow on the ground created a lonely atmosphere to the story.

Figure 41: Story Page3

Figure 42: Story Page4
The next two pages (fig.43) (fig.44) told that Max left his home and traveled through the forest. Then, he found a deep hole and there was something hidden inside.

Because of the strong connection between these two pages, they were designed as a long camera shot. A road crossed both pages and ended on the deep hole. It functions as a guide to direct the users through the pages.
The scene on page seven (fig.45) illustrated Max climbing down the deep hole where he finds an abandoned starship.

![Figure 45: Story Page7](image1)

After he entered the starship, the next page (fig.46) used a closer angle shot of the control station to describe how excited Max was when he saw those nearby planets.

![Figure 46: Story Page8](image2)
Story page nine (fig.47) used an outer view to describe that the starship had flown higher and higher. The moving flame on the starship provides a more energetic feel to the scene.

![Figure 47: Story Page9](image)

As he flies higher and higher, Max is getting more curious and excited about this journey. He looks back and watches his planet become smaller and smaller until it becomes to a tiny point of light.

The page ten (fig.48) displayed that Max saw the first unknown planet and he felt excited about it. It used Max’s perspective to show the galaxy through the window. This way, the user would have more reaction and feeling for what the character was experiencing.

![Figure 48: Story Page10](image)

Through the window, everything appears fresh and new to Max. The vastness of the universe full of mystery.

After a while, a glowing planet gradually appears in the distance.
Next page (fig.49) exhibited a whole view of the first planet.
The color palette of the planet mixed both red and green tones.

The page twelfth (fig.50) illustrated a scene that Max met a resident on this red-green planet and they had a short conversation. They introduced each other and the resident invited him into the house.
After entering the resident’s house, in the next page (fig.51), the resident introduced that they were one type of color blindness—red/green color blindness.

This page provided two switch buttons so the user could see the normal color mode and red/green color-blind vision mode (fig.52). It helped the user learn color blindness in a visual way.
After switching the color mode, the next page (fig.53) offered two selections from which the user could choose to either play a game or learn more information of this type of color blindness. The buttons are a large shape and the bright color made it easy to recognize.

![Figure 53: Story Page14](image)

After playing the game and learning the information, Max received a gift from the residents and prepared to leave the planet (fig.54). The added the glow highlighted the necklace, and the layers of glow attracted more attention from the users.

![Figure 54: Story Page15](image)
In this page (fig.55), Max said goodbye and flew to the next planet. This screen contained both of the planets and located them on the diagonal corners. The starship in the center depicts a flying direction that matched the story plot.

Figure 55: Story Page16

The next page (fig.56) exhibited a whole view of the second planet. The color palette of the planet mixed both blue and green tones. It also contained some flowing bubbles in the planet. It created a strong visual impact for the users.

Figure 56: Story Page17
When he landed on this planet, Max found something hidden behind the bushes (fig.57). There he found the resident.

![Figure 57: Story Page18](image)

The resident introduced himself and that they were one type of color blindness—yellow / blue color blindness. This page (fig.58) provided two switch buttons so the user can see the normal color mode and yellow / blue color-blind vision mode (fig.58). It helped the user learn color blindness in a visual way. Because the plot of those pages happened in the same planet, the landscape of each page was similar.

![Figure 58: Story Page19 – Regular (left) and Yellow/Blue Color Blindness Vision Mode (right)](image)
After switching the color mode, the next page (fig. 59) offered two selections from which the user could choose to either play a game or learn more information of this type of color blindness. The buttons are a large shape and the bright color made it easy to recognize.

After playing the game and learning the information, Max prepared to leave and the resident gave him a necklace as a gift (fig. 60). The blue-green glow highlighted the necklace on the screen, which emphasized the importance of the gift.
Max left the yellow/blue planet and then was accidently sucked into a black hole (fig.61). A black and white tone was used on this page in order to create a darker environment for the users. It reflected the dangerous situation that Max faced.

![Figure 61: Story Page22](image)

The next page (fig.62) described that Max felt terrified and he opened his eyes to check if he still alive. The dark layers around the face demonstrated an unknown fear, and it drew the users attention on Max’s expression.

![Figure 62: Story Page23](image)
The next page told that Max woke up on his bed (fig.63). It used a closer view on Max's bed and put the focus point on his hands. In that way, the two necklaces were popped out from the bed. In the next scene (fig.64), the perspective was moved away from the bed. Max believed this journey was real and it was not a dream. He tried to remember all the words the residents said to him and he felt encouraged.
This page demonstrated that Max started opening his heart and began making a lot of new friends (fig.65). On the screen, five children stood and held hands together, which represented that they respected and accepted each other. Even though they all looked different, they still had a big smile.

Figure 65: Story Page26

In the last page, Max cherished this experience and wrote it down at his personal diary (fig.66). The diary was centered on the screen with bright color, which was visually important to the users.

Figure 66: Story Page27
Interactive Prototype

Once all the visual design was polished, it was time to make the project readable and playable. User scenarios were needed to demonstrate and predict the activities of users, which narrated different interaction purposes while using the application.

For this application, the main walkthrough (fig.67) allowed users to read the entire story and play the game. In this situation, the user first needed to open the application on iPad and tapped the start button to move to the next page. Then, the content page appeared, which offered three selections for the user to choose. The user selected the Read Story button to start reading. They can go back at any time when tapping the home button in the right lower corner of the screen.

