

# HOLOKIN

INNOVATIVE WORKSPACES



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Bachelors of Industrial Design

# **Dyslexia and Alternative Work Spaces**

by

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# ABSTRACT

Keywords: Dyslexia, Spatial Thinking

Dyslexia is a lifelong neurological condition, that affects a person's experience of learning and thinking processes, specifically literacy. It makes time-constrained literacy-based tasks and the memorization of patterns very strenuous. This results in greater challenges achieving social mobility and competing with neurotypical people in climbing the corporate ladder. These extra stressors result in low esteem and mental health issues. Holokin addresses these problems by leveraging the dyslexic thinkers' strengths such as 3D spatial thinking and visualization. Wearable glove controllers, reduce the user's struggles with memory and pattern recognition with intuitive motion. Haptic sensors additionally allow users to easily remember patterns with multisensory engagement. Holokin takes working to another dimension, that leverages strengths while alleviating weaknesses of dyslexic office workers.

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## CHAPTER 1. INTRODUCTION

### 1.1 Problem Definition

Dyslexia is a lifelong neurological condition, that affects a person's experience of learning and thinking processes specifically regarding literacy. It makes it difficult for them to do time-constrained literacy-based tasks and memorize patterns. Adults with dyslexia struggle in educational systems and once they leave often do not get the resources needed to succeed in the professional world. This means it is harder for them to achieve social mobility and compete with neurotypical people in climbing the corporate ladder. These extra stressors additionally result in low esteem and mental health issues. Obtaining resources can also depend on a person's socio-economic status; if not even while young, symptoms become harder to manage when older.



Dyslexia Art: Ash Casper, 2016. Retrieved from: Ash Casper for NPR

### 1.2 Rationale & Significance

#### 1.2.1 Key Information to be Determined:

The pains and gains of dyslexics in the workplace, specifically the office, will need to be determined to understand how to create a solution for them to best operate. Their struggles will need to be analyzed to alleviate them and minimize any additional problems added to the user in my solution. Neurological strengths will also be analyzed to create

a solution amplifying their strengths. Their learning styles will be assessed to gain an understanding of how they best operate in ways not already optimized in the office. The investigative approach will be both qualitative and quantitative.

### 1.1.2 Key Questions to Be Answered

Some key questions that will need to be answered include:

- What are the pains and gains of dyslexic persons in the workplace?
- What are their learning styles and how can they be enhanced?
- How can their unique leaning profiles be incorporated into the work environment?
- What are the specific requirements of a work place solution?

## 1.3 Background, History & Social Context

### 1.3.1 Demographic Trends

There are many commonalities in the experiences of dyslexic adult demographics. Starting in education they typically have a harder time than their neurotypical counterparts. This often leads to low self-esteem, especially in the early years of education. After high school, adults with a learning disability have lower rates of post-secondary education. Once leaving the school system they also have a lower employment rate and income rate than those without learning disabilities. However, in creativity, and communication dyslexics do shine. Dyslexia is also closely and usually diagnosed with ADHD. Lastly, dyslexia does not discriminate against gender or race, although those with higher socioeconomic demographics may have easier access to help.

### 1.3.2 Social Media Trends

The word dyslexia was coined in 1883, and although its awareness has grown since

then, most of the public is unaware of its true meaning and implications. In the media dyslexics are often portrayed as being 'stupid' or dumb, often the worst in the class. These stereotypes carry out into peoples everyday lives, creating low self-esteem and barriers to success. Despite this, there are many high profile dyslexic achievers such as Albert Einstein, Tom Cruise, Jamie Oliver, and Richard Branson.

### 1.3.3 Product Trends

Products on the market for dyslexics fall into the categories of educational resources, software apps, and reading assistants. Educational products are overwhelmingly designed for children both psychologically and ergonomically. They include games, assistive pen grips, and teachable slide decks. There is also an extensive amount of software designed for dyslexics such as the dyslexic font, and online writing assistants like Grammarly. Speech-to-text and text-to-speech technology are also extremely popular both in physical and software formats.

Along with products, dyslexia is often tackled with special teaching methods such as tutoring with an Orton-Gillingham specialist. this style of teaching is "a direct, explicit, multisensory, structured, sequential, diagnostic, and prescriptive way to teach literacy when reading, writing, and spelling does not come easily to individuals, such as those with dyslexia" (What is the orton-gillingham approach? 2019). The OG method is based on science based evidence of dyslexic learning.



Phonic Card Deck



Text Scanner



Orton-Gillingham Symbol

## CHAPTER 2. RESEARCH

Research and understanding the user are the foundation of good design. Users, environments, competitors, and experts were researched and investigated to have a solution grounded in theory and facts.

### 2.1 User Research

Users were explored from a variety of standpoints to get a grasp on the primary, secondary, and tertiary users. The user was first narrowed down in the form of a persona, then interviews and surveys were conducted to find out about their needs and feelings.

#### 2.1.1 User Profile & Persona

The user profile was created to have a persona to base the product on, document activity cycles and understand on a deep level their specific emotions. The primary user is as listed below:

**Name:** Rose Peterson

**Age:** 25

**Job:** Designer

**Income:** \$ 45,000

**Education:** Post Secondary Diploma

**Location:** Toronto



Persona Woman

**Profile:** Rose is a 25 year old woman living in the greater Toronto area. She works in the city at an office in a 9 to 5 job. She has to work twice as hard as her neurotypical coworkers to succeed in her daily work tasks. Work often exhausts her and makes her struggle with hope of career growth. Outside work she is known as a creative and charismatic person to her friends and family. She has hobbies such as making music, kickboxing and spending time with friends.

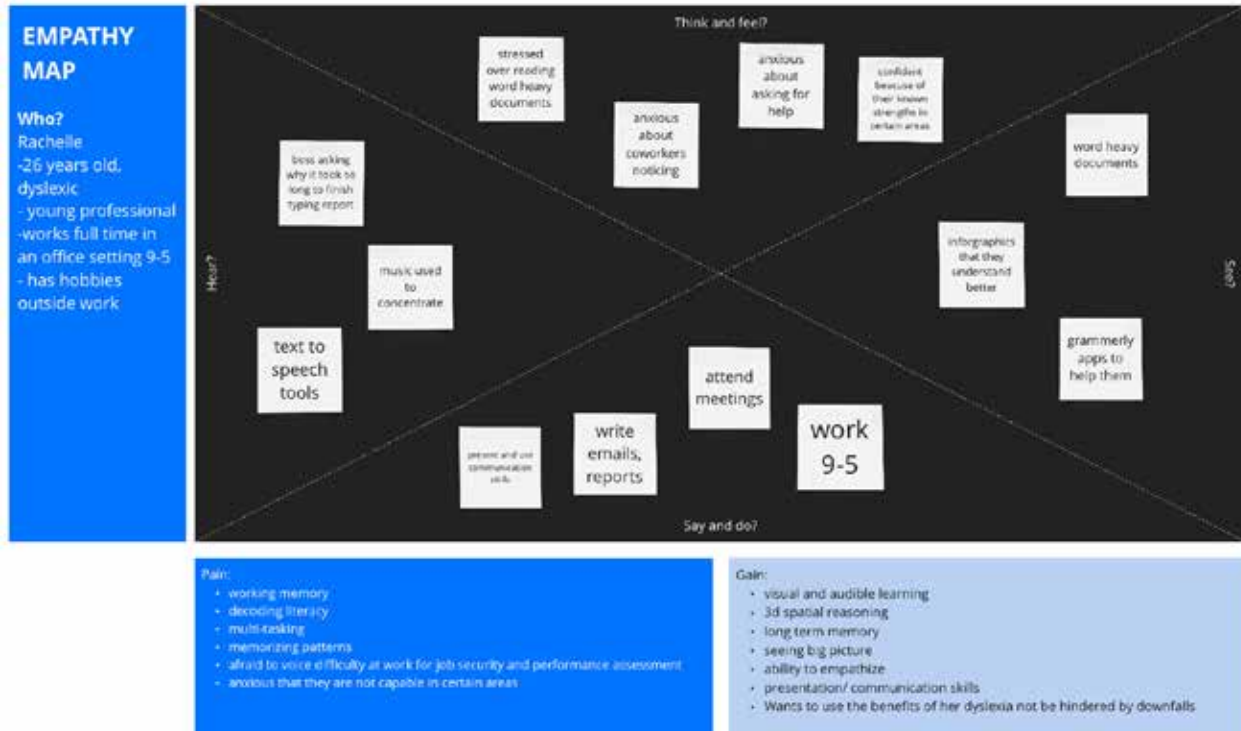
**Primary User:** The primary user is a dyslexic adult within the age range of 23- 26, who works in professional environments. They are the user that will have the highest degree of interaction with the solution and whose needs will be considered fully. Professional environments include jobs such as office workers, designers, doctors, or jobs that require post-secondary education.

**Secondary User:** The secondary user would be coworkers and other office associates of the primary user. They could be neurotypical and interact with the primary user with work-related tasks. They would have the next level of degree of contact with the solution.

**Tertiary User:** Tertiary users include buyers of the final solution such as business owners, managers, and corporate entities. This solution being oriented towards an office may be put in place by those other than the workers. Anyone involved in the purchase or installation of the solution would fall into tertiary, and have the least degree of contact with the final solution.

### 2.1.2 Current User Practice

Dyslexics in the workplace typically develop coping mechanisms to keep up with coworkers. Most dyslexic employees keep their disability private from their employer to avoid discrimination or embarrassment. This often leads to struggling in silence. If they are transparent with employers, they may receive some support or extra time on tasks, depending on the grace of their managers and the capability of their organization. It is relevant to note that it is a legal right in Ontario for workplaces to accommodate persons with disabilities under the Ontario Human Rights Commission (see Appendix F). Below is an empathy map created to help understand the user's current practices.

