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ALPHABOT: Using Interaction Design to Help Children with Reading Disabilities through a Multi-sensory Approach

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ALPHABOT
Using Interaction Design to Help Children with Reading Disabilities through a Multi-sensory Approach

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A Thesis Submitted in partial fulfillment of the Requirements for the Degree of:
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School of Design
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ABSTRACT

A reading disability is one form of learning difficulty, caused by neurological factors. Young children with reading disabilities are recognized as having trouble with spelling, reading, writing, and other academic activities. Even though there is no cure for reading disabilities so far, there are many things we can do to help these children. For young children, the best way to help them learn is taking advantage of all their senses.

Multimedia has been widely used in education today. Designers use various formats of digital multimedia to enhance user’s experience in learning. It provides an excellent opportunity to help children with reading disabilities. The mission of this project is using motion graphics and interaction design to stimulate their motivation to learn how to read. The final format of the project is an interactive game on the web. It helps children to learn about letters, phonics, words and how they can be combined into meaningful text.

It could be attractive for children by calling on their different senses as they watch and hear. Interaction design may help children with reading disabilities to remember the information by encouraging them to participate in the learning process actively. Motion graphics is a good way to visualize some complex and abstract text. Overall, the project is focusing on creating a tool that may be helpful, as well as enjoyable, for children with reading disabilities.

Keywords: reading disability, game design, design for children, interaction design.
INTRODUCTION

Situation Analysis

Reading is one of the essential components of learning. It is important for being a way of discovering new knowledge and understanding the world. About 85% of children diagnosed with learning difficulties have a primary problem with reading and related language skills.\(^1\) Consequently, performance in most of the subjects in school can be affected by reading ability. The process of reading could be divided into three phases: decoding, comprehension, and retention. The brain helps to convert the letters and words we see into abstract representations of sounds and translates those representations into the language. Then, another part of the brain converts the collection of words in any given sentence into meaningful ideas.\(^2\) The fluent reading is involving automatic or effortless processing in the balanced brain. Unfortunately, for many young children, learning to read is one of the most difficult things they have ever met. According to the Dyslexia Research Institute, ten to fifteen percent of the US population has dyslexia, yet only five out of every one hundred dyslexics are recognized and receive assistance.\(^3\) On the other hand, there are many areas in the world where children simply do not have access to attentive, qualified teachers. Without proper guidance, the barriers to stop children learning is difficult to get over.

Designers are paying attention to people with reading disabilities and are making efforts to help. There are typefaces designed for dyslexic people. Some reading tools provide the function of voice reading to make the reading process easier. Some games are designed for children to practice spelling and reading. Most of these measurements are trying to solve problems outwardly but not capturing the core essentially. For helping children with reading disability, it is certainly worth understanding cognitive neurosciences and psychology on how the brain learns reading. It has been proved that the best way for children to learn is motivated by their interests and desire to figure things out. Using multi-sensor techniques is a good way to help children with reading disability. They need to see, hear and touch. In this way, they could understand better and make associations among what they have seen, heard and felt.

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1  “Misunderstood minds”, 2012
This thesis project is a prototype of an interactive game that involves multi-senses. The game will help children with reading disabilities in spelling, reading, and learning. There are two main design components in the project. Motion graphics is playing an important role in visualizing information using multi-senses. The goal is to help young children to learn the shapes of letters and grow into words and meaningful text by stressing the relationships. Phonics sounding is also associate with the meaning and shape of the word. Interactive games engage children in playing while they are watching and listening.

It has potential to become a useful tool to make learning easier and more interesting for children with reading disability. Relevant research is necessary to direct the design process. For further research, the most difficult part is how to find the target users and the way of doing the primary research and user evaluation. The aim of the research is to answer the following question:

1. What are the most difficult things for children with reading disability at early elementary school age? How do their brains work?

2. What is the proper visual style for young children? And the tone of voice?

3. What kind of game could help children learning as well as having fun?

4. How to involves multi-senses to work together without exerting pressures on the brain?
SURVEY OF LITERATURE

Reading Disability

IDA Dyslexia Handbook: What Every Family Should Know
International Dyslexia Association

This is a handbook provided very detailed information about Dyslexia and the education of students with Dyslexia. Common characteristics of dyslexia are listed in the book, for example, difficulty identifying or generating rhyming words, or counting syllables in words (phonological awareness), difficulty with hearing and manipulating sounds in words (phonemic awareness), difficulty distinguishing different sounds in words (phonological processing), difficulty in learning the sounds of letters (phonics), difficulty remembering names and shapes of letters, or naming letters rapidly, transposing the order of letters when reading or spelling. Other than the reading difficulties, there are common symptoms that occur with dyslexia, such as difficulty naming objects rapidly in a sequence and week memory for lists, directions, or facts. Another important chapter of this book is The Principles of Instruction - How It Is Taught. The Structured Literacy is introduced with a detailed instruction about what to teach and how to teach. The handbook provides guidelines for helping children with dyslexia and designing this thesis project.

Understanding Dyslexia: A Practical Approach for Parents and Teachers

This book provides a common-sense approach to defining and learning about dyslexia. There are two main parts of the content. In the first part, the author explained different types of dyslexia, made it clear that the etiological factors and clinical manifestation of visual dyslexia and auditory dyslexia. That could be the theoretical fundamental of my thesis project. From the backgrounds the thesis candidate could know about what practical problems do they have during the learning process.

In the second part of the book, the author provided suggestions for parents and teachers to help dyslexic children learn in an easy-to-understand way. It is helpful for this thesis project since it suggested useful methods and things to avoid that the thesis candidate can refer to in design.
Home Literacy Exposure and Early Language and Literacy Skills in Children Who Struggle With Behavior and Attention Problems


The author of this article has a struggling reader son. She shared her experience of helping her son as a case study to tell methods of assisting young children who are making slow progress in reading. She also provided an analysis and critique on five different reading method. This article is helpful because it tells the core problem of reading disability. Also, it gives me an idea about how to help young struggling readers.

Orthographic Processing Efficiency in Developmental Dyslexia: An Investigation of Age and Treatment Factors at the Sublexical Level


This article is discussing orthography in helping dyslexic children reading efficiency. The orthographic of a written language includes the probability of where certain letters appear within words, which letter sequences are permissible, and information about the pronounceability of words.

What Time May Tell: Towards a New Conceptualization of Developmental Dyslexia


This article to described a new conceptualization of reading disabilities, the double-deficit hypothesis, that depicts and integrates work on two core deficits in the phonological system and processes underlying naming speed. There are three sections in this article. The first one is about the cognitive puzzle concerning the nature of the processes underlying naming speed. The second part focused on the double-deficit hypothesis. The third section is about an innovative reading intervention program called “RAVE-O”.