A second walkthrough (fig.68) represented that the user assumed to play the game before or after reading the story. In both situations, the user could select the Play Game in the content page to enter the game content page. In this page, the user could choose red / green color–blind game on left circle button, or choose yellow / blue color–blind game on right circle button.
The third walkthrough (fig.69) described a process of activities when the user clicked on the Info & Help button to learn how to use this application or read the full information about color blindness.

Figure 69: How to Use the Application and Learn the Information

After the user entered the Info & Help content page, there were three parts includes: About Color Blindness, Instructions and Character Guide. When the user was concerned about the information and wanted to learn more, a walkthrough (fig.70) demonstrated this progress. If the user required the profiles of all the characters, the walkthrough (fig.71) could satisfy the user’s demands.

Figure 70: Learn Detailed Information of Color Blindness

Figure 71: Check the Character Guide
Interactive Prototype: Flash HTML Canvas

After clarifying all the interaction development and refinement of the visual elements, an interactive prototype was needed. In order to achieve the goal, it was essential to apply the project by implementation suitable tools. The final interactive prototype was edited and animated in Adobe Flash CC HTML Canvas (fig.72). It also required JavaScript for programming (fig.73), which allowed the realization of all the interactive effects and dynamic animations.
Figure 73: Adobe Flash CC HTML Canvas and JavaScript
With the published HTML and JavaScript files (fig. 74), the final interactive prototype was published online so people can read and play when connected with the Internet.

Figure 74: Programing of JavaScript1
Interactive Prototype: Proto.io

For the purpose of better user testing, another interactive prototype was built with a professional prototyping application called Proto.io (fig.75).

The prototype designed on Flash had a limitation of publishing to the iPad, so the second one was necessary to address interaction with the app properly. Proto.io had the advantage to allow preview on iPad, and it was the closest version compared with the real application.
User Research and Testing

The evaluation process and feedback was important for my thesis. There were two main methods employed for the user testing: face-to-face observation of user-interaction with children and surveys from the MFA Thesis Show in December 2015. Each of the testing events had a different approach and aimed on achieving various goals. The analysis of the feedback was both qualitative and quantitative.

Before the user testing, a user study consisted of an interview survey and it had ten participants between the ages of 6 – 12 years of mixed gender. It investigated commonly used iPad for reading or playing games, the frequency of reading story a on their own or by parents. The survey results provide information that many children are growing up with apps and digital devices as part of their lives. They are familiar with using the iPad to read and play games. The feedback was collected through a written survey and face-to-face interview. All users were asked to provide basic information about themselves and their habits. This survey laid a good foundation for the final testing.

A testing event was conducted with elementary school children aged 6 to 9 years, at Leary Elementary School in Rochester, NY (fig.76), observing how they used the application if the product clearly conveyed the message they could easily comprehend.

Figure 76: Face-to-Face Interview at Leary Elementary School
The face-to-face interviews had ten participants. The grade level of the interviewees was from first to fourth grade. It included four girls and six boys. The process of testing was observing how children use the interactive prototype on an iPad and then asked few simple questions about how they felt about it. The questions are:

1. Do you like the graphics in the storybook?
2. Is it an interesting story that you would want to read again? – If not, which part did you not like?
3. Do you learn something about color blindness? – If not, which part was hard for you to understand?

The graphics and interface design worked for the targeted audience and they liked it as is. The characters and colors were effective and fit for children to read. And all the buttons were functional and easy for them to click.

One of the phenomenon occurring during the observation was that all of the children selected to play games first instead of reading the story. It reflected that the reading the story section needed to be more highlighted to draw their attention. Eight of ten children could learn about the color blindness and read the story fluently. However, some of the words were still difficult to understand, especially for first grade children (e.g. mystery). Another valuable feedback was the need of audio. A second grade child suggested that she wanted voice assistance to help her with reading. It would be helpful when she would be reading on her own.

Overall, the face-to-face interview was a direct method that brought a lot of benefits and valuable feedback to the application. It truly raised the awareness for children about color blindness.
The thesis show was able to support another user testing method. It was conducted on December 4th in the Visual Communication Design lab at RIT. For this method, a random group of people were selected. They were asked to complete a survey (fig. 77) about the visual, content, and usability after using the See a Different World interactive prototype.

<table>
<thead>
<tr>
<th>Part 1 Basic Info</th>
<th>Age</th>
<th>6-9</th>
<th>10-12</th>
<th>13-15</th>
<th>16-18</th>
<th>19-22</th>
<th>23-30</th>
<th>31-40</th>
<th>40+</th>
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</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Visual Style</td>
<td>Effective</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Ineffective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Character Design</td>
<td>Likes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Dislikes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Story in App</td>
<td>Effective</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Ineffective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarity to Learn the Info of Color Blindness</td>
<td>Easy to learn</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Hand to learn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usability</td>
<td>Easy to use</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Hard to use</td>
<td></td>
<td></td>
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<tr>
<td>Game Play</td>
<td>Easy to play</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Hard to play</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback of games</td>
<td>Effective</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Ineffective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 77: Thesis Show Survey Form

Results from the thesis show demonstrated the visual style that was appropriate for children to read. They thought both of the prototypes were efficient and functional. Three users responded that they would like to ask their children to read this story. Meanwhile, some improvement suggestions were proposed from the users, they were:

“There should be a menu that could give me a status of where I am in the interactions”

“Add sound may keep engagement”

“Maybe add a voice to read the story”

“Should change page even if do not press button”

“Maybe add more dynamic animations”
Overall, the feedback from user testing and interviews was informative. The visual style was attractive and the functions were effective. All the users learned new knowledge and raised the awareness of color blindness. This application has a potential for future development and may sell on the App store.