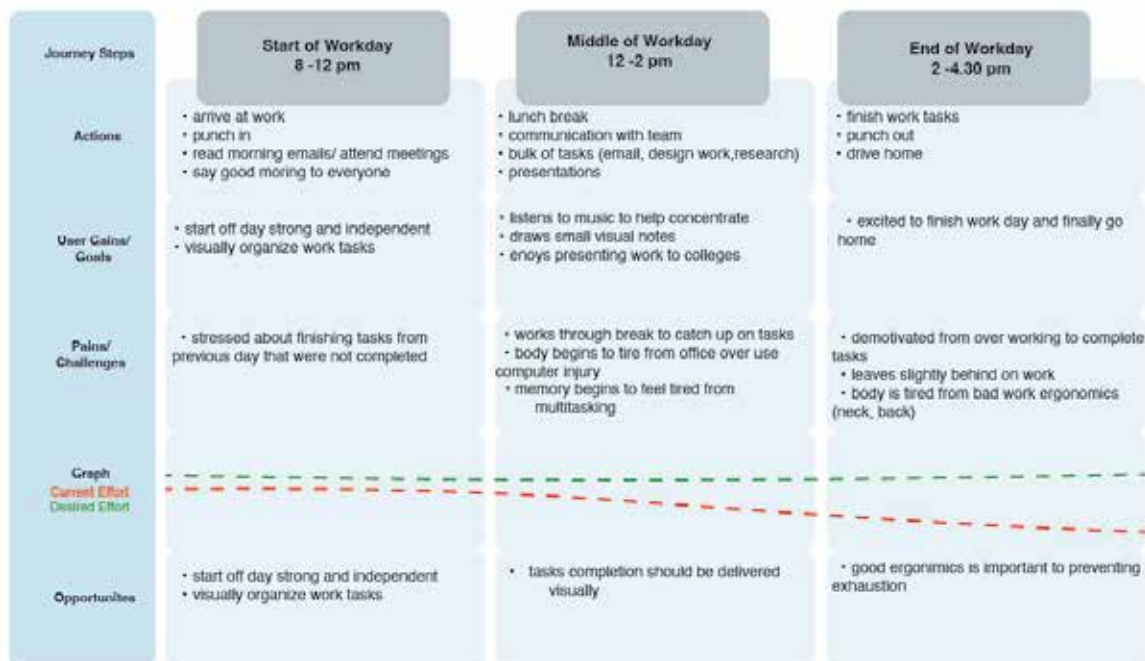


Empathy Map

### 2.1.3 User Observation - Activity Mapping

Below is an activity map describing the users day to day activities and stressors.

Key takeaways are that the persona has a steady decline of effort, and morale throughout their work day due to exhaustion of keeping up with tasks.



Journey Map

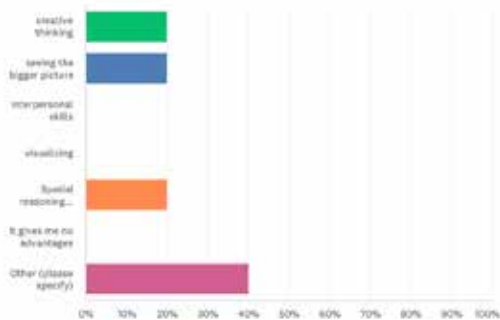


## 2.1.4 Survey

In research efforts, a survey was created to collect general information from a wide scope of dyslexic adults and their broad experiences. The survey was placed on public sites such as Reddit to receive answers. Key takeaways include that dyslexics do feel they are hindered in their jobs; however, some feel it also provides them specific advantages.

Do you feel your dyslexia gives you any advantages at work?

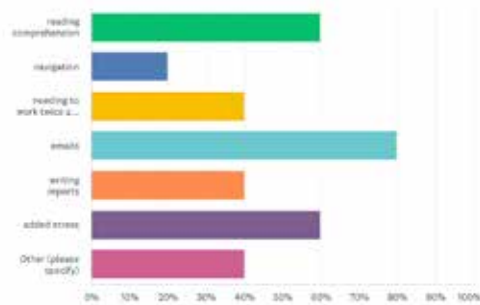
Answered: 5 Skipped: 0



Survey Monkey Results 2

How do you feel your dyslexia hinders you in your job?

Answered: 5 Skipped: 0



Survey Monkey Results 1

## 2.1.5 Expert Interview

An interview with an expert in the field was conducted to collect specific data on research questions from an experienced source on the outside. Cheryl Urbanczyk was interviewed on September 19, 2022, over the telephone. She is a certified structured literacy instructor with 15 years of experience in teaching dyslexics. Below is a sample excerpt from the interview:

Reem:

“What are the top three challenge of those that struggle with dyslexia are?”

Cheryl:

“First one would be with large volumes of reading. If students with dyslexia get proper teaching and remediating, they can read and they can read at grade level, the problem is it's every slow, very labored and takes much longer to read, then it would a neurotypical counterpart. The causes issues because if you are confronted with large volumes of info it can take you 2 times 3 times as long to read it as someone else. That has

to do with the brain, it's working at a different pace tis not linked to intellect. Second issue would be having to memorize lots of basic information. Dyslexics are often challenged with memorized basic facts, like addition facts, low level memorization is a challenge, so if there is ways to support that would be great. Memorizing letter strings is often challenging. The third challenge which kind of incorporates the first two, not having supports in place to utilize strength and support them with challenges. Because dyslexics bring many strengths but if supports are in place to help with volumes of reading or help with other aspects, the strengths the dyslexics have can be put in place.”

### 2.1.6 1:1 Interview

A 1:1 interview was conducted with an interviewee who matched the user persona being studied. They are an adult male with dyslexia, diagnosed in their early youth, now working in the professional design industry. The interview was conducted over the phone in winter of 2022. Below is a sample transcript from the interview.

#### **Anonymous Interviewee:**

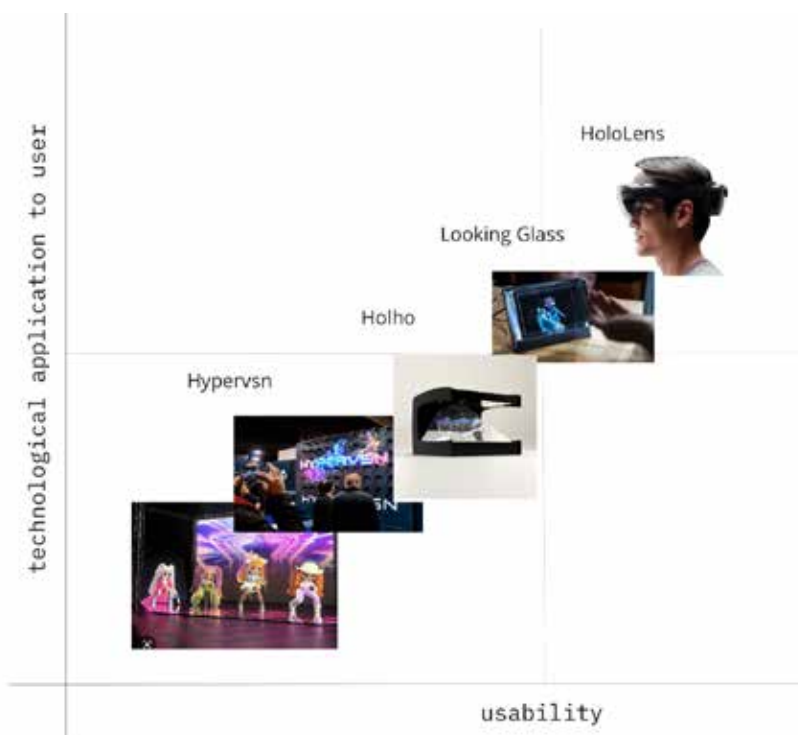
“Ever since a very young age it was figuring out how I learned and a big part of that was realizing ima very visual and audible learner. So um I'm not a person to take notes during your lecture I'll just sit there and listen to it and watch it and preferably if their is pictures on the board, or anything I could connect those pictures too visually that was very helpful. I'm a very visual learner I also have a very good understanding of 3D space, which comes in handy as an industrial designer. So yea it's just realizing how you learn as an individual and what career is going to cater towards that.”

This interview highlights the ways that dyslexics learn and the specific strengths that they have. It also reveals that their neurodivergence has an impact on their career path and progression of career. (For sull transcripts see Appexdix E).

## 2.2 Product Research & Benchmarking

Product benchmarking was conducted to determine the benefits and features of competitor products on the market. The direction of design after ideation and research is holographic computer technology and 3D workplaces. In this chapter, we will investigate technologies that already exist in this area of technology, design, and holograms.

### 2.2.1 Benefits and Features of Existing Products



Benchmarking Existing Products






This graph demonstrates a usability vs technological application for the user. It contains popular AR and holographic technology on the market in a variety of use sectors such as education, entertainment, and personal use. A wide sector of use was picked to learn from a variety of products.

### 2.2.2 Functionality of Existing Products

Functionality was determined by which product closest resembled the design

direction and solution for the target user. This includes technology, usability, and optimization. From this chart, it is gathered that most products do not have 360-degree holographic or are not interactive. Although many have phone or computer plug-ins to connect with other devices and are saleable.

**Existing Holographic and Augmented Reality Products**

Name	Profile	Benefits	Drawbacks	
<b>Product 1: Looking Glass</b>	Holographic lens inside box for retail and personal	<ul style="list-style-type: none"> <li>▪ portable</li> <li>▪ compatible with many softwares</li> <li>▪ 100 degree viewing angle</li> <li>▪ interactive</li> </ul>	<ul style="list-style-type: none"> <li>▪ 2d screen</li> <li>▪ only viewable from 100 degrees</li> </ul>	
<b>Product 2: Hypervsn</b>	Catalog of 3d displays for retail consumers, with interactivity elements	<ul style="list-style-type: none"> <li>▪ modular/ scaleable</li> <li>▪ multi-use</li> <li>▪ supports visual thinking</li> <li>▪ uses spinning light technology</li> </ul>	<ul style="list-style-type: none"> <li>▪ viewed from limited perspectives</li> </ul>	
<b>Product 3: Hololens</b>	"untethered mixed reality headset" by Microsoft	<ul style="list-style-type: none"> <li>▪ portable</li> <li>▪ ergonomic</li> <li>▪ wide use scope</li> </ul>	<ul style="list-style-type: none"> <li>▪ requires headset wear</li> </ul>	
<b>Product 4: Holoho</b>	Consumer and business holographic solutions	<ul style="list-style-type: none"> <li>▪ multi-use</li> <li>▪ smart phone plug ins</li> <li>▪ not interactive</li> <li>▪ high definition image quality</li> </ul>	<ul style="list-style-type: none"> <li>▪ mainly for display purposes</li> <li>▪ no interactivity</li> </ul>	
<b>Product 5: Kaleida - Holonet</b>	Holonet contains real silver which reflects high levels of projected light to create bright and stunning 3D visuals and holographic effects.	<ul style="list-style-type: none"> <li>▪ bright holographic gauza</li> <li>▪ transportable</li> <li>▪ scaleable to any size</li> <li>▪ hyperrealistic</li> </ul>	<ul style="list-style-type: none"> <li>▪ not interactive</li> <li>▪ not 360 degree viewing angle</li> </ul>	

**Table of Existing Holographic and Augmented Reality Products**

### **2.2.3 Aesthetics and Semantic Profile of Existing Products**

Aesthetics for most existing holographic products have minimalistic design language with subtle details. They tend to have a serious black grey, monochrome or chrome palette. This likely to not distract from the holograms themselves. The devices are created with the purpose to showcase the holograms and have their sources hidden.

