Edutainment System for Children with Autism Spectrum Disorder

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Edutainment System for Children with Autism Spectrum Disorder

by Chunxiao Zhu

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Industrial Design
School of Design
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Approvals

Edutainment System for Children with Autism Spectrum Disorder

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May 2015

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Abstract

I have always believed that a qualified designer should design products that can help society; therefore, I have kept my eye on core social issues. My graduate thesis is definitely a great opportunity for me to help minority groups in society through a designer’s perspective.

As we all have noticed, the number of families that have a child with autism spectrum disorder (ASD) is increasing year by year, and these families are all struggling with difficult issues. That's why I chose ASD as my thesis topic. I want to help children with ASD through design.

Because ASD is a broad subject, my project started with plenty of research from books, online articles, and community activities, in order to narrow down the main topic and to decide on a target group. The design process included background research, research of children with ASD and their families, the creation of a problem definition, ideation, design advancement, and specifications. I hope my final design will not only help children with ASD with their physical performance but also help them with their social and communication skills.

All in all, I think my thesis design shows how a product designer can care about individuals with unique needs in the society and originate a new product system that can help resolve issues for them. In the future, I also would like to develop this project into a universal design that can help all children, whether they are challenged or not.
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CHAPTER I. BACKGROUND OF STUDY
Design Intent

“You can design and create, and build the most wonderful place in the world. But it takes people to make the dream a reality.”

-Walt Disney

As Walt Disney once said, a design should take peoples’ dreams and make them a reality. When I started with my thesis topic, I always wanted to do something that would help people in our world. That's why, from the beginning, I chose three topics for my thesis: low carbon design, space-saving design, and a design for a minority group, such as the elderly, children or females. Finally, I choose individuals with autism spectrum disorder (ASD) as my topic for the following reasons.

First, from my own point of view, I've seen a family with a child with ASD and the way in which the parents were struggling with this issue. A friend of my family has a little daughter with ASD. They barely can communicate with her. Because there is no "cure" for ASD, the family has traveled to a number of places and spent a great deal of money to find ways to help her. However, it is not only about the cost but also about the emotional implications of the condition of ASD.

Plus, many children with ASD are excellent artists and mathematicians. Indeed, some seem to have infinite talent. If they receive the proper guidance, they can increase in development because they have great potential. For example, Figure 1 is a
copy of a painting done by Iris Grace, who is a four year-old girl with ASD. Despite the ASD diagnosis, she has talent with color and drawing. It is an amazing piece of work.

There are millions of children like Iris Grace in this society. They have talent, but it comes along with a disability. They need more help and care than children who do not have such challenges.

The number of children with ASD is increasing every year. Families of children with ASD suffer many pressures in their relationships, in the feeling of hopelessness, and in their finances. As a result, I have always wanted to give my help to others and support them through my designs. I want to design a product that can help communication between children and adults, in order to allow educators to teach and guide children toward a better future.

*Fig.1: Painting by Iris Grace*
CHAPTER II.
DESIGN METHODOLOGY
For the thesis design, I used the same design methodology as most of my projects. I started the design with research, which included:

**Literature Research**
Reading books and articles about all aspects of ASD, from its meaning to causes and treatment.

**Online Research**
Searching blogs and posts from families with a family member with ASD, as well as related experts.

**User Research**
Volunteered at a local ASD community to get in touch with families of children with ASD and organizations for ASD.

Fig.2: Design Methodology
Market Research
Search in the marketplace to see exciting products that can help individuals and families with ASD.

Through the research, I came to understand the needs of children with ASD and their families. Then I started analyzing my information to find the main users’ needs, target groups, and design opportunities, so I could start my design.

Design and Testing
I believe design is a cycle of creating, designing, and testing, and creating, designing, and testing again. It is a process of refining and modifying a design from early ideas, making changes, creating mock-ups, and testing them with users for feedback until I reach the ultimate design goal and finalize it.