Improvement suggestions mainly focused on the story and usability defects in the application. Adding audio was another valuable recommendation to keep the user engaged. The feedback gathered from the face-to-face interviews primarily reflected on the visual design and readability of the story; the thesis show survey suggested on the usability.

The See a Different World application was continually modified with that aim to create a better user experience. For the future, further polishing of the application would be made to fit the needs of the users.
The Solution and Conclusion

During the process, on design area, the See a Different World application combines interactive technology with traditional graphic design that provides a more interesting method for children to learn.

In subject matter, the See a Different World application is meaningful for both children who are color blind and those with normal vision, and raises the awareness of color blindness with an emphasis on empathy. Incorporated tests into the story in the form of games also assist with testing for color blindness. With this method, children are not afraid of completing the test. And it provides a method for teachers and parents to help children learn about color blindness. This storytelling app with games and testing provides a new way for them to communicate.

This application has great potential for further growth. The next steps of the thesis are focusing on the following aspects:

1. Continuing to polish the prototypes based on the gathered feedback of user testing.
2. Apply interactive effects to the entire application and add more dynamic animation into the story.
3. Adding audio or background sound to keep user engagement.
4. Consider making a responsive design that may be more suitable for mobile device or a website.

The See a Different World application provided the author of this thesis with a better experience about communication and interaction design. Personal visual style and design implements were also enhanced, and allowed for proficient learning on how to apply research, design thinking, and systems to the whole process.
Appendices

1. Original Thesis Proposal
2. Story Script
3. User Interview – Interview Record Form
4. Thesis Show – User Survey with Results
Appendices 1
Original Thesis Proposal

See a Different World:
Interactive Storytelling to Raise Awareness of
Color Blindness for Children

Dan Yu
Thesis Proposal for the Master of Fine Arts Degree
Rochester Institute of Technology
College of Imaging Arts and Sciences
School of Design
MFA Visual Communication Design
October 28, 2014
Thesis Proposal for the Master of Fine Arts Degree

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Submitted by: Dan Yu
Date: October 28, 2014

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Thesis Proposal for the Master of Fine Arts Degree

See a different world: Interactive storytelling to raise awareness of color blindness for children

Dan Yu

Abstract

Children play with interactive applications to gain knowledge in their daily life. There are different kinds of interactive applications that help educate children through visual storytelling. In reviewing the current apps available, few of them were written or designed for children with disabilities, especially children with color blindness. Through research, I discovered that children lack an awareness of color blindness. My thesis aims to design an efficient, interactive visual storytelling application to raise awareness of color blindness for elementary children. The project will help elementary children gain knowledge about color blindness through reading and playing activities within the app. In addition, a small color blind test for children will be included. Based on the research of children's interactive apps and illustration geared towards children, my thesis project's visual style will help facilitate the children's goals of learning about color blindness. The visual storytelling will also attract children through the design of different characters and colorful elements, such as backgrounds, props, and user interface buttons. Visual design principles will be integrated and using basic design software to produce the an effective user interface. Usability testing will be done to test the visibility of this app and address any issues that need to be modified and improved.

Keywords: interactive app, educational app, children storytelling, interactive design, color blindness, children illustration, visual storytelling, color blind test, electronic book.

Situation Analysis

A majority of children are not aware of color blindness. Considering children are more sensitive about visual graphics than literal text, I will design an efficient, interactive visual storytelling application to raise awareness of color blindness (color vision deficiency) for elementary children (age 7–12).

Children can be educated through the combination of the visual storytelling and playing. A Children’s research institute, named Common Sense, claims that the time children spent on mobile devices tripled over the past three years ago. Combining interactive technology with the traditional graphic design can provide a more interesting method for children to learn. Vivid visual images not only help children to gain the knowledge, but also can raise their awareness about vulnerable groups, especially children with color blindness.

About 2% of the population is color blind all over the world. [1] Based on a number of research results, it points out that about 8% of the male and 0.5% female population has some sort of color blindness. [2] Majority of children lack the awareness of color blindness. For these children who are color blindness, they afraid about it and feel different when compared with other children, so they urgently need a platform that other child can learn and understand them. Some children may have some color vision deficiency, but they do not notice or recognize it. Faced with these problems, how can visual design and interactivity to raise children's awareness of color blindness?

Problem Statement

Looking at interaction design, there are lots of good interactive educational applications for children. But few of them relate to the knowledge of color blindness, and most of them have poor visual style and are too literal for elementary children to comprehend. Except the traditional children books, color blindness test is another part of design that may help children to play and learn. But the test is too serious for children that they may be intimidated by taking a test. So an effective design is needed that solves the concerns of color blindness and avoids a too literal or serious presentation for children to play and learn.

For my thesis, I will propose a study that explores how design an interactive storytelling application to raise awareness of color blindness for elementary children. My research will investigate and develop the children education design, children illustration design, interactive design, and color blindness information, and aim to answer the following questions:

1. What kind of visual storytelling is more suitable for elementary children to learn the information of color blindness?