### **2.2.4 Materials and Manufacturing of Existing Products**

Current materials for benchmarked products are in line with that of other tech products on the market. Including being built from aluminum, plastic, and glass with some precious metals. Most work by either including a projector and screen system or a transparent screen display.

### **2.2.5 Sustainability of Existing Products**

Sustainability of office furniture and technology can be benchmarked by the footprint of current products. Most contemporary office furniture and technology, like many other products, are created in mass, with a planned obsolescence. This is especially true of technology such as computers and phones. Creating furniture and products with longevity in mind is key to increasing sustainability. Longevity helps with “reduction in waste, but another takes the form reduced carbon emissions resulting from the use of fossil fuels in their production: all manufactured products contain embedded carbon.” (Cooper, T. (2012). Longevity in office products can greatly reduce the office waste output.

## **2.3 Summary of Chapter 2**

Over the course of the preliminary research through surveying, interviews, and data collection, a large net of understanding has been gained of the user. Both qualitative and quantitative data were accumulated to ensure a rounded understanding of how dyslexics operate and cope in their environments. Key conclusions include:

- dyslexics have struggled with literacy, and their disability often has an impact on their career and career path.
- dyslexics do have and feel their disability provides them with certain strengths in areas of visualization and 3d thinking.
- current products do not fully address these strengths for adults. current holographic products are not office designed or interactive.

## CHAPTER 3. ANALYSIS

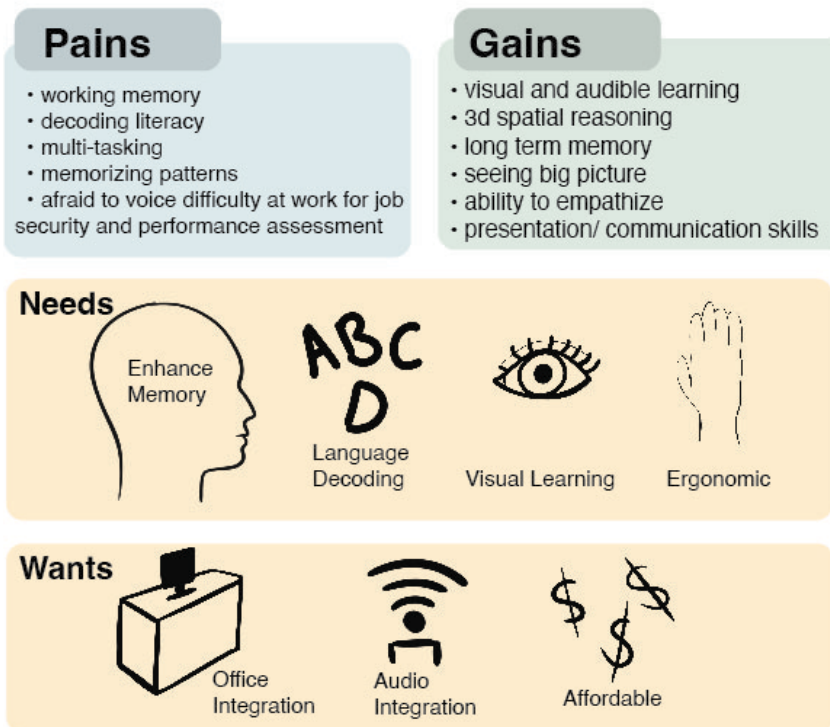
Through research in chapter 2, analysis can now take place to uncover hidden needs and dig further into solution criteria for solution building. This chapter explores ergonomics, sustainability, aesthetics, and design solution criteria.

### 3.1 Analysis - Needs

#### 3.1.1 Needs & Benefits Not Met by Current Products

The main issue with most dyslexic products currently on the market is that they are targeted to children or adolescents first learning to read. Resources for adults are limited, further isolating them from getting help. They are also often very targeted to particular uses such as handwriting or reading and do not provide well rounded solutions that enhance capabilities. Most importantly, current products are not office or work specific.

#### 3.1.3 Categorization of Needs



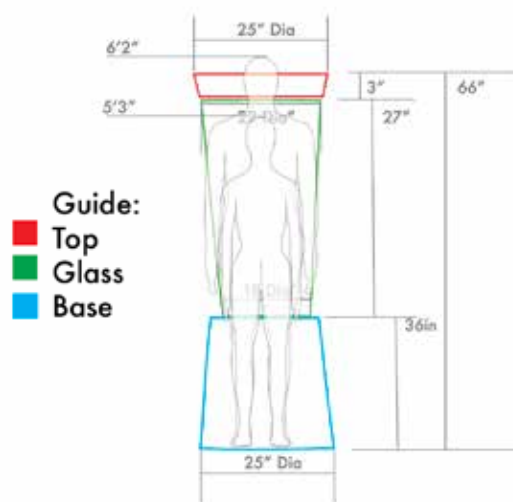
## 3.2 Human Factors

The method for this ergonomic study is to build a physical 1:1 size mock-up to accurately assess the full-body human ergonomic touch points and interactions. The major positions being assessed are standing and sitting and arms distance when used. The Holokin computer model was made of cardboard, tape, and books for height. The controller was created by taping up a hand for reference. While little detail was given to the aesthetic of the model, it was the first step in ensuring my design was viable going from paper to product. The target audience for this study is typical office workers, ages 22-28 within my target user range. Ideally, a variety of body types will be used to represent the diverse population of an office. The subjects will be tested standing in front of the model and sitting.

### 3.2.1 Product Schematic

The beginning stages of ergonomics was developing overall basic dimensions for the glove and holographic stand. The height of the glass portion was designed to be used from both a sitting and standing position.

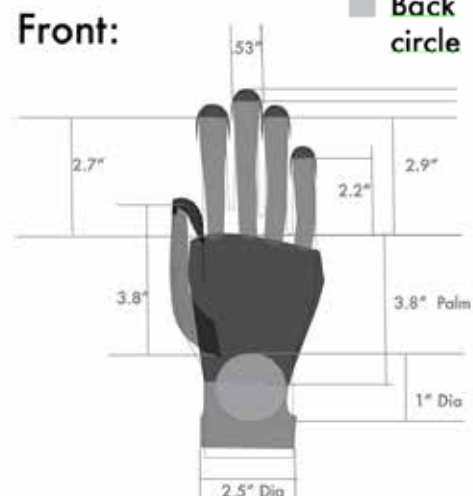
#### Front: Standing/ minimum:



#### Women Hand:

**Guide:**

- Hard Plastic (Black)
- Cloth (Grey)
- Back circle (Light Grey)





### 3.2.2 Ergonomics & 1:1 Human Scale Study

A human scale study was done to understand the overall dimensions in 1:1. The tests included the participant in front of a stand that would be the same height as the product both sitting and standing. Additionally, to understand the pattern and level of flexibility needed for the wearable controllers, a simple scratch model made of tape was created to wrap around a user's hand.



Ergonomic Test 1- Front



Ergonomic Test 2- Side Seated



Ergonomic Test 3- Side Standing



Hand Ergonomics Test- Side



Hand Ergonomics - Flat

### 3.4 Aesthetics & Semantic Profile

Aesthetic inspirations for the design solution include ultra-futuristic, tech, modern, and sci-fi inspirations. Design cues were pulled from various product experiences that include a full-body interaction, futuristic movies, and office concepts. The chosen color palette is leaning towards chrome, greys with blue and orange accents. Materials include a mixture of industrial metals, glass with an emphasis on transparent surfaces and walls. Design language for the product could be minimalistic and rectilinear to easily mesh with a variety of offices and workspaces.



Mood Board solution

### **3.5 Sustainability: Safety, Health and Environment**

People spend majority of their day in their workspaces, whether it's at home or in office. These spaces typically include a desk, chair and computer configuration. While this is the norm, their sustainability and safety are far from optimized. Health concerns include the musculoskeletal risks of long hours of sitting, which have been well documented. Sustainability concerns include that of furniture longevity and recyclability. The Holokin work system puts safety and sustainability first with its materials, build and ergonomics. It does through choosing sustainable materials, emphasizing reusability and getting rid of a space that requires repetitive motion.

#### **3.5.1 Materials & Manufacturing**

##### **Office**

The office enclosure of the system can be manufactured from simple recycled metal bending and bonding techniques. Fabric will then be upholstered to the frame using plant based biodegradable fabric such as hemp. The simple exposed design can also make it easier if the user needs to replace certain parts without disassembling or buying a new system. The desk will also be made from reclaimed wood.

##### **Technology**

The Holokin computer will be a combination of metals and plastics for inner and outer. The outer shell could be made with aluminum CNC manufacturing. Aluminum is lightweight, durable and recyclable. The glass screen could be formed from C2C certified Float Glass or regular glass. Due to the size of the glass components, forming it in parts that are fused together is a more realistic approach. Inner components will be electrical metal and plastic pieces.

##### **Glove**

The glove will be fabricated with a combination of soft and hard components. The glove will be made of some type of leather or leather alternative such as Piñatex which is

made from cellulose fibers extracted from pineapple leaves, PLA, and petroleum-based resin. It is strong durable and water resistant the hard components will include ABS (Acrylonitrile butadiene styrene) for the hard plastic fingers and a Bluetooth connector. Additionally, the band will include a magnetic strap for adjustability.

### 3.5.2 Safety

The prominence and necessity of technology in the workplace has created many technology related ailments or 'technological diseases'. These are mostly related to prolonged use of computers and their related unergonomic chairs posture. For example, overuse of the computer mouse is dubbed 'mouse arm syndrome'. Which can affect the regions of the hand, wrist and forearm. Not only the mouse use but also "to a lesser extent keyboard usage, were the main risk factors for forearm pain" (Kryger, A. I. (2003). Carpal Tunnel Syndrome is also a high risk with repetitive motions of computer use, which "at least



Carpal Tunnel

1 out of 10 people develop this disorder or suffering from the symptoms of this syndrome. This is one of the most common causes of absenteeism in the workplace and disability in the United States" (Tiric-Campara, M., Krupic, F., Biscevic, M., Spahic, E., Maglajlija, K., Masic, Z., Zunic, L., & Masic, I. (2014, October)). This demonstrates the importance of good ergonomics in office spaces and their devices.

Safety aspects include an emphasis on preventing common workplace injuries stemming from overuse such as carpal tunnel and mouse arm. The Holokin system does this by introducing a standing to seated environment, and motion controls that free the user from repetitive movements. By allowing the user of freedom of motion they are not going to overuse certain muscles, rather use motions that come more natural to the body. Seating to standing options also mean they can avoid spinal stress and prevent exhaustion. The open concept space is also optimal for accessibility.