Future Plans
Last but not least, design is a process of constant improvement and amelioration of identified problems. Therefore, even if I use my final design for this thesis project, there is still room for it to be improved. That’s why I feel there is a future beyond just this project.
CHAPTER III.
RESEARCH
**ASD Definition**

ASD is a complex developmental disability. It usually appears during the first three years of a child's life, and it affects a child's ability to communicate and interact with others. Autism is a "spectrum disorder" that affects individuals differently and to different degrees.

**Statistics**

In March 2012, the Centers for Disease Control and Prevention issued their ASD and Developmental Disabilities Monitoring (ADDM) prevalence report. The report found that the prevalence of ASD has risen to 1 in every 88 births in the United States, and almost 1 in 54 children diagnosed with ASD are boys. In addition, the number of ASD diagnoses continues to increase year by year.

*Prevalence is estimated at 1 in 88 births.*

*1% of the population of children in the U.S. ages 3-17 have an ASD.*

*10 - 17% annual growth.*
Cost
Currently, the Autism Society estimates that the lifetime cost of caring for a child with ASD ranges from $3.5 million to $5.0 million, and the United States is facing almost $90 billion annually in costs for ASD.

Cause
There is no known single cause for ASD, but it is generally accepted that it is caused by abnormalities in the structure or function of the brain. Researchers are investigating a number of theories, including the links to heredity, genetics, and medical problems.
Diagnosis

Unfortunately, there is no medical test that can be performed to diagnose ASD. Rather, diagnosis is made based upon careful evaluation of behavior by professionals (e.g., pediatricians, psychologists) and confirmed through interview with parents and consideration of the child’s developmental history. Usually parents are the first to notice that their child is showing unusual behaviors, such as failing to make eye contact, not responding to his or her name, or playing with toys in unusual, repetitive ways.

There is a checklist provided by the ASD Speaks Organization (http://www.autismspeaks.org) to help parents decide if their child might have with an autism spectrum disorder (ASD) (Figure 7).

![About half of parents notice their child's unusual behaviors by age 18 months.](image1)

![About 4/5 of parents notice their child's unusual behaviors by age 24 months.](image2)

*Fig. 6: Noticed Age of ASD*
1. If you point at something across the room, does your child look at it? (For example, if you point at a toy or an animal, does your child look at the toy or animal?)

2. Have you ever wondered if your child might be deaf?

3. Does your child play pretend or make-believe? (For example, pretend to drink from an empty cup, pretend to talk on a phone, or pretend to feed a doll or stuffed animal?)

4. Does your child like climbing on things? (For example, furniture, playground equipment, or stairs)

5. Does your child make unusual finger movements near his or her eyes? (For example, does your child wiggle his or her fingers close to his or her eyes?)

6. Does your child point with one finger to ask for something or to get help? (For example, pointing to a snack or toy that is out of reach)

7. Does your child point with one finger to show you something interesting? (For example, pointing to an airplane in the sky or a big truck in the road)

8. Is your child interested in other children? (For example, does your child watch other children, smile at them, or go to them?)

9. Does your child show you things by bringing them to you or holding them up for you to see — not to get help, but just to share? (For example, showing you a flower, a stuffed animal, or a toy truck)

10. Does your child respond when you call his or her name? (For example, does he or she look up, talk or babble, or stop what he or she is doing when you call his or her name?)

11. When you smile at your child, does he or she smile back at you?

12. Does your child get upset by everyday noises? (For example, does your child scream or cry to noise such as a vacuum cleaner or loud music?)

13. Does your child walk?

14. Does your child look you in the eye when you are talking to him or her, playing with him or her, or dressing him or her?

15. Does your child try to copy what you do? (For example, wave bye-bye, clap, or make a funny noise when you do)

16. If you turn your head to look at something, does your child look around to see what you are looking at?

17. Does your child try to get you to watch him or her? (For example, does your child look at you for praise, or say "look" or "watch me"?)

18. Does your child understand when you tell him or her to do something? (For example, if you don’t point, can your child understand "put the book on the chair" or "bring me the blanket")

19. If something new happens, does your child look at your face to see how you feel about it? (For example, if he or she hears a strange or funny noise, or sees a new toy, will he or she look at your face?)