2. How to combine the mini game and color-blind test into the application that easily for children to accept?

3. How interactive elements help the story more attractive than others for children to play?

4. Consider both color blindness and normal vision children, what color palette will be using in the design?

5. What character will be create in the storytelling that more easily for children to understand and want to share their feelings for others?

The result of my research will be meaningful for both children with color blindness and normal vision. Its goal to raise the awareness of color blindness with empathy.
Survey of Literature

Books

1. **Erik the Red Sees Green: A Story About Color Blindness**
   By Julie Anderson and David Lopez

   The children book narrates a story of a boy named Eric. He is a color-blind. The book combines the basic information of color blindness and vivid illustrations to convey the knowledge. The story starts from a confusion that Erik seems doing everything wrong because he is color blind. And end up with a happy ending that his family, friends and teachers helps him get into right direction. In the design part, the book uses some examples tell the readers the visual differences between what normal people see and what color blindness see. The content is clear and easy to read and follow. The layout is simple but not repeat that can attract the children’s attention. It is a cohesive and complete story about color blindness that is a good example for me to learn.

2. **The Sound of Colors: A Journey of Imagination**
   By Jimmy Liao

   The book tells a story about a young girl whose eyesight began slipping away a year ago and then she start using her imagination travel when she stay on a subway. The author applies his imagination and unique visual style on the story. It has a series of beautiful illustration with some philosophy of life. I can learn the composition and the use of color from the book to my thesis, especially for illustration and visual style.

3. **Dr. Seuss’s Horton Collection**
   By Dr. Seuss

   This is a collection of Dr. Seuss’ books that includes some of its famous and popular children books, such as the bestselling *Green Eggs and Ham*, *The Cat in the Hat* and *One Fish Two Fish Red Fish Blue Fish*. The author good at using simple characters and story to educate the children the basic knowledge. In those books, each character has its unique outlook and personality that can attract the children’s attention. Although the contents of the books are not relate to color blindness, it is still relevant and helpful in character design and storytelling to my thesis.

4. **The Black Book of Colors**
   By Menena Cottil, Rosana Faria and Elisa Amado
   Groundwood Books, Toronto, Canada. 2008

   This children book creates an atmosphere that allows readers to experience colors the way blind people do by using entirely black and white. It gives young readers the ability to experience the world in a new way. Totally black and white provides readers stronger visual effects that evokes their sympathy for vulnerable groups and raise the awareness of color blindness.
Survey of Literature

5 Storytelling with Children
By Andrew Wright

The book is a resource book for teachers to learn and educate children through storytelling. It includes some popular stories in different cultures. The first chapter lays out how to choose, tell, and read stories aloud. The second chapter presents some common activities that happened before, during or after the story. The third chapter points out the stories and lesson plans through some examples. The last chapter highlights guidelines about writing, visualizing, grammar, music, characters in storytelling. This book provides teachers a guide, helpful and practical structure for storytelling.

6 What Is Color Blindness?: What to Know If You're Diagnosed With Color Blindness
By Egill Hansen

The book presents basic facts about defects in color vision—how they arise, how they become apparent, how many different types, and which diagnostic methods are used. Part one presents the extent of color blindness and its history. Part two indicates what causes color vision deficiencies. Part three introduces some tests that examine if you are color blindness. Part four describes ramifications of color blindness. The last part indicates how the influence of color vision among artists can be estimated. The content of the book offers me the information of color blindness that I can apply to my thesis.

7 Digital Storytelling: A creator's guide to interactive entertainment
By Carolyn Handler Miller

The book is a guide for designers who need to create interactive entertainment. This book is organized into five sections, each of them with a different function. The first section describes the history of digital storytelling. The second section investigates some of the major concepts and tools of digital storytelling. The third section talks about harnessing digital storytelling for pragmatic goals. The fourth section introduces different types of digital media and models. The last section examines the career issues and discusses how to create one’s showcase.

8 Flash Cinematic Techniques: Enhancing Animated Shorts and Interactive Storytelling
By Chris Jackson

The book focuses on some projects that readers can effectively apply Flash to enhance their visual storytelling skills. The first section explains the basic information about story and character. The second section explores the visual elements used in stories. It includes three chapters about how space, line, color, and movement can be framed on the Flash Stage to communicate emotion and meaning. The third section of the book teaches how to using cinematography techniques such as camera movement, lighting, and editing into the Flash workspace.
Survey of Literature

9 Chris Crawford on Interactive Storytelling
   By Chris Crawford

The book helps designers navigate and open their mind to more creative ways of producing stories. The author firstly lays out the fundamental ideas behind interactive storytelling. Then he details about interactive storytelling into five parts. The first chapter explains the differences between story and interactive storytelling. The second chapter provides different styles of thinking. The third chapter focuses on strategies for interactive storytelling. The fourth chapter points out the core technologies for interactive storytelling. The final chapter introduces the applications relevant to the interactive storytelling.

Applications 10 Monument Valley
   Developed and published by indie studio Ustwo
   Ustwo. 2014.

Monument Valley is a puzzle game played on iOS and Android. The player leads the princess Ida through mazes of optical illusions and impossible objects in ten levels. It has beautiful illustration and provides unique user experience for players to control.

11 LIMBO
   Developed by Playdead and Double Eleven
   Microsoft Studios, Playdead. 2010.

LIMBO is a puzzle-platform video game. The player guides an unnamed boy through dangerous environments and traps as he searches for his sister. The developer built the game’s puzzles expecting the player to fail before finding the correct solution. The game is presented in black-and-white tones, using lighting, film grain effects and minimal ambient sounds to create an eerie atmosphere often associated with the horror genre.