### **Conclusion**

The Holokin office system prioritizes sustainability through materials, emphasizing reusability and takes away health risks by removing the necessity of repetitive motion. This helps reduce safety problems such as carpal tunnel and musculoskeletal ailments. Sustainability is also tackled through biodegradable materials and easy simple build that reduces carbon emissions. In a world where the workplace has become the focal point of our time these spaces must prioritize safety and environmentalism.

## **3.6 Analysis - Innovation Opportunity**

### **3.6.1 Direability, Feasability, Viability**

#### **Feasability**

The overall cost for the system would include the Holokin holographic computer and glove controller. For the product to be within the budget of a typical business it would have to be within the scope of other corporate use technology costs to gain traction. While raw materials may not cost individually, machinery to streamline the processes of manufacturing will be high driving up the price. This includes custom molds, machines, and parts.

## **Viability & Market**

While the target users are dyslexic adults, the buyers would be businesses themselves looking to provide employees with an elevated experience. The product would be marketed as having a great benefit to the business besides just the specific user, but for the business. An additional market expansion could then include areas such as education, medicine, and even private consumer use.

### **3.7 Defining Design Brief**

The goal of this thesis is to develop a system to maximize the productivity of adult dyslexics in the office and revolutionize workflow. The following 10 criteria were born from the research and analysis conducted and will be the meterstick of success for the goals of the project.

**Design Criteria**

<b>Utilize Strengths of Dyslexic User</b>	The product should utilize and maximize the strengths of the dyslexic thinker. This includes visualization, 3D spatial thinking, communication and empathy.
<b>Minimize Struggles of Dyslexic User</b>	The product should minimize and lessen the pain points of the dyslexic user. This includes memorization, pattern recognition, reading, text heavy comprehension.
<b>Work &amp; office Integration</b>	The product should be able to integrate into the environment of use which is the office.
<b>Ergonomics</b>	Ergonomics should be at the centre of the design for long use and safe interaction.
<b>Sustainability</b>	Sustainability is vital for the longevity of production.
<b>Affordability</b>	Solution should be within the budget of the buyer and intended environment of use.
<b>Work Flow</b>	The solution should be easily integrated into the users work flow at their office job.
<b>Adult &amp; Professional Target Audience</b>	Most products on the market for dyslexics are marketed and designed for kids, this solution should be specific and designed for adults.
<b>Intuitive Use</b>	Use should be intuitive and easy for user to learn.
<b>Design</b>	Design should be aesthetic and provide beauty to the work space without distracting from tasks. It should be visually appealing to business and users.

Table of Design Criteria

## CHAPTER 4. DESIGN DEVELOPMENT

After research and analysis, ideation began with the guiding information as its backbone. Using the interviews, maps, and personas created, the evidence was integrated into designing solutions tailored to the pains and gains of the user. This chapter explores the development for idea to final solution.

### 4.1 Initial Idea Generation

#### 4.1.1 Inspiration & Mood Board

The aimed style moving forward is both dynamic and rectilinear. Drawing from a dark, industrial, and futuristic color palette. This palette is also neutral enough to be incorporated into a variety of office spaces without disrupting the branding of buyers.

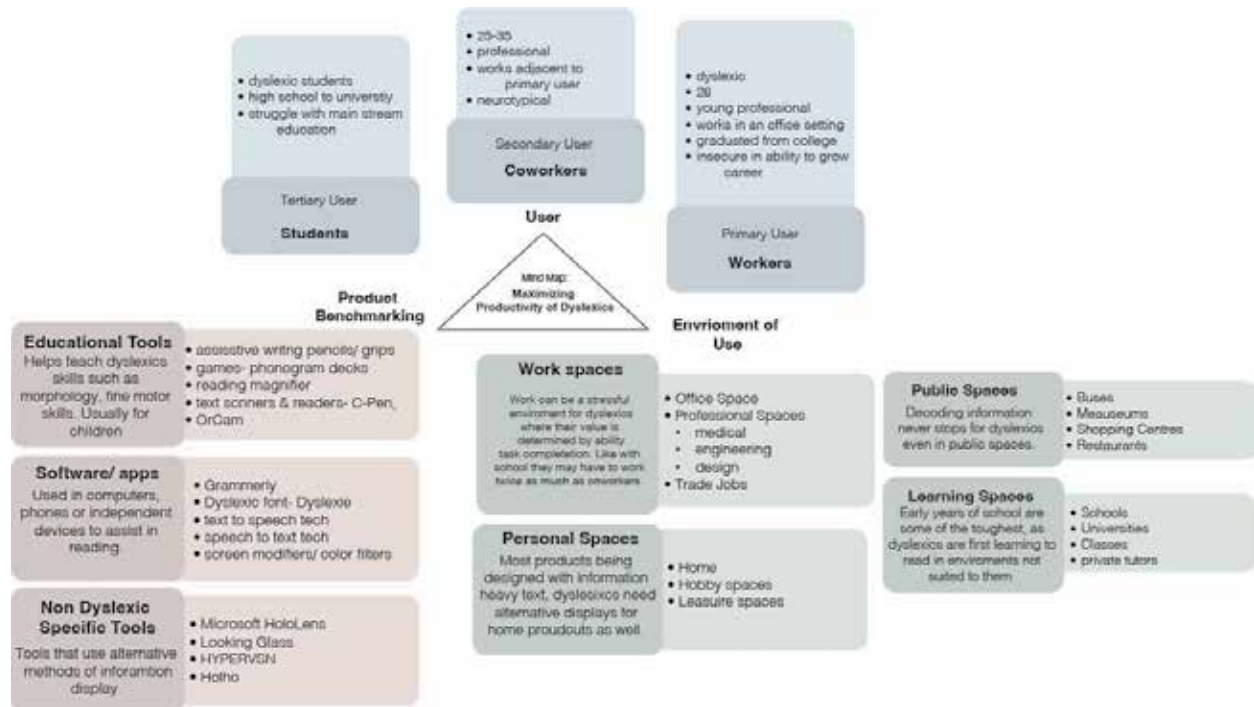


Mood Board aesthetic



### 4.1.2 Mind Mapping

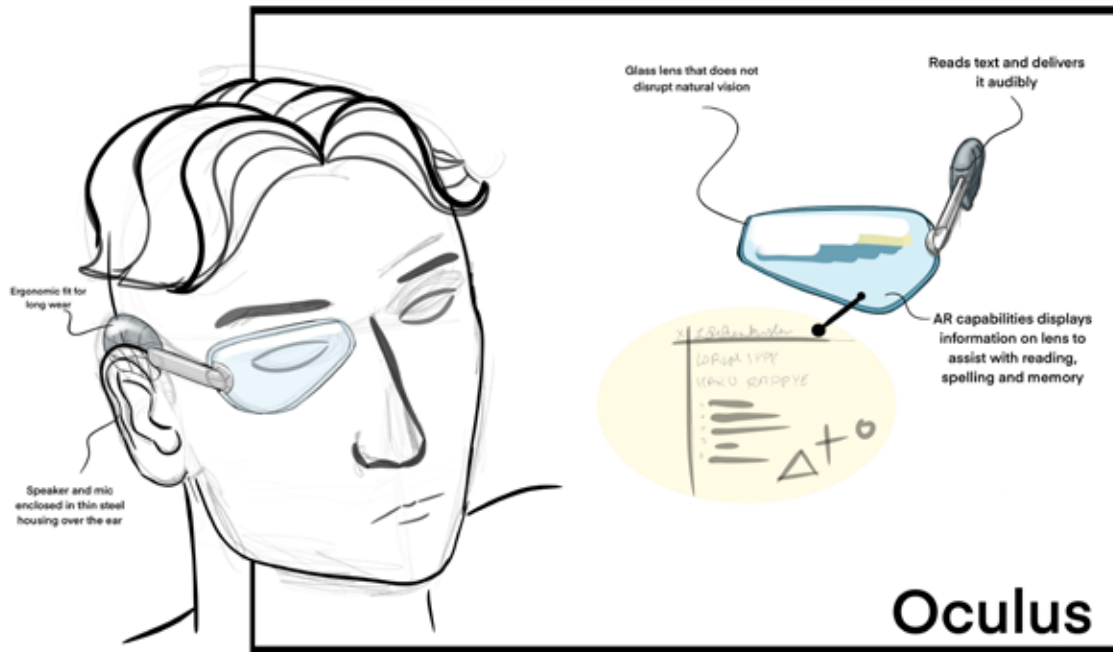
Below is a mind map showing connections and relations between users, environments and benchmarking. It is a complete summary of the analysis done from research to guide steps forward.