20. Does your child like movement activities? (For example, being swung or bounced on your knee)
Treatment

There is no single cure for ASD, but with appropriate treatment and education, many children with ASD can learn and develop. Research indicates the initiation of intensive intervention as soon after the diagnosis is made is critical in order for the child to realize the greatest level of independence. Early intervention usually can reduce challenges associated with ASD, lessen disruptive behavior, and provide some independence for the person with ASD. In a majority of cases, a combination of treatment methods is more effective than just one treatment. Autism spectrum disorders may require lifelong treatment.

According to the National Institutes of Health (NIH), treatment for ASD can include the following:

- Behavioral management therapy
- Cognitive behavior therapy
- Early intervention
- Educational and school-based therapies
- Joint attention therapy
- Medication treatment
- Nutritional therapy
- Occupational therapy
- Parent-mediated therapy
- Physical therapy
- Social skills training
- Speech-language therapy
User Research

*Field Trip of Study*

**Walk Now for Autism Speaks**

The very first chance that I could get in touch with children with ASD and their families was in participating in the Walk Now for Autism Speaks at Monroe Community College (MCC) in Rochester, NY.

This is a social activity for volunteers to do something for families with children with ASD. I was very pleased to join this event. Through this event, I was able to get a chance to talk with autism advocacy organizations and communities and apply for a volunteer position with Autism UP (was named UNYFEAT), which is a local community for the support of individuals with ASD.
Autism Up (UNYFEAT)
It’s definitely has been a great opportunity for me be a volunteer of Autism UP. The people there are very nice, and they have given me excellent supports for my project. It’s also my honor to be a volunteer and to help children in the field of autism. Instead of just doing my research at home and guessing what they may need, I was able to participate in several events that were hosted by Autism UP, and I had the opportunity to chat with children with ASD and their families.
Victor Primary School

With help of Prof. Daniel Mruzek, I had the opportunity to visit Victor Primary School, Victor, NY. The school has a special classroom for children with developmental disabilities, including ASD.

After watching their classroom and how teachers interact with children, I was able to gather a lot of information and come up with design ideas. One of ideas is that I can make this product not only a part of the home but also a product for schools. In that way, children with ASD will feel more comfortable and have less stress if they can have similar products both at home and at school.

I also had the chance to see the schools’ playroom. Through observing the children’s play, I could easily understand how the products helped the children and those products gave me a better reference for my design.

The teachers there were very patient and kind and gave me many helpful suggestions on how to improve my design.
Primary Problems
After the research from books, online resources, and the field trip, I noticed that there are three primary problems experienced by children with ASD: social interaction, communication, and restricted or repetitive behaviors.

Social Interaction
Many children with ASD have difficulties with social interactions including establishing friendships, understanding the social intent of others and recognizing common social cues, such as facial expressions and body language.

Communication
Many Children with ASD have difficulty understanding others, as well as difficulty expressing themselves to others.

Restricted or Repetitive Behaviors
Many children with ASD have a strong preference for routine, a tendency to repeat movements (i.e., “stereotypy”), and a restricted range of interests.

Based on this information, I found specific products designs in the market. Also, I classified their behaviors into three categories (Figure 15).

• Social Interaction – Education
• Communication – Communication
• Restricted or Repetitive Behaviors – Physical Behavior
Fig. 15 The Three Categories
Education

Apps on tablets, without a doubt, are one of the best educational tools for children with ASD. They can learn simple verbal and communication sentences during their play with game apps. Also, they feel safe during play with their own private tablet.

There are other similar products, such as mini computers, for teaching children with specific needs (Figure 16).

The only problem with those products is that they lack human interaction. It's hard to ask children with ASD to share a game with others. Although there are some games that require children to corporate with parents, they still do not feel and touch the real objects in a play environment. In other words, it is hard to help them learn social skills and feel the physical products by only playing app games.

Fig.16: Puzzle Piece: The Laptop for Children with ASD
Communication

Based on research, there are two main ways to help children with ASD communicate with others.

One is provide a comfortable environment, such as a comfort vest in Fig.17 that is snug and comforting and it may help children with ASD to feel secure and happy, and perhaps decrease anxiety when communicating with others.