12 Dumb Ways To Die
   Developed by Julian Frost and Samuel Baird

Dumb Ways To Die is a puzzle-platform video game that comes from the public service announcement campaign by Metro Trains in Melbourne, Victoria, Australia, to promote rail safety. The game invites players to avoid the dangerous activities engaged in by the various characters featured throughout the campaign.
Survey of Literature

13 Amelia and Terror of the Night
Developed by OhNoo Studio

Amelia and Terror of the Night is an extraordinary, quirky interactive story book app not only for children. It stands out for its visually stunning presentation and interactivity. Not only in art style but also in unique 3D effect and animations. The book tells a story about little girl Amelia and her three animal friends.

14 Who Stole The Moon?
By WindyPress

Who Stole The Moon? is an interactive e-book for children. It tells an story that a boy named Join Bertie on his quest to find the moon, with this charming bedtime story that will gently nurture your child’s imagination, and send them off into the magical world of dreams. It includes four games for children to play and eight original songs to listen.

15 http://www.colorblind.com/
Founded by Tom van Beveren

We are Colorblind.com is dedicated to making the web and beyond a better place for the color blind. It is founded by an colorblind (deuteranomaly) interaction designer who uses examples to illustrate certain mistakes and pitfalls on this website.

16 http://www.colourblindawareness.org/
Founded by Kathryn Albany-Ward

The Colour Blind Awareness site has been founded to raise awareness of colour blindness (colour vision deficiency) and aims to be the first point of reference for in the UK for people seeking information on colour blindness. This website provides support for colorblind people, especially colour blind children and their families and teachers. It also provides information on the everyday problems experienced by colour blind people and offers advice to parents.

17 Color blindness
By Wikipedia
http://en.wikipedia.org/wiki/Color_blindness#Diagnosis
Date of Access: September 2, 2014

The term of Color Blindness in Wikipedia provides the history, causes, types, tests of color blindness. It also offers many reference and links about color blindness.
Methodological Design

**Objective**
The final design product will be an interactive application for mobile devices, specifically an iPad. The project’s visual storytelling and interaction design will raise an awareness about color blindness for elementary children. Elements of design will include character design, background layouts to illustrate a narrative story about color blindness. Interaction design will allow children to gain knowledge about color blindness by manipulating the characters and/or situations in the story. A color blind test will also be incorporated and will use best practices in user interface design.

**Story:** a boy starts a space journey and travels to different planets. Each planet represent a kind of color blindness effect and includes some basic information and testing. The story will be approximately 20 pages.

**Visual Style:** two dimensional, low – polygon, colorful, humorous.

**Characters:** a main male child, different residents live on the planet. These residents include: a King, a lost boy and a couple.

**Interaction design:** Color blind test, tap for information hints and/or feedback, control character movements using gestures.

**Deliverables**
Based on the limitation of the techniques, the final design product will be an interactive prototype of the app. It will include the following parts:

1. An interactive storybook that display on desktop, it includes all the interface design and 3 main games to test if the children are color blindness.

2. An reading sample on iPad. Children can click and read it, but it has limitation of some interactive effects, such as the games or moving items.
Methodological Design

Approach
1. Study and analyze the visual storytelling and illustration for children.
2. Research information about color blindness and how it can be used to develop a story for an interactive app. Compare similar or related apps on the market.
3. Brainstorm visual design principles and the design process that focuses on visual illustration, character design, storytelling and typography. Also apply interface design and interactivity cues.
4. Evaluate the prototype and obtain user feedback.
5. Collect feedback and data from user testing and then make modifications to improve the app.
6. Evaluate final recommendations and critiques, based on my research findings, for visual and logic of the interactivity of the app.

Implications
My thesis will bring the following benefits:
1. To attract children to read and learn through a unique visual style and raise awareness of color blindness with empathy.
2. Combining interactive technology with the traditional graphic design can provide a more interesting method for children to learn.
3. Incorporating tests into the story in the form of games to assist with testing for color blindness.
4. For the color blindness children, the app will offers tips and helpful advices to them. It also provides a method to help teachers and parents learn their children.

Target Audience
The specific target audience for my thesis will be elementary children who lack the knowledge of color blindness and are interested in reading and playing interactive application on the iPad.

The specific target audience for the questionnaires and surveys will be both color – blind and normal – vision children. The users surveyed will be 7–12 years of age.

<table>
<thead>
<tr>
<th>Software</th>
<th>Adobe Creative Suite:</th>
<th>Programming:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Illustrator</td>
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<td>CSS</td>
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<td></td>
<td>Photoshop</td>
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</table>
Design Ideation

My Design Style

Illustration

LEARN ABOUT

GALILEO GALILEI (1564 – 1642) ITALIAN

Galileo, was an Italian physicist, mathematician, astronomer, and philosopher who played a major role in the scientific revolution.
## Design Ideation

<table>
<thead>
<tr>
<th>My Design Style</th>
<th>Interactive Design</th>
</tr>
</thead>
</table>

### Hot Pot

**Ingredients:**
- Fish
- Crab
- Seafood
- Vegetables
- Misosauce

**Cooking Steps:**
1. **Cooking Step 1:** Prepare a bowl of water and add fish and seafood. Boil for 10 minutes or until cooked.
2. **Cooking Step 2:** Add a mixture of crab, seafood, and vegetables. Stir for 5 minutes or until cooked.
3. **Cooking Step 3:** Add misosauce and stir well. Simmer for 2 minutes or until the sauce thickens.