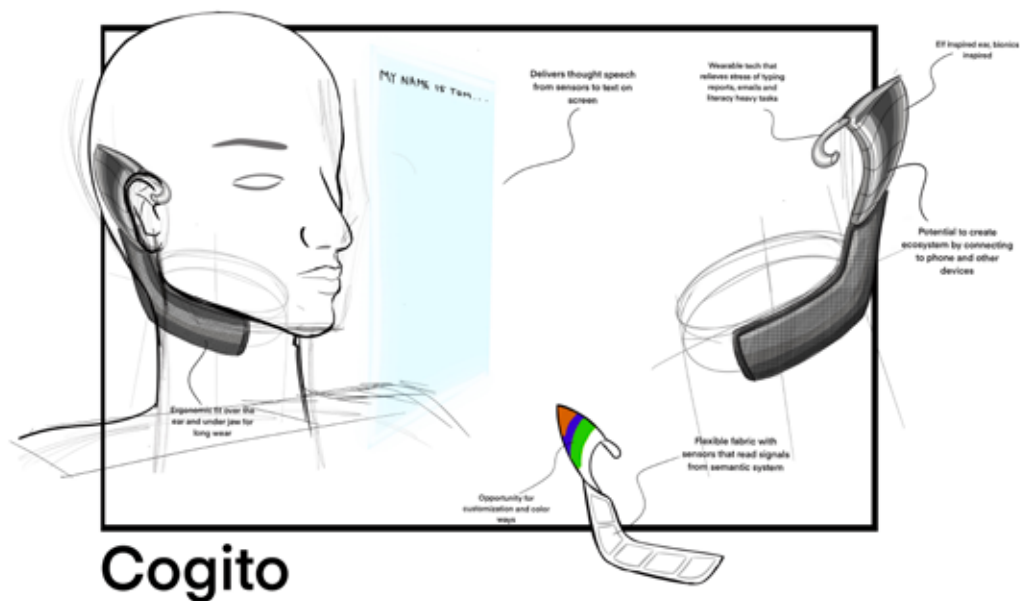
Triangulation Mind Map

### 4.1.3 Ideation Sketches

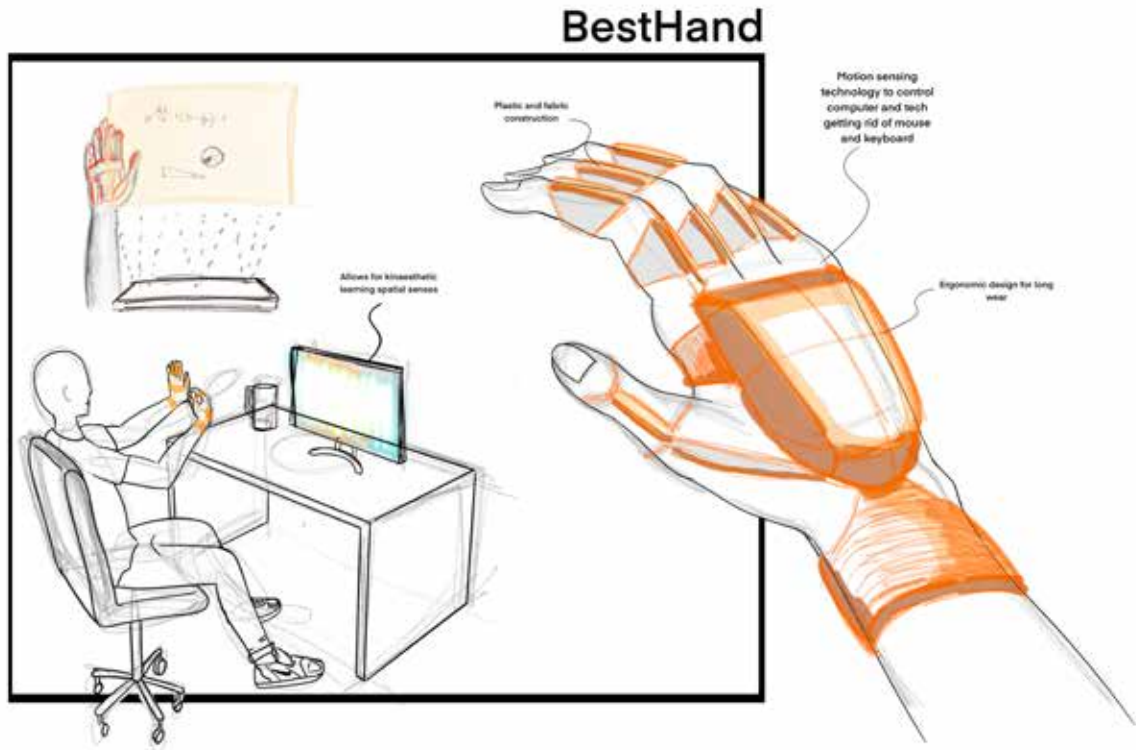
Initial ideas drew from a large pool of solution opportunities and were distinctly different to ensure all bases were touched upon. They include wearables and office solutions.



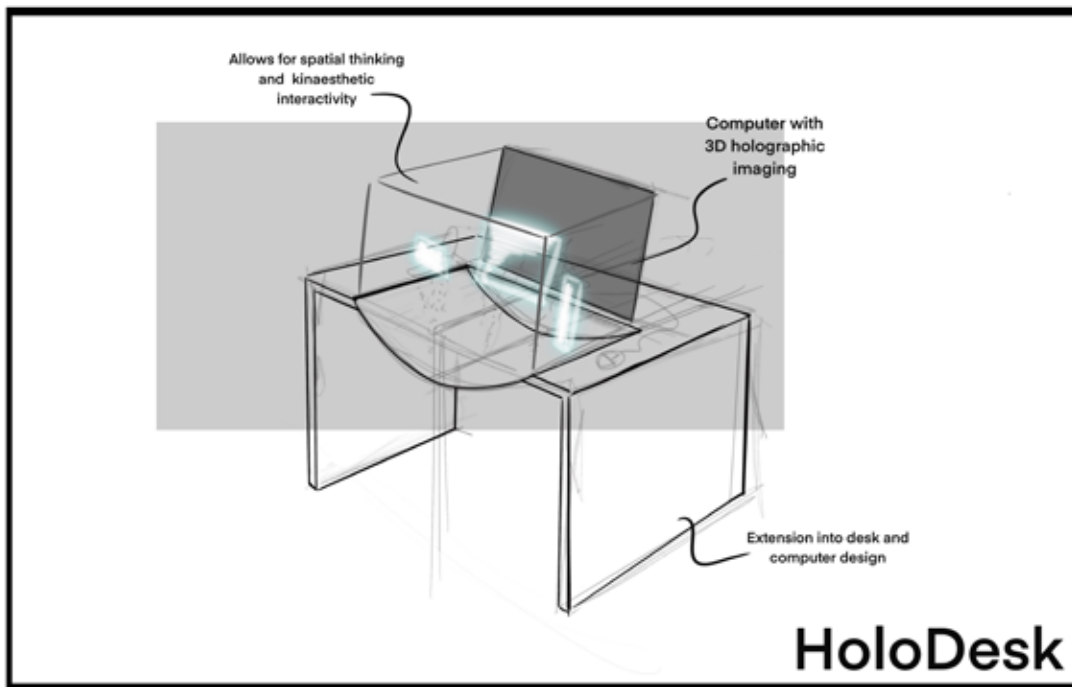
Oculus Sketch



Cogito Sketch



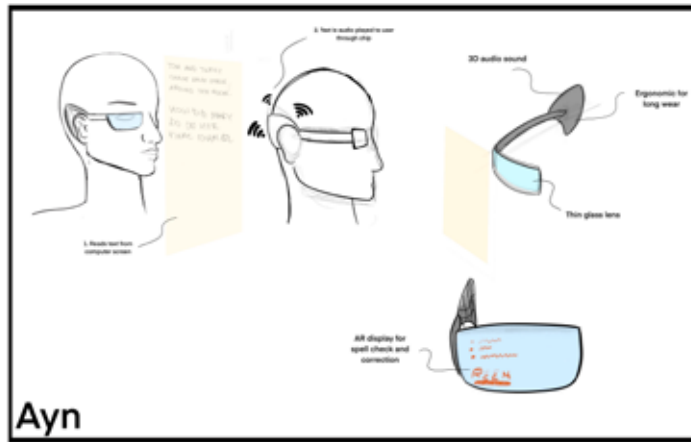
Best Hand Sketch



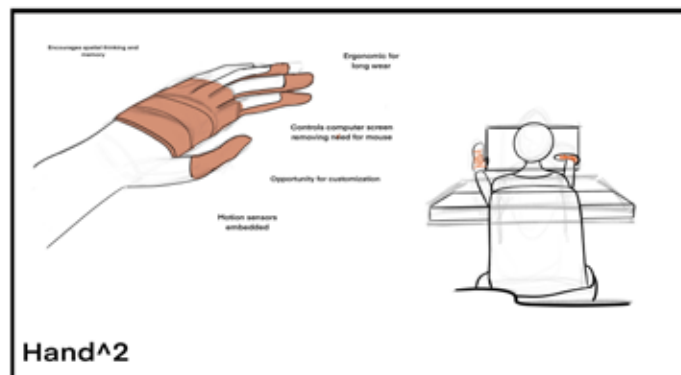
Holodesk Sketch

## 4.2 Concepts Exploration

A wearable controller and glasses were the two chosen solutions with most potential for concept exploration. The last concept is a combination of a glove with what would become Holokin in later concepts, holographic computing.