Dyslexia

The work shown is an educational motion graphics piece focused on the disability Dyslexia. The video informs the viewer of what Dyslexia is, the symptoms and other relevant information using text, imagery and sound. The video is targeted at parents, teachers and guardians specifically in the UK and offers advice on dyslexia amongst children aged 7-11.

Educational Game Design
Learning By Design: Good Video Games As Learning Machines

This article argued the relationship between good video game and good learning. The author held the opinion that good game is a good method for young people to learn something long, hard, and complex, and yet still enjoy it. There are some good learning principles incorporated in the video game, such as identity, interaction, production, risk taking, customization, system thinking and so on.

Nessy.com | Dyslexia Quest

Dyslexia Quest is a game designed for children with dyslexia. It has six small games, each test a different learning ability. There are three different paths up the mountain encourage users to replay games and improve skills. After playing the game, there are suggestions provided to users about how to make better use of learning strengths. The game also explains what difficulties the player will experience where he/she have a weakness.

Design for Children
Just Kidding!: A to Z Designs for Kids & Kidults

This book provides some ideas about how to design for children. It is a collection of two hundred and thirty-one pieces of good design for children, sorted by alphabet. The collection included product design, graphic design and environmental design
from all over the world. This book will inspire the thesis candidate by the visual style, colors patterns, name, the way of interaction between products and children, and also the psychology matters in the design.

**Designing for Children: Marketing Design That Speaks to Kids**  

Marketing to kids is the main theme of this book. There are more than twenty case studies of successful product for children in the book. The products are sorted by different age. That will help the thesis candidate to recognize how the design clues changed according to the age cues. The author, Catherine Fishel, did a wide range of research about how to create designs that truly speak to the interests of kids. For analyzing the users, she started from physical skill to intellectual and cognitive development. In this way, it is getting clear that how the marketing strategies work. This book will be helpful for this thesis project not only because of the professional perspective of design but also because of the expert perspective of doing research on children.

**Growing Graphics: Design for Kids.**  

In this book, target users were divided into five groups according to the age, as the 0-1 year, 1-3 years, 3-6 years, 6-9 years, and 9-12 years. There are design cases in each of the groups. The authors mainly focused on the graphic visual style of the design. It is not difficult to see how the visual style changes according to the user’s age growing. This book will give the thesis candidate inspiration from the color tone, typefaces, and visual style.

**Adaptive Learning**  
**A Study of Adaptive Learning for Educational Game Design**  
*Edward D Lavieri Jr.*, Colorado Technical University, March 2014

In this dissertation, the author introduced the ALGAE(Adaptive Learning GAme dEsign) model, which has been developed and validated as a comprehensive adaptive learning model based on game design theories and practices, instructional strategies, and adaptive model. Right now, the biggest challenge of designing educational games
is the determining of instructional strategies. ALGAE model should facilitate the
design and development of educational games that provide adaptive instruction to
learners based on their real-time, in-game actions.

The ALGAE model will be considered as one direction of future development of this
thesis project.

The Global Literacy Collaborative: A New Approach to World Literacy
Cynthia Breazeal, Maryanne Wolf, Robin Morris, Tinsley Galyean

This is an introduction to The Global Literacy Project. The goal of this project is to
“Bring Literacy to 100 million by the end of the decade” and to have an impact in
the next two decades sufficient to remove 10% of the world’s poverty. What people
do in this project is evolving technology, such as ever more inexpensive tablets and
pervasive networks, as the tools to collect large amounts of usage data. New forms of
data analysis help to understand how best to create engaging experiences that can live
within both physical and virtual social environments and that can foster child driven
learning on a global scale.

Our ‘Deep Reading’ Brain: Its Digital Evolution Poses Questions

The author of this article, Maryanne Wolf, argued that if we will lose the deep
reading ability in the digital age. This question is incorporated with historical and
neuroscience facts. She found that whenever we learn something new, the brain forms
a new circuit that connects some of the brain’s original structures. The brain builds
connections between and among the visual, language and conceptual areas that are
part of our genetic heritage, but that were never woven together in this way before.
However, there is a concern that the digital information that requires and receives
less and less intellectual effort, we need to find the ability to pause and pull back from
what seems to be developing into an incessant need to fill every millisecond with new
information.
DESIGN PROCESS

Approach
ALPHABOT is an interactive game incorporated with motion graphics to help children with reading disabilities learn how to read. Based on the limitation of the techniques, the final design product is a web-based interactive prototype of the game. All the visual assets are designed in Adobe Photoshop and Adobe Illustrator, the prototype is created in Adobe Animate, using JavaScript in HTML5 canvas.

- Do research on children with reading disability and study about their special needs regarding reading and learning
- Design the storyline, character, rules and interfaces of the game
- Develop an interactive prototype
- Conduct user evaluation
- Gather feedbacks and revise

Target Audience
- Children with reading disabilities
- Age: 6 to 8
- Education: Elementary school, first and second grade
- Language: English
Mindmap

The key point of the game concept is the subject matter. As introduced in IDA Dyslexia Handbook, people with dyslexia and other reading disabilities may have trouble in oral language, reading, written language, and other difficulties such as naming objects rapidly and weak memory. As this game is designed for young children, after careful consideration the following subject matters were chosen as the most challenging and important topics: alphabet order, letter shapes, uppercase & lowercase letters and phonics. There are four levels in total and each level of the game focused on one of the topics.

There is a story talking about a robot’s journey after his spaceship crashed on a planet. The mission of the game is to help the robot to rebuild his spaceship by finishing all four levels of the game. There are short animations with voiceover to connect the four levels to be a complete story. The effectiveness of the educational game highly relies on the story and the gamification. In this phase of the project, the most challenging part is how to design the proper game for each level to pass on the information behind it.
In the initial stage of this project, the thesis candidate started with addressing the four subject matters chosen in the previous step (SUBJECT MATTER in Fig. 2). For each subject matter, there would be more certain and detailed information to pass on to the users through the games. After doing more research on the common characteristics of target users, the information had been scaled down to be more focus on the following scope (INFORMATION in Fig. 2):

1. For the game about alphabet order, the initial information will be a partial or complete alphabet.
2. According to the research result, there are some most easily confused letters for children with reading disabilities, such as b/p/d/q, m/w, n/u and so on, in both uppercase and lowercase. So, these letters are selected as the key information in the letter and word matching game.
3. In the phonic game level, vowel sounds, R-controlled vowels, and consonant sounds are considered as the major information.
4. The Dolch Word List provides the most difficult list of words for Dyslexics. For the letter shape game, the letters and words will be chosen from the list.