Another way to reach the goal is that provide them an environment which requires them to talk. For example, the concept design in Fig.18 is a race car, but it requires three players to collaborate together to play; otherwise, it will not work. This is great if the kids like racing cars or any racing games. But what if the kids don’t like racing?

Fig.17: BearHug

Fig.18: Gobug
Physical behavior
There are several products on the market that focus on helping with restricted or repetitive behaviors. Most of them involve physical touch. When children who engage in self-injurious behavior feel anxious, they might attend to those products instead of hurting themselves. For example, as the product shows in Fig.19, children can wear the band, when they feel anxious or nervous. They can scratch the band instead of their own hand or skin.

During my research, I also found another way to get children with ASD's attention. It is the "rocking" movement. When children with ASD sit on a ball or something else that is not necessarily rigid and unmoving, they may feel more calm and comfortable because they can be moving and do not have to sit still.

Fig.19: REPEAT

Fig.20: Weighted Lap Pad
Other products
In considering the previous products, we can recognize that they share the same limitation: they are too specific. They all solve one problem at one time but ignore others. However, autism, as mentioned in the introduction, is different to individuals. If a product focuses too much in one direction, it may lose the purpose of helping with other problems. How about combining the solutions together and making the product a system?

As a result, I started my second product research, which focuses more on multiple functional design. Here are two examples:

Figure 21 shows a shell-shaped chair with that rocks back and forth. On one side, it provides children with a safe and half-private space, and on the other side, it provides a repetitive rocking motion.

Figure 22 is a toy set that not only gives children with ASD the opportunity to use physical touch, but it also provides a cooperative mode of play and help them to learn about different expression.

*Fig.21: the Cradle Chair*  
*Fig.22: Build-A-Robot*
**Conclusion of Research**

**Design Opportunity**

I learned the main problems of ASD from the literature research and field study, then I derived my design opportunity from existing products. In conclusion, I noticed that no single product can cover all of the three main problems of ASD.

As a result, I decided to design an interactive educational and entertainment – “edutainment” system – for children with ASD to play, learn and talk with others (parents or teachers). Meanwhile, it can provide a relaxing environment that channels their repetitive actions.

![Design Opportunity Diagram](image-url)
Target Group

Because ASD has a very broad range of needs, I decided to narrow down my target group to get my design to be the most feasible to create and be used.

I chose my target group to be primary school children (4-8 years old), in the mid-to-high functional range of ASD. Also, I am considering those children who participate in, at-home treatment intervention with their parents and other caregivers, as well as those children participating in special education programs in school settings.

Mid-to-High Function

Home Treatment

Primary School
Ages 4-8

Fig. 24: Target Group
Design Principles
Before the design process, I listed four main principles for this system.

- Interaction
- Safety
- Education
- Entertainment

Interaction
The product should provide an opportunity for children with ASD to interact with others (parents or teachers). For example, the product might require two or more people to be active in its function, or this product requires teamwork.

Safety
The material and the product, itself, should be user friendly and very safe for children.

Education
This product can create an environment for children with ASD to feel comfortable when learning things.

Entertainment
This product should provide an interesting and playable space that can let kids feel calm and relaxed.
CHAPTER IV.
CONCEPT DEVELOPMENT
At the beginning of the development, I got my inspiration from the classroom in the Victor primary school. During observation, I saw how teachers interacted with the children. Then I got the idea that a system could be created that combined a table and chairs, and it could be used both at home and at school.

Fig.25: Early Sketches
To the table section, I got inspiration from the over-bed table. I also wanted the chair to be an active part of the interaction. So I brainstormed seesaw type seats combined with table surfaces. Beginning with these ideas, I received positive feedback from my thesis advisors. Then, I started with small mock-ups to figure out how it would look. After that, I built a full-sized, rough model to get a better test. Below is the feedback from my classmates and advisors:

<table>
<thead>
<tr>
<th>Category</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Entertainment</td>
<td></td>
</tr>
</tbody>
</table>

Safety: Because it was a rough model, during testing, we found that it was very hard to keep the seesaw balanced. Also, it was not very comfortable to sit on a slim board.