Ayn - Arabic for eye



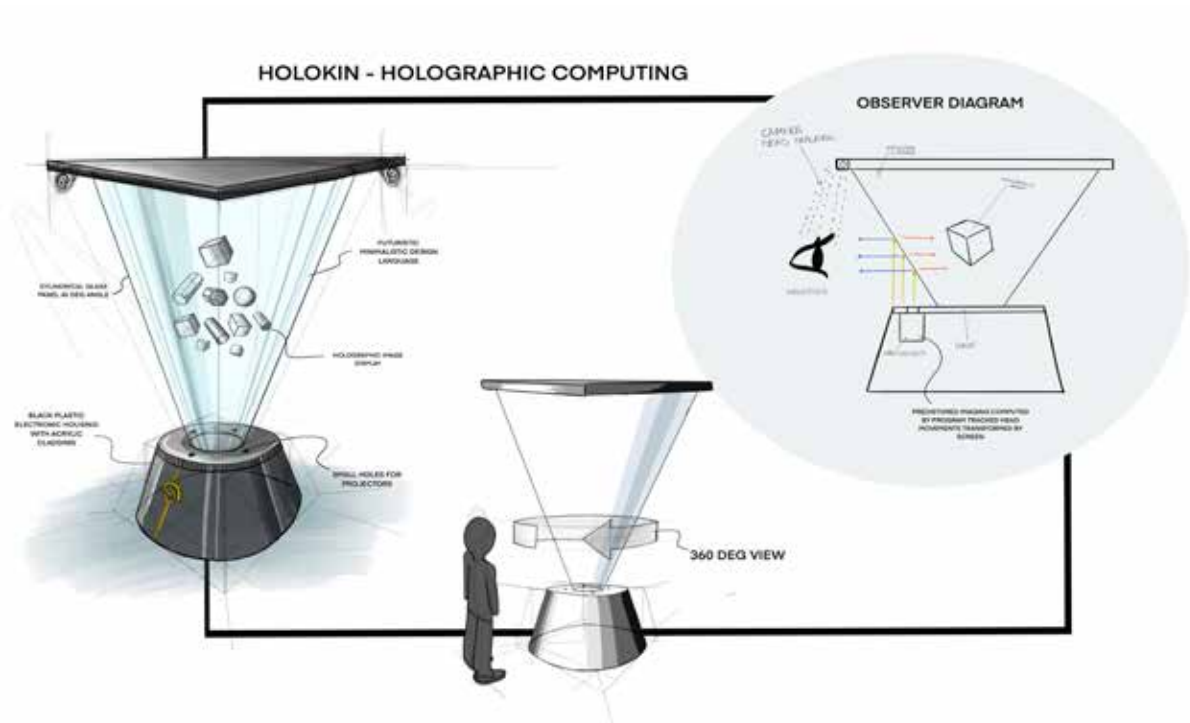
Hand ^2 Sketch



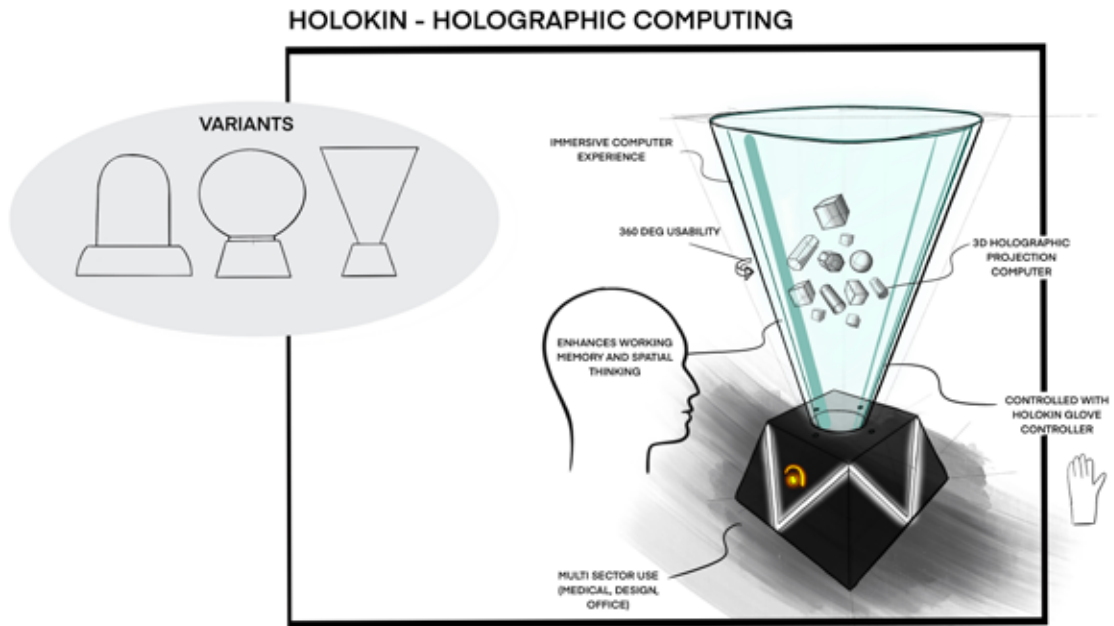
Holokin x Hand ^2 Sketch

### 4.3 Concept Strategy

A combination of both the wearable controller with a 3D computer system was put together to create a solution that meets user needs with full-body interaction. The solution began to take form in the shape of a large-scale interactive holographic projection system. The holograph technology is based on Pepper's Ghost illusion (see Appendix C). It projects images through the glass cone creating a pure hologram. There is increasing evidence that seeing images in 3D promotes cognitive understanding, especially for dyslexics. Hence, the Holokin becomes the concept strategy moving forward. See the following sketching for detailing and shape.



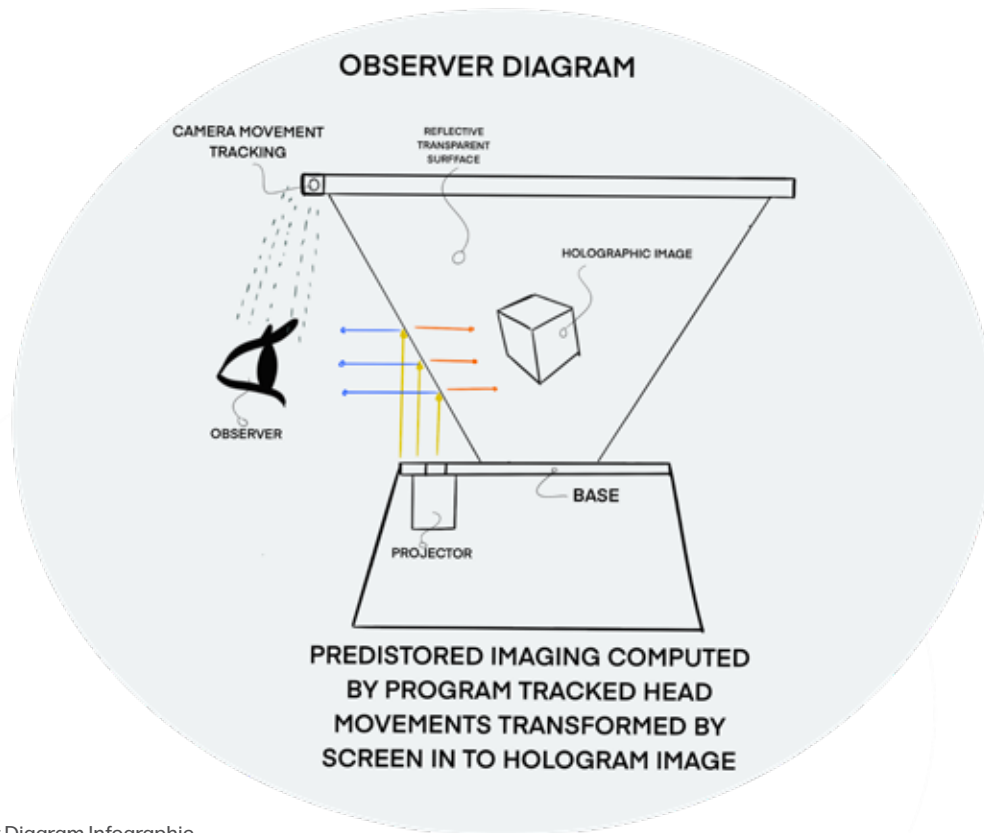
Holokin Holographic Computing with Diagram Sketch



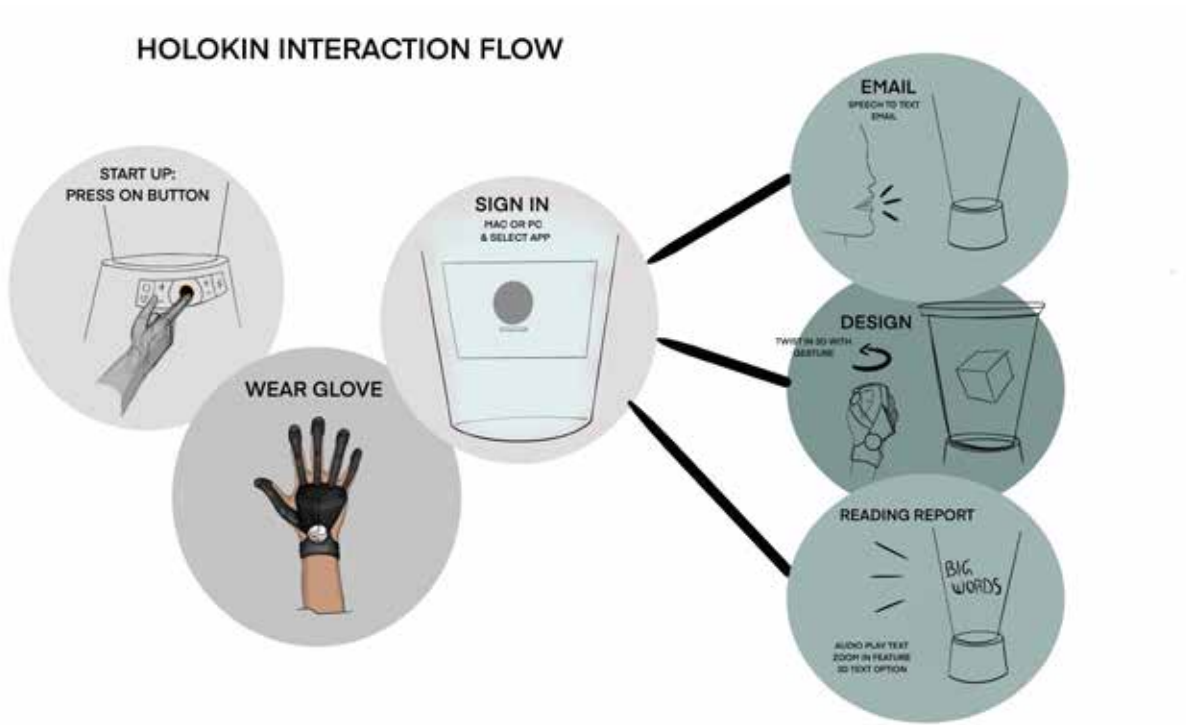
Holokin Holographic Computing Details Sketch