Then the story was divided into six phases, including the beginning and the ending. The four subject matters are connected to the four levels with different types of game.

**Figure 2 Information Flowchart**
**Story & Wireframes**

After figured out the information flowchart, the different aspects of each level need to be explored deeper and considered as a cohesive whole. While creating the wireframes, it is necessary to think about the game scenes and storyline at the same time since every part of the game need to be connected logically. This is a game design project, so the wireframes are not as complicate as App design. The main propose of wireframes is to make early plans for the game structure. The wireframes, stories, and narratives will be introduced together in this section.

![Figure 3 Wireframe - Instruction page](image)

**The beginning**

The robot is traveling the universe, and suddenly his spaceship breaks down. The spaceship crashes on a planet, and the robot is trapped.

Narrative: *where am I? Can you help me out?*

User clicks on the robot to enter the first level. Before each level begins, there is an instruction page to tell the rules.

**Level 1**

This is a drag and drop game. In the game scene, there is a blueprint (targets in Fig. 4) shows the outline of the robot. The body parts of the robot (objects in Fig. 4) are on an assembly line. User needs to drag and drop the robot body parts in alphabetical order to re-assembly it. After finish assembling the robot, he will jump out of the capsule. The game goes to level 2.
Level 2

Narrative: [*There is something under the water, can you help me to get it? *]

This is a memory and match game. The view is from the top. There are sixteen ice cubes (objects in Fig. 5) floating on top of the water. On the back of each ice cube, there is a random selection of a letter or a word from 8 pairs. The eight pairs are: M, W, N, U, P, Q, D, B and eight words started with each of these letters in lowercase. For example, “D” and “dolphin” is a pair.

User click on one ice cube, the ice cube flipped to show a letter or a word. When a pair of letter and word shows at same time, the two ice cubes will disappear. The mission of this level is to clear up all the ice cubes. It helps user to remember uppercase and lowercase letters.

After clear up all the ice cubes, user will get a key from under the water.

Narrative: [*You found a key under the water! *]

The level 3 scene shows. User could user the key to enter the house.

Narrative: [*There is an old house, how can I get into it? *]
**Level 3**
This level is about picking up the right answer. The words with missing letters will show in question area in Fig. 6. When a word shows, it’s pronunciation will play at same time. User needs to find out the right answer between the three options according to the phonics.

Narrative: *[Full of energy! Let's go to build a new spaceship!]*

**Level 4**
This level is about letter shape and word spell. Two main parts in the game scene. On the left, user needs to pick up letters in the options area and put them into the target area according to the letter shapes. Every time user puts all the letters in the right position, one part of the spaceship will be produced. On the right, the animation will show the process of building up the spaceship in real-time.

**The ending**
After building up the new spaceship, the robot is ready to go back home.

Narrative: *[Thank you for your help! I'm ready to go back home, see you!]*
Character Design

For this children’s game, the character design is one significant part of visual design. While the story was created, the thesis candidate decided a robot to be the only character in the game. Two key challenges while designing the character:

1. Visually, the character must be appealing and kindly to the target users. The first impression is an important factor for the users to decide whether they will like the game or not.
2. Functionally, the robot will guide users through the game. It needs to have several movements and postures in different scenarios.

After the discussion with thesis committee members, the thesis candidate made a few times of revise before the final character created (Fig 11). Also, short animations were created to show the robot’s movements, the storyboards are shown in Fig 12-14.
Figure 12 Jump

Figure 13 Walk

Figure 14 Confused
Background Scene

The background scene design is a major part of this project because it contains most of the visual elements. Some key points need to be considered while designing the background scenes:

1. The game is designed for children from six to eight, so the visual style was carefully selected to be cartoonish, flat and geometric.
2. Overall, colors should be bright, delicate but not disturbing. Blue was considered to be the primary color in the background scenes.
3. The robot should fit well in the background scenes.
4. The background need to be easily distinguished from the UI elements, such as buttons and other visual feedbacks.
5. For the beginning scene, ending scene and the transition scenes, the thesis candidate need to think about how the motion graphics work.

To break down the huge design challenge, the first step is to draw up the visual elements in the story. The background scenes include game scenes for the four game levels, the beginning and ending scenes and transition scenes between each level. According to the information flowchart (Fig 2), the beginning scene will show the universe, stars, and the spaceship. There will be a short animation about the spaceship traveling and then crashes. For level 1 and level 3, engineering elements need to be added to the game scenes and other scenes are more about nature - land, water, mountain, and sky.

Figure 15 Beginning Scene_1

Figure 16 Beginning Scene_2
Figure 17 Beginning Scene_3
Figure 18 Spaceship Interior
Figure 19 Water Scene
Figure 20 Night Scene
Figure 21 Charging Station
Figure 22 Ending Scene
Instruction Animation

There are instruction pages with looping short animations (3s-5s) for each level.

**Figure 23 Level 1 Instruction Page**

**Figure 24 Level 2 Instruction Page**

**Figure 25 Level 3 Instruction Page**

**Figure 26 Level 4 Instruction Page**
Game Interface Design

Based on the game background scenes designed in the last section, the game interface design is to integrate the UI elements into the background scenes.

Level 1

As introduced, user picks one object (Fig. 29) each time, and drag it to the targets area (Fig. 28). The objects need to be placed in alphabetical order. If the order and position are both correct, the objects will stay in the target area. If wrong, it will go back to the objects area.
**Level 2**

The 16 ice cubes are active. User clicks on one, it will show a letter or a word on the back. The letter/word pairs are as shown in Fig. 31.

![Figure 30 Level 2 User Interface](image)

![Figure 31 Letters and Words](image)
Level 3

There are three parts in Level 3 interface. The active area (Fig. 33) are clickable. User could click on the words or letters to hear the pronunciation. After selecting one answer, user needs to click on the button (Fig. 34) to see the result. The feedback will be shown in the battery, together with sound effect. If the answer is right, the battery will be changed by 10%.
Level 4

There are two main parts of level 4. On the left side, there is letters and target. User needs to pick up each letter to put them in the right place according to the shapes. The letter shapes are as shown in Fig. 37. On the right side, there are visual feedbacks. The spaceship will be assembled step by step as the components are produced. Fig. 38 shows the spaceship assembly drawing.