Interaction: The seesaw made the design interactive. However, I needed to do more study on the curve of the bottom part. In order to make the seesaw balanced between adults and children, I had to move around the pivot of the bottom curve to test.

Education: With a plain table surface, it was hard to have it function as an educational tool.

Entertainment: Children would like to sit on seesaws. They could learn and play at the same time, but how could I make the table be a part of the entertainment?
According to the Stage 1, I noticed that I needed to keep the combination of the seesaw and the table but improve its practicability. So I created some quick mock-ups to test the utility.

**Test 1. Shape of the curve (the position of the pivot)**

To provide a better rocking movement, I made two different curve for the bottom part of the seesaw. One was a regular even edge, and the other one was a little bit off center.

After testing, I found that the off-center one was closer to my goal because of the level principle.

**Test 2. Different angle of support sticks**

To provide a better balanced feeling and a stronger structure, I tested with different angles. As a result, the right figure is more sturdy and durable of the two pictures shown.
Test 3. Comfortable

The right design one is more comfortable.

According to the tests above, I came up with a improved idea for the seesaw and table system, as shown below:

Fig.30: Sketch 2.0
Based on the research and testing above, I built the 2.0 model and tested it with others. Below are the results for Model 2.0:

<table>
<thead>
<tr>
<th></th>
<th>Safety</th>
<th>Interaction</th>
<th>Education</th>
<th>Entertainment</th>
</tr>
</thead>
</table>
| Fig.31-34: Model 2.0

Safety: From the chart, we could tell that Model 2.0 was safer than 1.0 by enhancing the board and the angles. Also, the wider board made sitting more comfortable.

Interaction: The seesaw seat got the same value of interaction. So I planned to add more interactive features on the table surface.

Education: The seesaw seat provided a place to sit for education, but it was not very specific to this function. So I decided to work on the table surface for more educational features.

Entertainment: The rocking movement was fun and kept children engaged. Children could enjoy while they were learning things with their parents.
Moving on from Stage II, I received a lot of positive feedback, but I also realized some problems. The primary one was how to keep the seesaw in a range so that it was safe for the children and it would help avoid them from falling down. Below are the additional mock-ups I did to find out the best way to solve the problem.

**Test 1. Bouncing Ball**
Instead of using a wooden block, I tried different materials to avoid dangerous falls. The first thing that came to my mind was a big bouncing ball. I obtained one and screwed it on the bottom of the seesaw. However, when I tested it with others, we all felt it was a little hard and not aesthetic.

**Test 2. Sponge**
Next, I tried working with a piece of sponge to smooth the shaking and rocking movement. I glued the sponge under the seesaw, then I found out it was too soft to handle people’s combined weight. If there are two small children sitting on the seesaw, it might have helped, but with adults using the seesaw, the sponge does not help at all.

**Test 3. Spring**
I tried using a large spring and used a door hinge to connect the spring to the seesaw. The result was that a normal spring was not strong enough. The solution might be a much more heavier and stronger spring, but that idea did not seem very realistic.
After all of these tests, I went back to the original design and started to try think from a different way by changing the shape and the materials. I did a quick test with four small models. After receiving suggestions from advisors, I decided to change to another material for the support part of the seesaw.

Fig.38: Model Test 3.1
Stage IV

I decided to build the model with steel instead of wood. So I brainstormed the shape based on the previous research and tests (see sketch below).

![Sketch 4.0](image)

Fig. 39: Sketch 4.0

The same as previous stages, I built a full-sized model based on several small mock-ups, to research the scale, interaction and possible production methods. With the help of my advisors and shop assistants, I finally used steel as the material for the bottom part of the seesaw and a wood board for the top (Fig. 40-42).
It was getting to be pretty sturdy looking. I felt that I was getting really close to my final design. Again, with tests, I received the following results.