Holokin & Controller Sketch



Observer Diagram Infographic

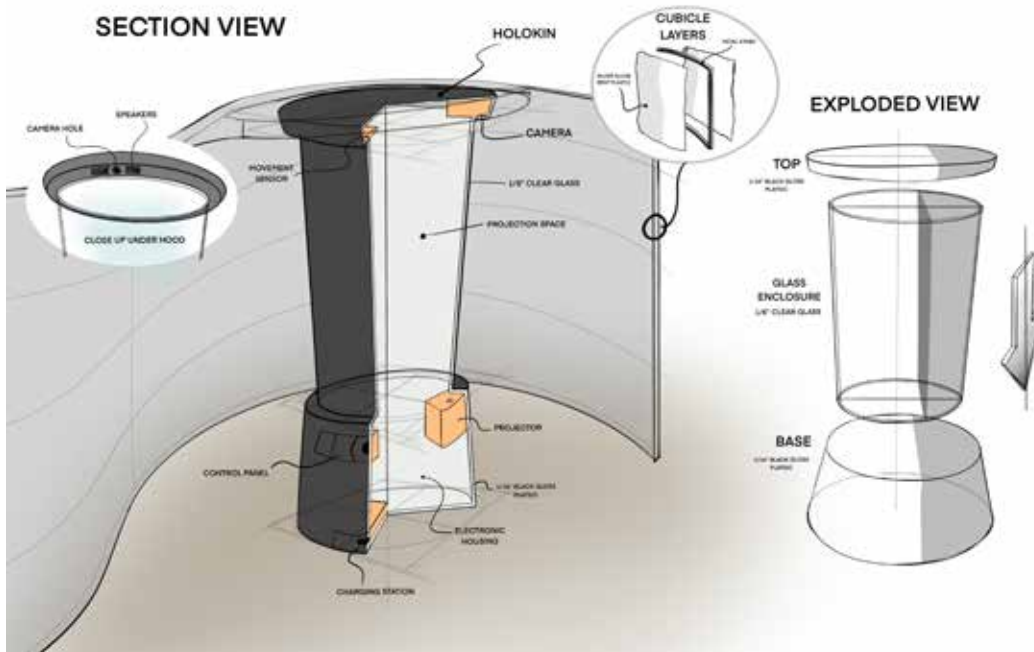


Interaction Flow Sketch

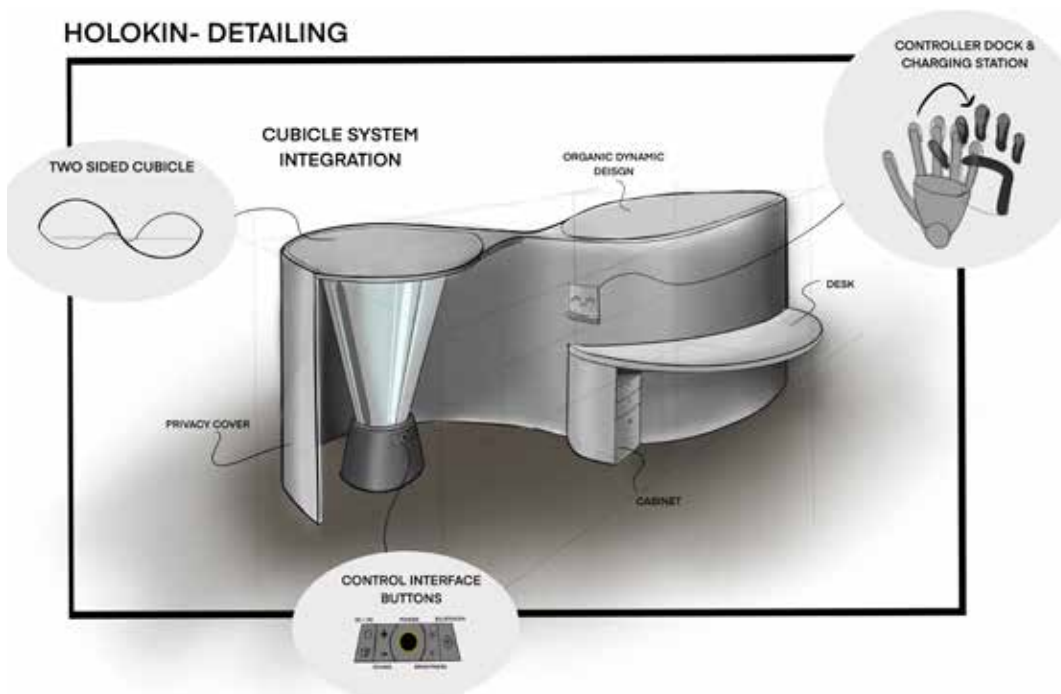
## 4.4 Concept Refinement & Validation

### 4.4.1 Detail Refinement

Design refinement included improving upon the shape of the system and adding in a cubicle to enclose the holographic computer.



Holokin Section View Sketch



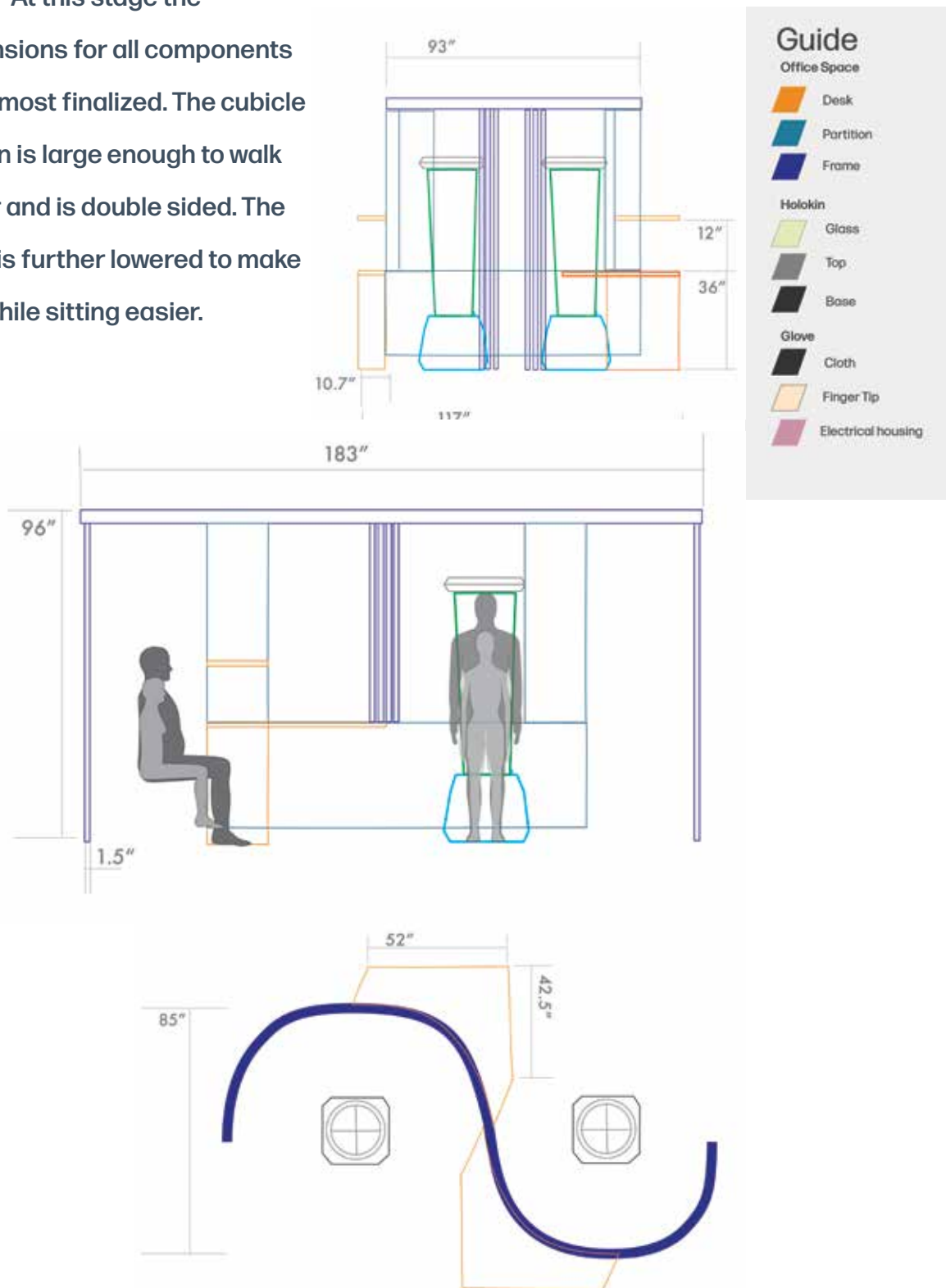
Holokin - Detailing Sketch

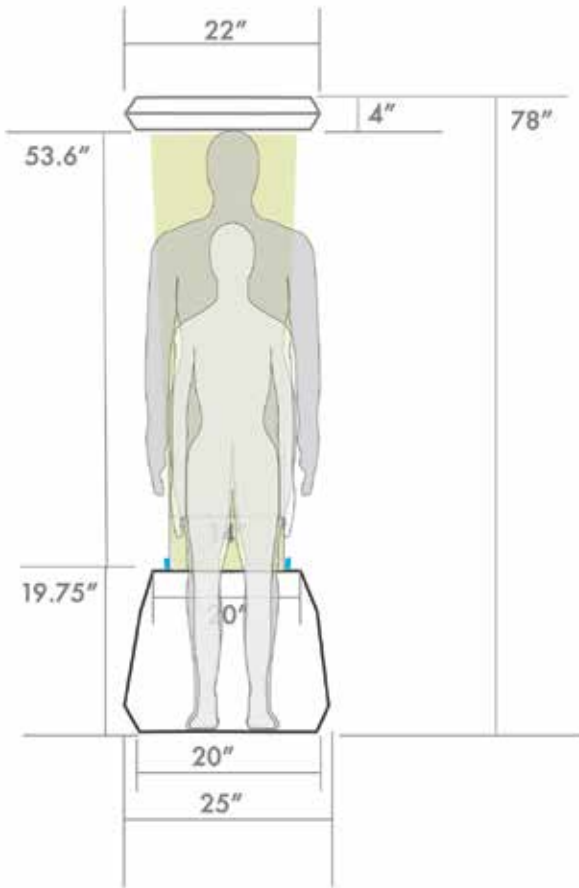


## 4.5 Concept Realization

### 4.5.1 Design Finalization

At this stage the dimensions for all components are almost finalized. The cubicle design is large enough to walk under and is double sided. The base is further lowered to make use while sitting easier.





### .5.2 Physical Study Model

The physical study model was created at 1:7 scale to test and fine tune the design dimensions. It was created from foam board, felt, poster board and other mis materials.

The hand was crafted over a wooden mannequin hand.