Figure 36 Level 4 User Interface

Figure 37 Letter shapes
Figure 38 Spaceship Assembly Drawing
Branding System

Logo

![AlphaBot Logo](image)

Figure 39 Logo

Webpage

![AlphaBot Webpage](image)

Figure 40 Webpage

Color theme

![Color swatches](image)

Typefaces

Two typefaces are used in the game. **Linotte** is used in the titles and other display text since it matches the visual style better. According to a research result from British Dyslexia Association, **Verdana** is one of the best typeface for dyslexic readers as it is bigger than many other typefaces and does well with **I, l, 1.** **Verdana** is used in the game when user needs to read carefully.
Prototype Development

Adobe Animate CC was chosen as the tool to develop the prototype. The document type is HTML5 canvas, and programming language is JavaScript (Fig. 41). It is challenging to create an interactive prototype using Adobe Animate. Both short animations and interactive games need to be developed in one document. The main technical challenges will be listed below while developing the prototype.

![Figure 41 Document Setup](image)

**Game Structure and Artworks Import**

The game follows a general programming structure. The complete prototype is divided into several parts: the beginning, the ending, four levels and the transition between each level. Because numerous visual elements in each part, a clear structure is important to make sure the visual elements are imported correctly.

![Figure 42 Main Structure](image)
Using Parallax Layers to Simulate Depth
Although this is a 2D cartoon style game, sometimes a simulated depth could create a better visual effect. For example, in the beginning animation (Fig. 43), in order to create an illusion of depth, the multiple layers are divided into four groups: foreground, spaceship, middle-ground, background. The stars on different layers need to be scaled or added burr to simulate a camera trucking in. In a certain time period, the foreground layers move the longest distance and the background layers move the least distance.

Adding Randomness to the Game
The most challenging part of the development process is to add randomness to the game. For example, in level 2, each time user enter the game, the arrangement of letters and words should be different. Fortunately, there are tutorials and many other online resources helped in developing all these features.
SUMMARY AND CONCLUSION

Evaluation

Unfortunately, the thesis candidate was not able to have the project tested on the target group - children with reading disabilities from 6-8. So the true evaluation of the thesis ALPHABOT effectiveness is not clear. To achieve better alternative evaluation result, the thesis candidate interviewed parents, teachers, and professionals who know reading disabilities well. They provided useful feedbacks and inspiration during the design process. While working on the Information Flowchart (Fig. 2), the thesis candidate tried different types of games for each level at first. The interviewees provided more information about what games are popular among children and which is more efficient in helping children to remember. Even though the feedbacks did not come from the target users directly, the parents and teachers gave their opinions from the educator's perspective to make it a valuable part of the thesis evaluation.

Usability evaluation is conducted throughout the design process of this game. Peer evaluation started at the stage of ideation. A formal presentation was given to the peers and faculty of Visual Communication Design Program. In the presentation, the process of work was presented in digital format. The feedbacks were carefully considered during the whole process of design.

After the interactive prototype was developed, the project is presented at 2016 Visual Communication Design Winter Thesis Show. An evaluation form was designed for collecting user feedbacks. There are two metrics to measure the performance of game design: clearness of the game instruction, effectiveness of each level. Three metrics to measure the performance of visual design: visual style, sound effect and motion graphics.

17 effective evaluation forms were collected at the thesis show (Fig. 44-45).
Figure 44 Game Design Evaluation Result

Figure 45 Visual Design Evaluation Result
According to the results collected from evaluation forms, both game design and visual design have achieved beyond-average grades. Compare with game design, visual design performed better in usability evaluation. For game design, the grades for effectiveness are quite close between each level while level 2 had a lower grade. For clearness of game instruction, level 3 and level 4 had better performance while level 1 was the weakest.

There are also valuable feedbacks collected at the thesis show. For example:
• For level 4, there’s no button to repeat the pronunciation of each word;
• A little bit confusing about how to find the key in level 2;
• The sound effect is great in level 3;
• In level 4, user may focus more on the letter shapes but ignore the spelling of words;
• Instruction for level 1 is not clear enough, it takes time to find out it's a drag and drop game and need to be in alphabetical order;
• For level 2, if user click on same ice cube twice, the letter will change. That could be a bug at the back end.

After carefully read and analyze all the feedbacks, some bugs in the code are fixed and some design changes are made for better performance.
• Added more clear instruction for level 1, both on instruction page and in game scene;
• Added audio play button in level 4;
• Changed some narratives which might be confusing for users;
• Made some minor improvements on illustration and colors.

Because of the limit of time and other resources, there is still room for improvement. There are some items haven’t been accomplished or developed well:
• More randomness should be added into the game. For example, in level 1 the robot’s body parts are supposed to come out on the assembly line in a random order;
• Enrich the vocabulary words;
• Learn more about the adaptive learning model and try to use it for future development;
• Make the short motion graphic pieces smoother and more attractive;
• Improve the code of the prototype and make it responsive for different screen size.

These points are considered to be future development opportunities.
Conclusions

To sum up, ALPHABOT is a game designed for children with reading disabilities. The aim of this project is to provide a fun way for the children to practice the reading skills. It is not a very rigorous learning material that could be used in a classroom as a textbook because it is still at very early stage and needs to be developed and tested more in the future. For now, this project meets the goal of helping children with reading disabilities through a multi-sensory approach.

After usability testing, users provided positive feedbacks for this project. The visual design of character and background scene are appealing and engaging. The storyline and game design are effective and applicable to young children. There are teachers and parents during the interview said they would like to have their students/kids try this game. Furthermore, they suggested that this game could be developed for all children, not only those with reading disabilities, since the game is attractive and effective.

ALPHABOT provided an excellent experience by engaging visual design, interaction design, and motion graphics. Through the design and development process of this game, the thesis candidate learned a lot about how to do visual design for young children, how to design an engaging game with stories, and how to use Adobe Animate with Javascript to develop an interactive prototype. More important, designing for people with special needs is another meaningful and rewarding experience.
APPENDIX

1 Original Proposal
2 Evaluation Form
3 Code Sample
Original Proposal

BETTER READING

Using Interaction Design to Help Children with Reading Disabilities Learn to Read through a Multisensory Approach

Thesis Proposal for
Master of Fine Art Degree

Rochester Institute of Technology
College of Imaging Arts and Sciences
School of Design
MFA Visual Communication Design

Chao Luo
# THESIS PROPOSAL FOR

## THE MASTERS OF FINE ARTS DEGREE

**Title**

Using Interaction Design to Help Children with Reading Disability Learning through a Multi-sensory Approach

**Submitted by**

Chao Luo

**Date**

October 30, 2014

**Approval**

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<td>Associate Professor, MFA Visual Communication Design</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Shaun Foster</td>
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<tr>
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<tr>
<td>Chao Luo</td>
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ABSTRACT

A reading disability is one form of learning difficulty. It is caused by neurological factors. Young children with reading disabilities are recognized as having trouble with spelling, reading, writing and other academic activities. Even though there is no to cure for reading disabilities so far, there are many things we can do to help these children. For young children, the best way to help them learn is taking advantage of all their senses. That could help them to relate to ideas they learned and retain the information.