<table>
<thead>
<tr>
<th>Category</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>4</td>
</tr>
<tr>
<td>Interaction</td>
<td>4</td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
</tr>
<tr>
<td>Entertainment</td>
<td>3</td>
</tr>
</tbody>
</table>

Safety: By attaching two arched steel bars on the bottom of the seesaw, it ensured a safer and better experience.

Interaction: The seesaw remained the same value in interaction. Children and parents would enjoy the rocking movement.

Education: The seesaw, on its own, only provides seats. I planned to work on the table surface in regard to adding more educational functions.

Entertainment: The rocking movement kept children moving and that could be fun. Children would enjoy the seesaw while learning things with their parents.

Finally, I achieved my goal for the seesaw design. Now I needed to start to working on the table surface and make it functional as a way of helping with interaction and education.

Fig.40-42: Model 4.0
Stage IV
Table Surface

After testing with the seesaw, the function of the table surface became clear to me. I needed to concentrate on the interaction and educational aspects. I thought it would be better to figure out how parents could communicate with their children with ASD easier and, simultaneously, how the children could learn during the communication.

1. Learning
Those two main questions reminded me of the situation in the classroom of the Victor primary school. They have a reward system (token board) to encourage children as they learn new things.

For example (Fig. 43): If a boy likes to use computer play games, he can get a range of time for playing based on his performance. If he finishes his learning in a short amount of time with a good result, he gets one token. After collecting five tokens, he is rewarded by being able to play on the computer for 15 minutes. Otherwise, he cannot play those computer games.

Therefore, my first idea for the layout of the table surface was, instead of using a sheet of paper as the token board, I could make the token board be a part of the table surface (Fig. 44). Children can get one token after finishing one challenge on the checklist and properly put the colored token into the same colored hole in the table. After he/she gets five total tokens, he/she can have a chance to participate in something where they have the most interest, as a reward. On one hand, they can learn things better for a longer time reward, and on the other hand, they have better knowledge of the colors.
2. Communication

Another problem for children with ASD is communication. In this system, a pen is an essential product. I created two storage areas on both sides of the table surface and put pens with different color in each. If the child wants to use the pen on the parent’s side, first, he/she needs to ask for permission; that is where the conversation starts. Second, the parent can also ask the child to share the pen on his/her side with him/her. I shared this idea with Prof. Daniel, and he was in agreement with me, regarding this arrangement.
3. Data Log
There is one side of the table for the parent on the table surface, therefore, I decided that it could be used as a place for keeping the child’s data log. In this way, parents can record children's activities while using the system and save the log on their side of the table.

4. Portable Boards
Because the majority of children with ASD like to have things that are very familiar with, or things that belong to them all the time, otherwise they might feel fearful, nervous, and even anxious in a strange environment. As a result, sometimes it might be hard for them go to school from home. That is why I have created a table on the children’s side that is portable. In that way, if the school also has the same table with the same surface, the child will have his/her own board insert in the school's table, or the child can use the portable pad directly. Therefore, the study environment in the school will be very similar to the one at home.

Fig.47: Rough Modeling of Table Surface
CHAPTER V. FINAL PRODUCT AND FEATURES
1. Seesaw Chair

The seesaw chair provides a rocking motion that can help children with ASD, who have repetitive activities, and it helps them feel calm and comfortable. Meanwhile, the seesaw itself requires that children with ASD perform teamwork with their parents. When people don’t use it as a treatment tool, the seesaw itself can also be a fun facility for playing only.

Pivot (Lever Principle)

The pivot of this seesaw is attached closer to the parent’s side in order to reach a balance between adults and children’s sizes.

Steel Rods

The steel rods on the bottom of the seesaw keeps a safe range for rocking.

Fig.48: Final Prototype of Seesaw Chair
2. Table Surface

The table surface provides an open environment for children with ASD to learn things with their parents. The features are listed below. Besides that, the table itself can be used as a normal working surface as well.

Storage Area
There is a storage area for pens, blocks, or cards on both sides. If children need items on the adult’s side, they will have to ask for them, and vice versa with the parent.

Token Reward
Once children finish their training well, they’ll put a small cylinder in the right colored hole as a reward. When they collect the specified number of, they can be given some break to do their favorite things.