### REUNION DINNER

**Ingredients:**
- Spring rolls
- Noodles
- Steamed fish
- Boiled vegetables

**Cooking Steps:**
1. **Cooking Step 1:** Prepare the spring rolls by wrapping the ingredients inside the wrapper and deep-frying for 5 minutes or until golden.
2. **Cooking Step 2:** Boil the noodles in hot water for 5 minutes or until tender.
3. **Cooking Step 3:** Steamed fish should be cooked for 10 minutes or until fully cooked.

---

See a Different World
Design Ideation

1. Conceptual solutions of preliminary ideas related to my children’s interactive app designed to make them aware about color blindness.

2. Brainstorming of interactive app

3. Organizing design, subject and technology aspects and elements of thesis ideas

Information Flowchart

1. Digital application – interactive storytelling app (20 pages)
2. Interactive, colorful, unique illustration, color blindness test for children
3. Appropriate look and feel for the subject matter of color blindness
Design Ideation

PLOT: A boy notices that he seems different than other kids because he see the world in different colors. He decides to travel to find someone similar to him who can help him understand about his color blindness.

Start

Part 1
- "Red-Green" planet
  - Outlook
  - Info
  - Test
  - Feedback

Part 2
- "Yellow-Blue" planet
  - Outlook
  - Info
  - Test
  - Feedback

Part 3
- "Black-White" planet
  - Outlook
  - Info
  - Test
  - Feedback

End
- Go back home
  - Summarize
Design Ideation

<table>
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<tr>
<td>Test in the</td>
<td></td>
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<tr>
<td>App</td>
<td></td>
</tr>
</tbody>
</table>

1. The color dots game
   There will be five treasures hide in the sky. Player should find all of them in 30 seconds.

2. The puzzles
   The player should follow the example in the left side to make the same building in 60 seconds.

3. The match games
   The player should find the correct shapes to match a heart.

Play Test

- **Pass**
  Thank you for visiting our planet. This is not the planet you are looking for, but stop by at anytime. (Feedback)

- **No Pass**
  Welcome! You have found the planet you are looking for. Please feel free to go and visit the other planets in the galaxy. (Feedback)

- **Find the stars.**

- **If you find correct.**

- **If wrong.**
Design Ideation

Storyboard

1. Home Page
2. A boy sees the world in different color.
3. He feels lonely, no one knows him.
4. He leaves home to find if someone similar with him.

5. Finally, he finds an abandoned spaceship.
6. He operates it and flies to a planet "Red-Green".
7. He lands on the planet and finds a boy.
8. He talks to the boy. (Information)

9. Game 1 (Dot color blind test), then get feedback.
10. He leaves the planet with a gift.
11. He finds a lake and notices a boy on a boat.
12. The boy brings him to his planet "Yellow-Blue" (Information).

13. Game 2 (Puzzle color blind test), then get feedback.
14. He leaves with a second gift.
15. He was accidentally swallowed into the water.
16. He falls into another planet "Black-White" (Information).

17. He meets the king of the planet Game 3 (Match color blind test), then get feedback.
18. The king sends him to his home and gives him a gift.
19. His parents and friends greet him. He farewells the king.
20. He becomes brave and loves to share with his friends and family.
Implementation Strategies

I plan to implement my research and analysis into an interactive storybook application for children for my thesis project. This thesis requires a background knowledge and data analysis of the field of color blindness. Based on the research that I have done, my research on the subject will continue throughout my thesis process. The breadth and scope of my thesis is to achieve an published application in Apple Store. I will use Adobe Illustrator, InDesign, Photoshop, Flash, JavaScript, and an Apple iMac to help build my thesis.
Dissemination

I plan on distributing my findings for future audience interaction by posting it on my thesis blog, http://danyuthesis2014.weebly.com. I will also leave printed copies with RIT Archives and the Graduate Graphic Design Program as well as submit electronic copies to the RIT Archives, Digital Media Library, and ProQuest/UMI. Lastly, I will submit my final thesis and research findings to design and communication journals that may have interest in my subject area as well as interactive application design competitions.

The following are publications and organizations I may potentially contact or inform of my thesis research and published printed book.

**Magazine**
Communication Arts
HOW
I.D.
Print

**Organization**
AIGA
Adobe

**Competitions**
AIGA Awards
ADAA
Red Dot Award
IF DESIGN AWARD

**Color Blindness**
Prevent Blindness
Colour Blind Awareness
**Evaluation Plan**

<table>
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<th>Type</th>
<th>The evaluation process and feedback is important for my thesis. There are two main methods that I will employ for my testing: face-to-face observation of user-interaction and online surveys. I will meet the elementary children to observe how they use the application and if my product clearly convey the message that they can easily understand. My analysis of the feedback be both qualitative and quantitative. After analyzing the feedback, I will modify and improve my application by polishing it.</th>
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| How  | Face-to-Face Observation of User-interaction  
|      | Online Surveys  
|      | Questionnaires |
# Pragmatic Considerations

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Numbers are an estimation of what I can expect to spend throughout my project. All expenses are subject to change.
Bibliography


Part1: Story Script

Page1
Max is a little boy. He feels confused because he sees the world differently than other children.