Multimedia has been widely used in education today. Designers use various formats of digital multimedia to enhance user’s experience in learning. It provides a good opportunity to help children with reading disabilities.

In my thesis project, I will use motion graphics and interaction design to help children with reading disabilities learn how to read. The final format of the project will be an interactive game for tablet devices. It will help children learn about letters, phonics, words and how they can be combined into meaningful text. Motion graphics is a good way to visualize some confusing and abstract text.

It could be attractive for children by calling on their different senses as they watch and hear. Interaction design may help children with reading disabilities remember the information by encouraging them to actively participate in the learning process. Overall, the project will focus on creating a tool that may be helpful, as well as enjoyable, for children with reading disabilities.

Keywords: reading disability, game design, design for children, interaction design
PROBLEM STATEMENT

Reading is one of the essential components of learning. It is important for being a means of discovering new knowledge and understanding the world. About 85% of children diagnosed with learning difficulties have a primary problem with reading and related language skills. Consequently, performance in most subject in school can be affected by reading ability. The process of reading could be divided into three phases: decoding, comprehension and retention. The brain helps to convert the letters and words we see into abstract representations of sounds and translates those representations into language. Then, another part of the brain converts the collection of words in any given sentence into meaningful ideas. The fluent reading is involving automatic or effortless processing in balanced brain. Unfortunately, for many young children, learning to read is one of the most difficult thing they have ever met. According to the Dyslexia Research Institute, ten to fifteen percent of the US population has dyslexia, yet only five out of every one hundred dyslexics are recognized and receive assistance. On the other hand, there are many areas in the world where children simply do not have access to attentive, qualified teachers. Without proper guidance, the barriers to stop children learning is difficult to get over.

Designers are paying attention to people with reading disabilities and are making efforts to help. There are typefaces designed for dyslexic people to read easily. Some reading tools provide the function of voice reading to make the reading process easier. Some games were designed for children to practice spelling and reading. Most of these measurements are trying to solve problems outwardly but not capturing the core essentially. To help children with reading disability, it is certainly worth understanding cognitive neurosciences and psychology on how the brain learns to read, and designing appropriate methods for them. It has been approved that the best way for children to learn is motivated by their interests and desire to figure things out. Using multi-sensor techniques is a good way to help children with reading disability. They need to see, hear and touch. In this way, they could understand better and make associations among what they have seen, heard and felt.

In my thesis project, I will design a game that involves multi-senses. The game may help children with reading disabilities in spelling, reading and learning. There will be two main design components in my project. Motion graphics will play an important role in visualizing information using multi-senses. The goal is to help young children to learn the shapes of letters and grow into words and meaningful text by stressing

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1 “Misunderstood minds”, 2012
the relationships. Phonics sounding will also be associated with the meaning and shape of the word. Interactive game design will engage children to do while they are watching and listening. In this way, the game will involve different parts of their brain in learning.

It has potential to become a useful tool to make learning easier and more interesting for children with reading disability. Relevant research is necessary to direct the design process. For further research, the most difficult part is how to find the target users and the way of doing the primary research and user evaluation.

My aim is trying to answer the following question:

1. What are the most difficult things for children with reading disability at early elementary school age? How do their brains work?

2. What is the proper visual style for young children? And tone of voice?

3. What kind of game could help children learning as well as having fun?

4. How to involves multi-senses to work together without exerting pressures on the brain?
SURVEY OF LITERATURE

Books

Understanding Dyslexia: A Practical Approach for Parents and Teachers

This book provides a commonsense approach of defining and learning about dyslexia. There are two main parts of the content. In the first part, the author explained different types of dyslexia, made it clear that the etiological factors and clinical manifestation of visual dyslexia and auditory dyslexia. That could be the theoretical fundamental of my thesis project. From the background I could know about what practical problems do they have during the learning process.

In the second part of the book, the author provided suggestions for parents and teachers to help dyslexic children learn in an easy-to-understand way. It is helpful for my thesis project since it suggested useful methods and things to avoid that I can refer to in my design.

Just Kidding!: A to Z Designs for Kids & Kidults

This book provides some ideas about how to design for children. It is a collection of two hundred and thirty-one pieces of good design for children, sorted by alphabet. The collection included product design, graphic design and environmental design from all over the world. This book will inspire me by the visual style, colors patterns, name, the way of interaction between products and children, and also the psychology matters in the design.

Designing for Children: Marketing Design That Speaks to Kids

Marketing to kids is the main theme of this book. There are more than twenty case studies of successful product for children in the book. The products are sorted by different age. That will help me to recognize how the design clues changed according to the age cues. The author, Catherine Fishel, did a wide range of research about how to create designs that truly speak to the interests of kids. For analyzing the users, she started from physical skill to intellectual and cognitive development. In this way, it is getting clear that how the marketing strategies work. This book will be helpful for my thesis project, not only because of the professional perspective of design, but also for the expert perspective of doing research on children.

In this book, target users was divided into 5 groups according to the age, as 0-1 year, 1-3 years, 3-6 years, 6-9 years, and 9-12 years. There are design cases in each of the groups. The authors mainly focused on the graphic visual style of the design. It is not difficult to see how the visual style change according to the user's age growing. This book will give me inspiration about the color tone, typefaces, and visual style that could be used in my project.

Journal/Magazines

Home Literacy Exposure and Early Language and Literacy Skills in Children Who Struggle With Behavior and Attention Problems

The author of this article has a struggling reader son. She shared her experience of helping her son as a case study to tell methods of assisting young children who are making slow progress in reading. She also provided an analysis and critique on five different reading method. This article is helpful because it tells the core problem of reading disability, also it gives me an idea about how to help young struggling readers.

Learning By Design: Good Video Games As Learning Machines

This article argued the relationship between good video game and good learning. The author held the opinion that good game is a good method for young people to learn something long, hard, and complex, and yet still enjoy it. There are some good learning principles incorporated in the video game, such as identity, interaction, production, risk taking, customization, system thinking and so on.