Portable Board
Children with ASD love things that they are familiar. They can take the board to school, and if there are these tables in their schools as well, they can insert their own portable board into the table, therefore they won’t feel strange to the school classroom.

Data Log
Parents can take notes on their children’s activities and save them in the transparent area as the data log.

Fig.49: Final Prototype of Table
CHAPTER VI. MANUFACTURING PLAN
For the manufacturing of this product, I want to keep this system costing inexpensive, but maintaining great quality and appearance. Based on these considerations, I got the manufacturing ideas from Prof. Alan Redding. He suggested that I use plywood or ABS as the table material to save cost and to use steel and lumber as the material for the seesaw, in order to ensure safety and a reasonable price at the same time. He also provided me with some ideas for finishing the surfaces of the table and seesaw (Fig. 50).

For color, I got suggestions from Prof. Daniel and Prof. Lynne. They recommended me that use either wood color or white as the main color to maintain the feeling of neatness and cleanliness.

<table>
<thead>
<tr>
<th>Color</th>
<th>Material</th>
<th>Finish</th>
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</thead>
<tbody>
<tr>
<td><strong>Table A</strong></td>
<td>White/Grey</td>
<td>ABS</td>
</tr>
<tr>
<td><strong>Table B</strong></td>
<td>Wood color</td>
<td>Plywood/MDF</td>
</tr>
<tr>
<td><strong>Seesaw</strong></td>
<td>Wood color</td>
<td>Lumber, steel</td>
</tr>
</tbody>
</table>

Fig. 50: Manufacturing Plan
CHAPTER VII.
FUTURE PLANS
Thesis Exhibition

I received a lot of valuable advice from the exhibition of the thesis work. I was so glad that people affirmed and complimented this product. I also felt thankful that, through this exhibition, more and more people would start to pay attention to autism spectrum disorder. From the feedback, I also realized what part of the system should be strengthened in future designs.

Fig.51-52: Thesis Exhibition of Edutainment System for Children with ASD
User Test

With the help of Prof. Daniel Mruzek, my edutainment system was tested. Below are some valuable suggestions and advice I received from users:

Seesaw
They thought that's really fun to use a seesaw as the seats. They loved the design that puts the pivot off-center. So it was really easy for interacting between children and adults. However, they thought the single wood board might cause uncomfortable for a long time sitting, though it's good for a short time.

Table Surface
They liked the ideas of token and sharing. They gave me suggestions to make the token modular, so users could customize on it based on different needs.
Future Development

Design is a process of iteration and refinement, after I got suggestions from users, I began to think about how to improve the system in the future.

1. Universal Design
I should not limit this design to children with ASD. This design also can be a design for normal communication and interaction of children and their parents. With the seesaw, parents can teamwork with children for the "rocking" movement. And for the table, parents can teach children how to share, meanwhile they can spend more time with their children.

2. More Fun
For the token part of the design, instead of just using color as a learning tool, I can also design it as a modular part. As a result, parents can customize it based on the needs of children. For example, if the children have difficulty with knowledge of shapes, they can use "shapes" token for extra practice with this skill.

3. Comfortable
Because of having to consider the budget and the cost of the overall design, I didn't spend a lot of time on comfortable materials. In the future, if I get a chance, I will look for more comfortable seat material for this system.
CHAPTER VIII.
Summary
Summary of Major Findings

Through this year-round thesis project, I learned a lot.

Design Thinking
I understand that the design is not only about the designer, himself/herself, but also about users. Why do you wish to design something? What will you bring to others from this design? I needed to keep asking myself those questions.

User Feedback
Also, the design is not an individual’s work. It needs fresh ideas and suggestions from users and others. Sometimes those suggestions and ideas give you a totally different way of thinking about your original design.

Research
I also learned that research is an essential part of the design process. You will understand your topic deeper, with details, through conducting research.

Testing
The same as research, testing shows you the negative sides of your original thinking. Great designs come from multiple times of testing.

A year is definitely not enough for a masterpiece of design. So, I will keep exploring and developing it to make be as qualified a design as possible so that it can help people and the society.
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