Page2
Max is always alone. He feels lonely because he thinks no one understands him.

Page3
He suddenly has an idea: “Maybe somewhere there are others just like me! I must find out!”

Page4
After packing his bag, Max opens the door. “Here I am! I cannot wait to find you!” He says while standing in front of the house.

Page5
Then he leaves his home and begins his journey.

Page6
After a few hours walking, Max stumbles upon a deep hole with something hidden inside.

Page7
Max climbs down the stairs and finally reaches the bottom of the hole. There he discovers an abandoned starship.

Page8
Max opens the door of the starship and enters. He notices that there is a big red button on the control station. The radar screen shows two planets nearby. He thinks there is a great chance to find someone likes him.
He presses the big button and the starship blasts off!

As he flies higher and higher, Max is getting more curious and excited about this journey. He looks back and watches his planet becomes smaller and smaller until it becomes to a tiny point of light.

Through the window, everything appears fresh and new to Max. The vastness of universe full of mystery.

After a while, a glowing planet gradually appears in the distance.

“It looks amazing!” Max thinks, “I have to get close to see if there are any residents.”

After few minutes flying, the starship lands on this planet. Max opens the window, sticks his head, and finally sees a resident.

“Hi,” Max says, “I am Max. Nice to meet you!”

“What is your name?” Max anxiously asks, “Do you live here?”

The resident invites Max into his house.

“Hi, I am Green, we are called Deuteranopia. There is another ethnicity named Pretanopia.”

“Nice to meet you Green! I am looking for someone that sees the world differently, just like me! Are you facing the same issue?”

“Actually, both of two ethnicities – Deuteranopia & Pretanopia, see the world in different colors. You can turn on the switch to see how we look at the view.”
Page14

Top:

You can: “Play a Game to see if YOU are a Resident” Or “Learn more info about Deuteranopia & Pretanopia”

Conversation:

“I see. Your ethnicities really see the world in different colors. Can you tell me more? I am interested in learning about your differences!”

“Awesome! Do you want to play a little game to see if you are one of us, or learn our background? Just click a button above.”

Page15

“Hmm... Max, I think you do not belong to our planet.” Green says, “But I still wish that you can find someone who faces the similar situation.”

“Here is a small gift for you, I hope that you can remember me and my planet when you see this necklace.”

Page16

Max says goodbye to Green’s planet, as he boards the starship and flies to the next planet.

Page17

After a short flight, another beautiful planet appears to Max.

“Maybe this time, I will find the answer!” Max believes.

Page18

Max lands on the planet and exits the starship. He looks around to see if someone is there.

He notices someone is hidden behind the bushes, so he moves closer to check it out.
After getting closer, Max finds a resident. This resident also notices him.

“Hi, I am Blue, we are called Tritanopia. We have another relevant ethnicity that named Tritanomaly.”

“Nice to meet you Blue! My name is Max, and I came from earth. Now I am looking for someone that see the world differently, just like me! Are your ethnicities facing the same issue?”

“Actually, both of our two ethnicities – Tritanopia & Tritanomaly, see the world in different colors. You can turn on the switch to see how we look at the view.”

Top:

“Play a Game to see if you are a Resident” Or “Learn more info about Tritanopia”

“I see. Your ethnicities really see the world in different colors. Can you tell me more? I am interested in learning about your differences! ”

“Awesome! Do you want to play a little game to see if you are one of us, or learn our background? Just click a button above.”

Bye, Max. I’m so sorry that you do not belong to our planet.” Blue says, “But I wish you find it someday.”

“Here is a souvenir for you, which represents our friendship. Bon voyage, Max, hopefully, we will meet again.”

After leaving Blue, the starship is accidently sucked into a black hole.

“What happened?” Max is so afraid, “What do I do now?”

“Oooh!” “What happened?”

Max suddenly opened his eyes, “Am I still alive?”
Max wakes up on his bed.

“The necklace!” Max is excited, “This is not a dream, I knew it! Those planets are real and my journey really happened!”

“I still clearly remember their faces and how they encourage me. They helped me realize that everyone is different and we should not be afraid of those differences.”

Max sees the world in a new viewpoint. He truly believes that there are other people similar to him while everyone has their own uniqueness.

He starts to open his heart and begins to make a lot of new friends. He thinks each of his friends has their differences, which they accept and respect. Max is happier than ever before!

The End

Part2: Game Script

Game1:

“How many objects can you see?” – A.0; B.3; C.5

Game1: Feedback1

Thank you for visiting our planet! This is not the planet you are looking for, but please feel free to stop by anytime.

Select Buttons: “Continue Reading” or “Learn More”

Game1: Feedback2

You have found the planet you are looking for. Please feel free to visit the other planet in the galaxy.

Select Buttons: “Continue Reading” or “Learn More”
**Game1: Information1**

What is Deuteranopia?

We see color to specialized cells in our eyes called cones. Humans have 3 of cones that absorb red, blue and green light respectively.

Normal Color Vision: See Full-Color Spectrum

Deuteranopia Color Vision: Green-blind, M-cones missing.

**Game1: Information2**

What is Protanopia?

We see color to specialized cells in our eyes called cones. Humans have 3 of cones that absorb red, blue and green light respectively.

Normal Color Vision: See Full Color Spectrum

Deuteranopia Color Vision: Red-blind, L-cones missing.

**Game2:**

“Choose the image that best matches the one below:” – No.1; No.3.