The Global Literacy Collaborative: A New Approach to World Literacy
Cynthia Brozcel, Maryanne Wolf, Robin Morris, Tinsley Galvean

This is an introduction about The Global Literacy project. The goal of this project is to "Bring Literacy to 100 million by the end of the decade" and to have an impact in the next two decades sufficient to remove 10% of the world's poverty. What people do in this project is evolving technology, such as ever more inexpensive tablets and pervasive networks, as the tools to collect large amounts of usage data. New forms of
data analysis help to understand how best to create engaging experiences that can live within both physical and virtual social environments and that can foster child-driven learning on a global scale.

**Our 'Deep Reading' Brain: Its Digital Evolution Poses Questions**
*Wolf, Maryanne. Nieman Reports, June 22, 2010.*

The author of this article, Maryanne Wolf, argued that if we will lose the deep reading ability in digital age. This question is incorporated with historical and neuroscience facts. She found that whenever we learn something new, the brain forms a new circuit that connects some of the brain's original structures. The brain builds connections between and among the visual, language and conceptual areas that are part of our genetic heritage, but that were never woven together in this way before. However, there is a concern that the digital information that requires and receives less and less intellectual effort, we need to find the ability to pause and pull back from what seems to be developing into an incessant need to fill every millisecond with new information.

**Orthographic Processing Efficiency in Developmental Dyslexia: An Investigation of Age and Treatment Factors at the Sublexical Level**

This article is discussing orthography in helping dyslexic children reading efficiency. Orthographic structure of a written language includes the probability of where certain letters appear within words, which letter sequences are permissible, and information about the pronounceability of words.

**What Time May Tell: Towards a New Conceptualization of Developmental Dyslexia**

This article to described a new conceptualization of reading disabilities, the double-deficit hypothesis, that depicts and integrates work on two core deficits in the phonological system and in processes underlying naming speed. There are three sections in this article. The first one is about the cognitive puzzle concerning the nature of the processes underlying naming speed. The second part focused on the double-deficit hypothesis. The third section is about an innovative reading
intervention program called “RAVE-O”

<table>
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<tr>
<th>Online resources</th>
<th>Nessy.com</th>
<th>Dyslexia Quest</th>
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Dyslexia Quest is a game designed for children with dyslexia. It has 6 games, each test a different learning ability. There are three different paths up the mountain encourage users to replay games and improve skills. After playing the game, there are suggests about how to make better use of learning strengths. The game also explains what difficulties you will experience where you have a weakness.

Dyslexia


The work shown is an educational motion graphics piece focused on the disability Dyslexia. The video informs the viewer of what Dyslexia is, the symptoms and other relevant information using text, imagery and sound. The video is targeted at parents, teachers and guardians specifically in the UK and offer advice on dyslexia amongst children aged 7-11.
DESIGN IDEATION

Mind Map

Design Components

**Story**
Story is one of the important components of my design project. During the ideation process, I will create a story that speaks to young children's interests. The story is about a small robot travelling in the universe by a rocket. Suddenly the rocket is broken and he landing on a lonely planet. Users need to finish four levels to collecting enough rewards to help the robot fix the rocket.

**Character**
There is one main character in the game, shown as a robot. The robot collects different materials and tools in each level.

**Visual style**
It will be 2D animation style. Colors and typefaces will be carefully considered.

**Game function**
Game is another necessary component that helps to involve users in the story. In my thesis design project, the game will not be much challenging. It will be four levels deal with different aspects incorporated with reading. Users need to pass all the levels to collect enough rewards, and then finish the story.
Level 1
The aim of level 1 is to help enhance the user's visual sequential memory.
At the beginning of the story, the robot's rocket crashes into the planet and the robot is broken into several pieces. Instructions will be provided to show users how to put the robot back together in a proper sequence. The robot can only be built using that sequence. When the game begins, users will drag and drop the different parts of the robot to assemble it from memory, without looking at the instructions.
Level 2
In level 2, there will be a huge gap on the ground. Letters of the alphabet will create a bridge over the gap, but some letters are not in the right position. Users need to drag the letters and arrange them in the correct alphabetical order to fix the bridge. Then the robot can go to the next level. When dragging a letter, an audio clip will play a voice reading that letter. If the user taps on the bridge, the system voice will read the letters in alphabetical order from the beginning to the end, stopping at the first missing letter. In this level, the user can learn about the connection between shape and pronunciation of the letter. Also, it can help children to remember the letter’s alphabetical order.

Level 3
The third level focuses on teaching phonics and the spelling of words. In this level, the aim is to collect materials that are needed to fix the rocket. The way of getting materials is to match the word to the pronunciation. There will be several similar words as options, for example, “at”, “it”, and “eat.” The user should choose the right one after listening to the voice.

Level 4
The last level is about using handwriting to spell words. In this level, there will be water pipes clogged with dirt. The user needs to help the robot flush out the water pipes by handwriting the words. Pronunciation of the word will be provided as a hint. This level will help users to distinguish some easily confused letters such as “d” and “b”, “u” and “n”. Handwriting can help the user to remember by engaging more senses than watching and listening.
Past Works/
My Visual Style
Sketches
Character Design
IMPLEMENTATION STRATEGIES

In addition to the knowledge and skills of design, this thesis topic requires good understanding of reading disability and children. Research will be thorough out the whole process of design. The project’s scope is to achieve a completely interactive game design that needs to cooperate with different field of study. For the technology aspect, I will use software as list below. Within those tools, Adobe Flash is what I need to develop more.

<table>
<thead>
<tr>
<th>Software</th>
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<tbody>
<tr>
<td>Adobe Creative Suite</td>
</tr>
<tr>
<td>Photoshop</td>
</tr>
<tr>
<td>Illustrator</td>
</tr>
<tr>
<td>Flash</td>
</tr>
<tr>
<td>InDesign</td>
</tr>
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</table>
METHODOLOGICAL DESIGN

Objective

The design is going to be an interactive game. There will be a story as a clue, and the whole game will be divided into four levels. The levels of the game will help children with reading disability in the following aspects:

- Visual sequential memory
- Alphabet order
- Phonics
- Spelling patterns

The final product will be an interactive prototype on iPad, including four levels of the game.

Asset list:
Character, background, visual feedback, storyboard, voiceover, buttons, icons, progress bar, pop-up windows, typefaces, motions, rhythm, transitions, narratives.

Target Audience

My target audience is children with reading disability. They should be English speakers or learners. The range of age is 6 to 8.

Approach

1. Research on reading disability and existing game design as education tool, as well as children's book. I will also look at the graphic design and motion graphics on teaching language or with other concepts.

2. Gathering the information from research. Find design impact and direction from the information. That step will provide me the guideline of next ideation process.

3. Brainstorm for each design component. Create character, storyboard, determine the visual style and start learning the coding for interactive part.

4. Design development. Implement the design process and solve the difficulties.

5. User evaluation and collection of feedback.

6. Final defence and further dissemination.
DISSEMINATION

This thesis document will be printed and displayed in the Dissemination RIT Wallace Library, electronic copies will be submitted to the RIT Archives, Digital Media Library, and ProQuest/UMI.

I will use a blog to record each step in the design process, including the research findings, ideation and final interactive product.

I may potentially contact associations, conferences, competition and magazines to introduce my thesis project:

The International Dyslexia Association
The Dyslexia Foundation
Academic Language Therapy Association
Highlights Magazine
Scholastic News™
InDA Interaction Award
Adobe Design Achievement Awards
EVALUATION PLAN

Field Evaluation
Fieldwork evaluation will be started after most of the design part ends. One or two applicants will be conducted in an interview. The applicants will be with reading disability and at least one of them will be young child. During the interview, they will try to play the game first, and then have a discussion about it. The analysis of the feedback will be qualitative because the fieldwork evaluation will focus on the detailed interaction between users and product. There are some questions will be answered after the interview:

1. Is this game enjoyable? Could it speak to the interests of young kids?

2. As an education tool, is it functional? Have you learned something from it?

3. How do you like the visual style, as characters, typefaces and interfaces? How about narratives?

4. Which part do you think is not functional? Is the game too easy or too hard?

Peer Evaluation
Peer evaluation could be started at the stage of ideation. A formal presentation will be given to the peers and faculty of Visual Communication Design Program. In the presentation, the process of work will be present in digital format. Both students and faculty could provide their comment and suggestion. The feedbacks will be carefully considered during the whole process of design.
# PRAGMATIC CONSIDERATIONS

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BIBLIOGRAPHY


Gee, James Paul “Learning By Design: Good Video Games As Learning Machines” E-Learning: 5.


“Misunderstood minds”, 2012


**Evaluation Form**

**EVALUATION FORM**

Thesis Project  
Chao Luo  
MFA Visual Communication Design

### Game Design

<table>
<thead>
<tr>
<th>Level</th>
<th>Game Instruction</th>
<th>Effectiveness</th>
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### Visual Design

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<td>Sound Effect</td>
<td>Poor</td>
</tr>
<tr>
<td>Motion Graphics</td>
<td>Poor</td>
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Other suggestions:__________________________________________________________

### Program

Any Bug/Error found in the game?  

**How can I repeat the word? If I overheard it, there is no button to repeat it.**

Thank you! Your feedbacks will help me to improve the design.
# EVALUATION FORM

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## Game Design

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<th>Game Instruction</th>
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<th>Level 1</th>
<th>Level 2</th>
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<th>Level 4</th>
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## Visual Design

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<td>2</td>
<td>3</td>
<td>4</td>
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## Other suggestions

- I can play this game whole day.  
- A little bit confusing about how to find the key in Game 2. Rest of the game are very fun and cool.

Any Bug/Error found in the game?  

Thank you! Your feedbacks will help me to improve the design.
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<td>Level 4</td>
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<td>1 2 3 4 5</td>
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I focus only on shape than words → may be just me!

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### Visual Design

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<td>1 2 3 4 5</td>
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<tr>
<td>Motion Graphics</td>
<td>1 2 3 4 5</td>
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**Other suggestions**

- The sound effect is really great!

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### Program

Any Bug/Error found in the game?  
- Some part (level) I have to figure out if it's drag or click...  
- Ice cube part for me is the hardest...

Overall, I met a bit of error click, but apart from that is very enjoyable, fun & surprised!

Thank you! Your feedbacks will help me to improve the design.
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</tr>
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<td>Motion Graphics</td>
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Other suggestions

Program

Any Bug/Error found in the game? Put the replay button if kids want to listen again.

Thank you! Your feedbacks will help me to improve the design.
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### Visual Design

<table>
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<tr>
<th>Design</th>
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<th>Excellent</th>
<th>Other suggestions</th>
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<tbody>
<tr>
<td>Visual Style</td>
<td>1 2 3 4</td>
<td>5</td>
<td>Maybe remind people drag to the exact area or click to continue.</td>
</tr>
<tr>
<td>Sound Effect</td>
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<td>5</td>
<td></td>
</tr>
<tr>
<td>Motion Graphics</td>
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**Program**

Any Bug/Error found in the game?

Thank you! Your feedbacks will help me to improve the design.
# EVALUATION FORM

**Thesis Project**  
Chao Luo  
MFA Visual Communication Design

## Game Design

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</tr>
<tr>
<td>Level 1</td>
<td>1 2 3</td>
<td>✔</td>
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<tr>
<td>Level 2</td>
<td>1 2 3</td>
<td>×</td>
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<tr>
<td>Level 3</td>
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## Program

Any Bug/Error found in the game?  

The key is a little confused.

Thank you! Your feedbacks will help me to improve the design.
EVALUATION FORM

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---

**Game Design**

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<td></td>
</tr>
<tr>
<td>Motion Graphics</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

**Other suggestions**

The process took a bit longer time.

---

**Program**

Any Bug/Error found in the game? 

No.

---

Thank you! Your feedbacks will help me to improve the design.
# EVALUATION FORM

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## Program

Any Bug/Error found in the game?  

\[ N_0 . \]

Thank you! Your feedbacks will help me to improve the design.
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## Game Design

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<tbody>
<tr>
<td>Level 1</td>
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<td>2 ✅</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
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<td>1</td>
<td>2 3 ✅</td>
<td>4</td>
<td>5</td>
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## Visual Design

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</tbody>
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Other suggestions

## Program

Any Bug/Error found in the game?  

For the level 2, if I click the same "ice" twice, the letter/word will change. That should be the bug for the code in the back end.

Thank you! Your feedbacks will help me to improve the design.
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---

**Game Design**

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**Program**

Any Bug/Error found in the game?  

For **ليلإ** there’re two **اَٰلْ**’s but one **اَلْ** doesn’t work for the other one’s spot.

Thank you! Your feedbacks will help me to improve the design.
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Visual Design

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Program

Any Bug/Error found in the game?

For level 1, not clear instruction.

Good job overall! Bravo!

Thank you! Your feedbacks will help me to improve the design.
# EVALUATION FORM

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## Program

Any Bug/Error found in the game?

---

Thank you! Your feedbacks will help me to improve the design.
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</tr>
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<td>4</td>
<td>(5)</td>
</tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>(5)</td>
</tr>
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</table>

Other suggestions

Perfect! I love your visual style.

Program

Any Bug/Error found in the game?