**Game2: Feedback1**

Thank you for visiting our planet! This is not the planet you are looking for, but please feel free to stop by anytime.

Select Buttons: “Continue Reading” or “Learn More”

**Game2: Feedback2**

You have found the planet you are looking for. Please feel free to visit the other planet in the galaxy.

Select Buttons: “Continue Reading” or “Learn More”

**Game2: Information**

What is Tritanopia?

We see color to specialized cells in our eyes called cones. Humans have 3 of cones that absorb red, blue and green light respectively.

Normal Color Vision: See Full-Color Spectrum

Tritanopia Color Vision: Blue-blind, S-cones missing.
Part3: Help and Info Script

What is this?

“See a Different World” is an interactive story that displays an adventure of a color-blind child named Max.”

You can click “Left & RIGHT” button to read. You can play the game directly or play it during the game.

Character Guide

Character Guide: Max

Name: Max; Birth: 2009.2.29; Age: 6 years old; Planet: Earth;
Hobby: Reading

“I don’t like being alone. I wish I could find someone who sees the world like me.”

Character Guide: Green

Age: Unknown; Ethnic Group: Deuteranopia /Deuteranomaly;
Planet: Red-Green Planet

“Our ethnic group sees the world differently than others. Some of us see less of red colors while others see less of green colors.”

Character Guide: Blue

Age: Unknown; Ethnic Group: Tritanopia /Tritanomaly;
Planet: Blue-Yellow Planet

“Our ethnic group sees the world differently than others. Some of us see less of blue and yellow colors while others see less of green colors.”

Character Guide: Starship

Age: Unknown; Planet: Not sure, but found on earth;
Function: Fly to different planets

“I am an abandoned starship. Max found me, so I flew him to two different planets.”
Character Guide: Forest

Age: Unknown; Planet: Earth; Animals: Many (deer, rabbit, etc.)

What is Color Blindness: Information1

What is Color Blindness?

We see color through special cells in our eyes called cones. Humans have 3 cones that absorb red, blue and green light respectively. With normal vision, humans see the full visual spectrum. But Color Blindness is difficulty in distinguishing colors resulting in making errors when identifying colors.

What is Color Blindness: Information2

What cause Color Blindness?

Color blindness is a usually a genetic (hereditary) condition (you are born with it). Red/green and blue color blindness is usually passed down from your parents. There are still other causes of color blindness. Causes: Genes, Diabetes, Medication & Drugs, Eye Injuries, Pressure to Optic Nerve, Cataracts.

What is Color Blindness: Information3

What cause Color Blindness?

Dichromacy: Only two different cone types, the third one is missing completely.

Protanopia Vision: Red-blind, L-cones missing.
Deuteranopia Vision: Green-blind, M-cones missing.
Tritanopia Vision: Blue-blind, S-cones missing.

What is Color Blindness: Information4

What cause Color Blindness?

Anomalous Trichromacy: All three types but with shifted peaks of sensitivity for one of them.

Deuteranomaly Vision: Green-weakness, M-cones defective.
Tritanomaly Vision: Blue-weakness, S-cones defective.
### See A Different World Survey

**Children Interview Form**

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<tr>
<th>Basic Info</th>
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<tr>
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<tr>
<td>Do you like the graphics in the storybook?</td>
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</tr>
<tr>
<td>Is it an interesting story that you want to read it again?</td>
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<td>- If not, which part you don't like?</td>
<td></td>
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<tr>
<td>Do you learn something about color blindness?</td>
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<tr>
<td>- If not, which part you are hard to understand?</td>
<td></td>
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**Notes**

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## Appendices 4

### Thesis Show – User Survey with Results

### See A Different World Survey

**Part 1**

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<tr>
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### Part 2 - Design

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<td>3</td>
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<td>5</td>
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</tbody>
</table>

### Part 3 - Comments / Suggested Improvements

**Likes:**
- The visual style looks awesome, and the color/character is beautiful.

**Potential Problems:**
- A bit hard to figure where to go.
- Some improvements are needed to make it more engaging.

---

### See A Different World Survey

**Part 1**

<table>
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<th>Age</th>
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<th>10-12</th>
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<td>Ineffective</td>
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</table>

### Part 3 - Comments / Suggested Improvements

**Likes:**
- I like the game, it is very interesting.

**Potential Problems:**
- The game could use more challenges.
- The story could be more engaging.
### See A Different World Survey

**Part 1: Basic Info**

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- **Visual Style**: Effective 1 2 3 4 5 Ineffective
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- **Feedback of games**: Effective 1 2 3 4 5 Ineffective

**Part 3: Comments / Suggested Improvements**

**Likes:**
- Made me feel... 1 2 3 4 5
- Easy to understand

**Potential Problems:**
- Some issues we may see
- Icons could use more color

---

### See A Different World Survey

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<tr>
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**Potential Problems:**

- Difficulties with colors
- Hard to learn
- Unclear instructions

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- Need more instructions.
- Could not verify the comments.

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Thesis Show –
User Survey with Results

See A Different World Survey
(Please circle your answers)

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Part 3
Comments / Suggested Improvements
Likes: Amazing illustrations! So emotional!
Potential Problems: I could not remember the technical point from the story, but the overall mood is good.

See A Different World Survey

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Part 3
Comments / Suggested Improvements
Likes: Stylish colors
Potential Problems: I could not remember the technical point from the story, but the overall mood is good.
Bibliography