In level 4, I can only hear pronunciation one time. I would suggest that small speaker button so user can hear the word several times.

Anyway, I love this. Good job!

Thank you! Your feedbacks will help me to improve the design.
# EVALUATION FORM

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## Game Design

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## Program

Any Bug/Error found in the game? *add menu or play again in each level?* maybe.

Thank you! Your feedbacks will help me to improve the design.
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Other suggestions

## Program

Any Bug/Error found in the game?

![Symbol] → a little confuse.

Thank you! Your feedbacks will help me to improve the design.
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## Game Design

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Other suggestions:
- Level 1: Differentiate the two kinds of ice cubes used by color

## Program

Any Bug/Error found in the game?

Thank you! Your feedbacks will help me to improve the design.
This is a text authored by a human, and it describes a drag and drop game using code.

### Code Sample

```javascript
this.stop();

var aa = false;
var bb = false;
var cc = false;
var dd = false;
var ee = false;
var ff = false;
var gg = false;
var hh = false;

// pick up the right one
this.object_arm1.addEventListener("pressmove", dragArm1.bind(this));

function dragArm1()
{
    if (!aa){
        // scale the ball up
        this.object_arm1.scaleX = 1.2;
        this.object_arm1.scaleY = 1.2;

        // attach ball to the cursor
        this.object_arm1.x = stage.mouseX;
        this.object_arm1.y = stage.mouseY;
    }
}

this.object_arm1.addEventListener("pressup", dropArm1.bind(this));

function dropArm1()
{
    // determine point for a collision with target
    var pt = this.object_arm1.localToGlobal(0,0,this.target_arm1);
    if (this.target_arm1.hitTest(pt.x, pt.y))
    {
        this.object_arm1.x = this.target_arm1.x;
    }
}
```
this.object_arm1.y = this.target_arm1.y;
this.object_arm1.scaleX = 0.95;
this.object_arm1.scaleY = 0.95;
aa = true;
this.sound_switch.gotoAndPlay(1);
}

} else {

this.object_arm1.x = 898.15;
this.object_arm1.y = 618.65;
this.object_arm1.scaleX = 1;
this.object_arm1.scaleY = 1;
this.audio_wrong.gotoAndPlay(1);
}

/

// pick up arm2
this.object_arm2.addEventListener("pressmove", dragArm2.bind(this));
function dragArm2()
{
    if (!bb)
    // scale the ball up
    this.object_arm2.scaleX = 1.2;
    this.object_arm2.scaleY = 1.2;
    // attach ball to the cursor
    this.object_arm2.x = stage.mouseX;
    this.object_arm2.y = stage.mouseY;
}

} else {

this.object_arm2.addEventListener("pressup", dropArm2.bind(this));
function dropArm2()
{
    // determine point for a collision with target
    var pt = this.object_arm2.localToGlobal(0, 0, this.target_arm2);
    if (this.target_arm2.hitTest(pt.x, pt.y) && aa)
    {
        this.object_arm2.scaleX = 0.85;
    }
}
this.object_arm2.scaleY = 0.85;
this.object_arm2.x = this.target_arm2.x;
this.object_arm2.y = this.target_arm2.y;
bb = true;
this.sound_switch.gotoAndPlay(1);
}
else {
    this.object_arm2.x = 568.55;
    this.object_arm2.y = 622.60;
    this.object_arm2.scaleX = 1;
    this.object_arm2.scaleY = 1;
    this.audio_wrong.gotoAndPlay(1);
}

// pick up body
this.object_body.addEventListener("pressmove", dragBody.bind(this));
function dragBody()
{
    if (!cc){
        // scale the ball up
        this.object_body.scaleX = 1.2;
        this.object_body.scaleY = 1.2;
        // attach ball to the cursor
        this.object_body.x = stage.mouseX;
        this.object_body.y = stage.mouseY;
    }
}
The Randomness of Matching Game

var iceCount = 16;

var in1;
var in2;
var in3;
var in4;
var in5;
var in6;
var in7;
var in8;
var in9;
var in10;
var in11;
var in12;
var in13;
var in14;
var in15;
var in16;

var ra = [];

var doubleHit = true;

var iceNumber = 0;
var lastIceObj;
var secondIceObj;

var checkIce = 0;

// set the timer
//var timeRemaining = 1;

while (ra.length < iceCount) {
    var ranNum = Math.floor(Math.random() * iceCount) + 1;
if (!contains (ra, ranNum)) {
    ra.push(ranNum);
}

in1 = ra[0];
in2 = ra[1];
in3 = ra[2];
in4 = ra[3];
in5 = ra[4];
in6 = ra[5];
in7 = ra[6];
in8 = ra[7];
in9 = ra[8];
in10 = ra[9];
in11 = ra[10];
in12 = ra[11];
in13 = ra[12];
in14 = ra[13];
in15 = ra[14];
in16 = ra[15];

function contains (a, num) {
    for (var i=0; i < a.length; i++) {
        if (a[i] == num){
            return true;
        }
    }
    return false;
}

var timer = setInterval(function(){countDown()}, 10);

var timeRemaining = 1;

// create a timer that calls a function every 1 second
//var timer = setInterval(function(){countDown()}, 10);

// function called by timer to scale the bar
function countDown()
{
    // countdown the timer
    timeRemaining -= .025;

}

this.addEventListener("tick", startGame.bind(this));

function startGame()
{
    //this.mc_timebar.scaleX = timeRemaining;
    if(timeRemaining <= -10000){
        timeRemaining = -1;
    }
    //checkIce == 8
    if(checkIce == 8){
        this.parent.gotoAndStop("2to3");
    }
    if(timeRemaining <= 0 && doubleHit && secondIceObj != null && lastIceObj != null){
        this.mc_dropsound.gotoAndPlay(1);
        secondIceObj.y = -1000;
        lastIceObj.y = -1000;
        checkIce += 1;
    }
    else {
        this.mc_cracksound.gotoAndPlay(1);
        this.mc_cracksound.gotoAndPlay(1);
    }
}
secondIceObj.gotoAndStop(0);
lastIceObj.gotoAndStop(0);
//window.alert(3);
}
secondIceObj = null;
lastIceObj = null;
iceNumber = 0;
}

//code for ice1
this.ice1.addEventListener("click", showIce1.bind(this));
function showIce1()
{
	this.ice1.gotoAndPlay(in1);
doubleHit = !doubleHit;
	iceNumber = iceNumber + in1;
timeRemaining = 1;

	if(!doubleHit){
		lastIceObj = this.ice1;
		//window.alert(1);
	}else{
		secondIceObj = this.ice1;
		//window.alert(2);
	}
}
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