Sketch Model - Front



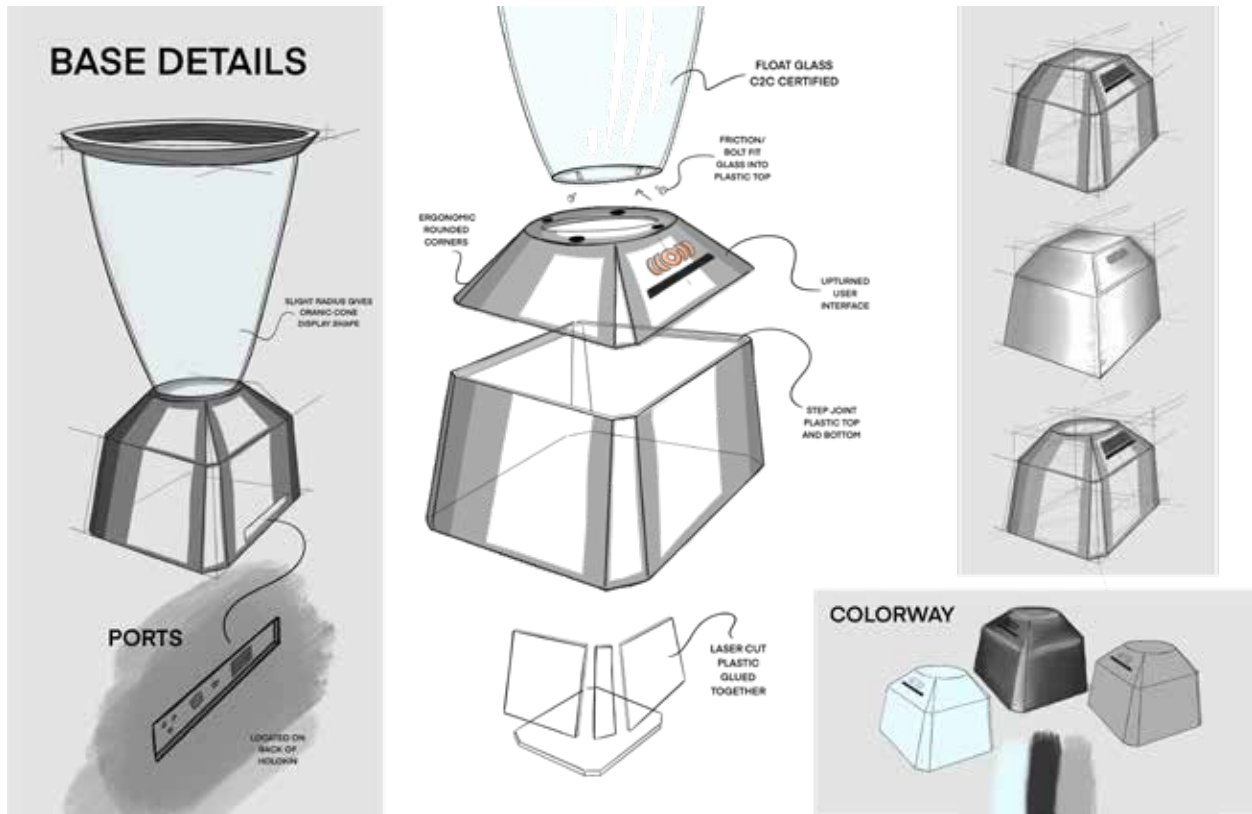
Sketch Model - Desks

Sketch Model - Holokin

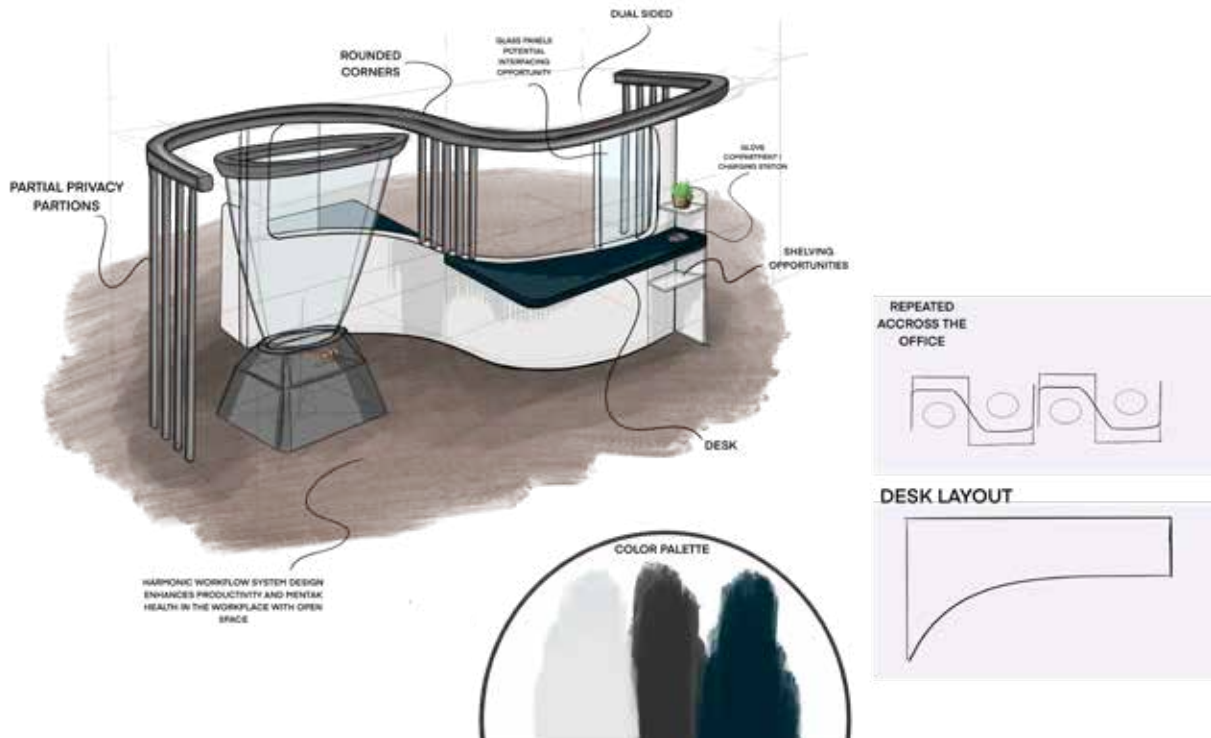


Glove Controller Sketch Model

### 4.6 Design Resolution



Base Details sketch

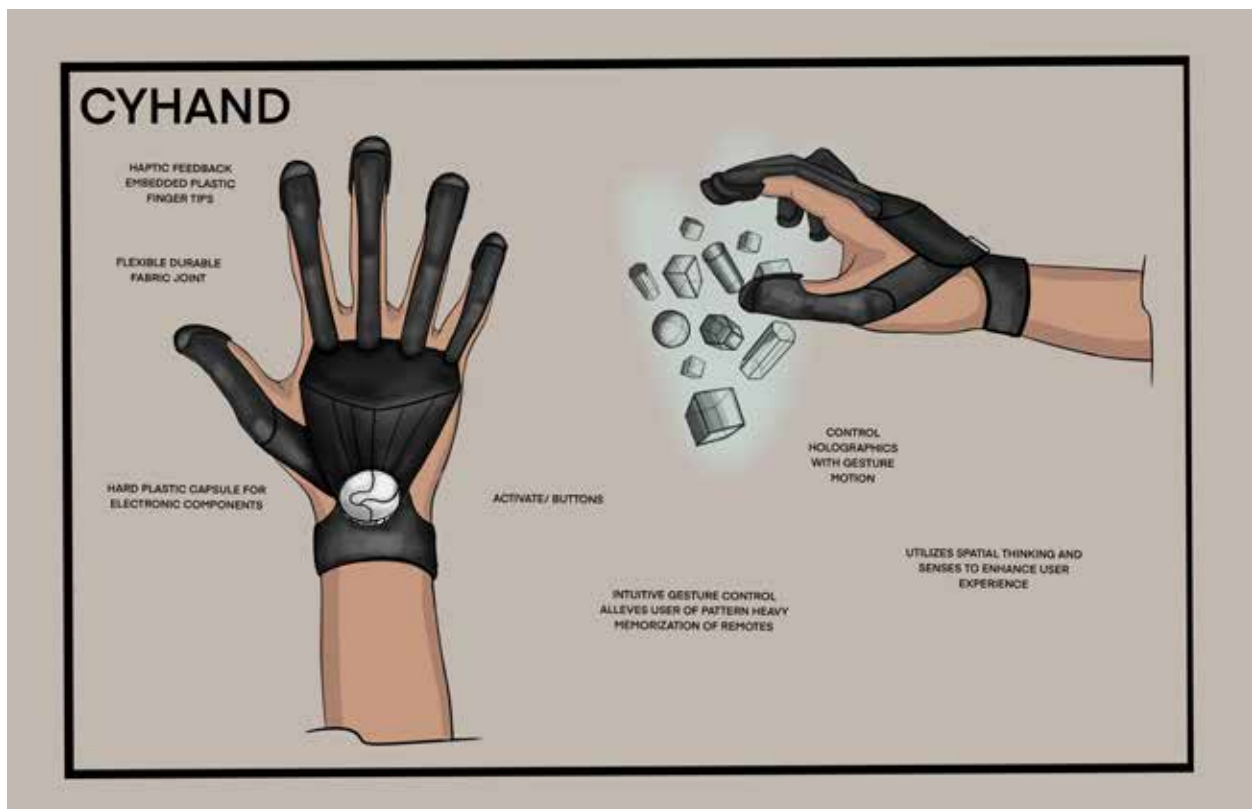


Holokin Office Cubicle Sketch

The wearable controller took form in the look for a deconstructed glove inspired by the human hand skeleton. The main housing of electronics including Bluetooth connectors, and the battery is enclosed in a circular disk at the wrist resembling where all the bones of the hand connect. The fingertips are all enclosed and tapered to house the haptic feedback that would work in combination with the holograms. Haptic feedback would include vibrations, and pulses. Adjustability will be in the wrist strap and bend of the fingertips to allow for different radii.

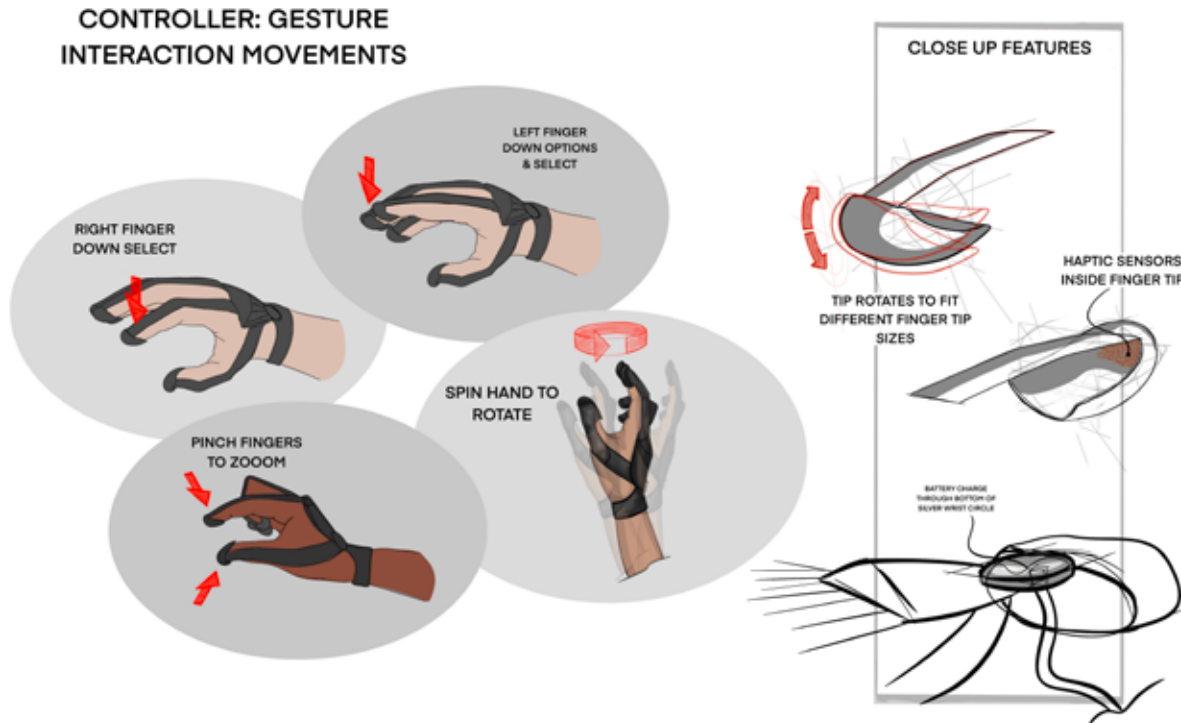


Hand X-Ray Skeleton



Cyhand Sketch

Interaction flow between the wearable and computer could include actions such as twisting, pointing, squeezing, and releasing.



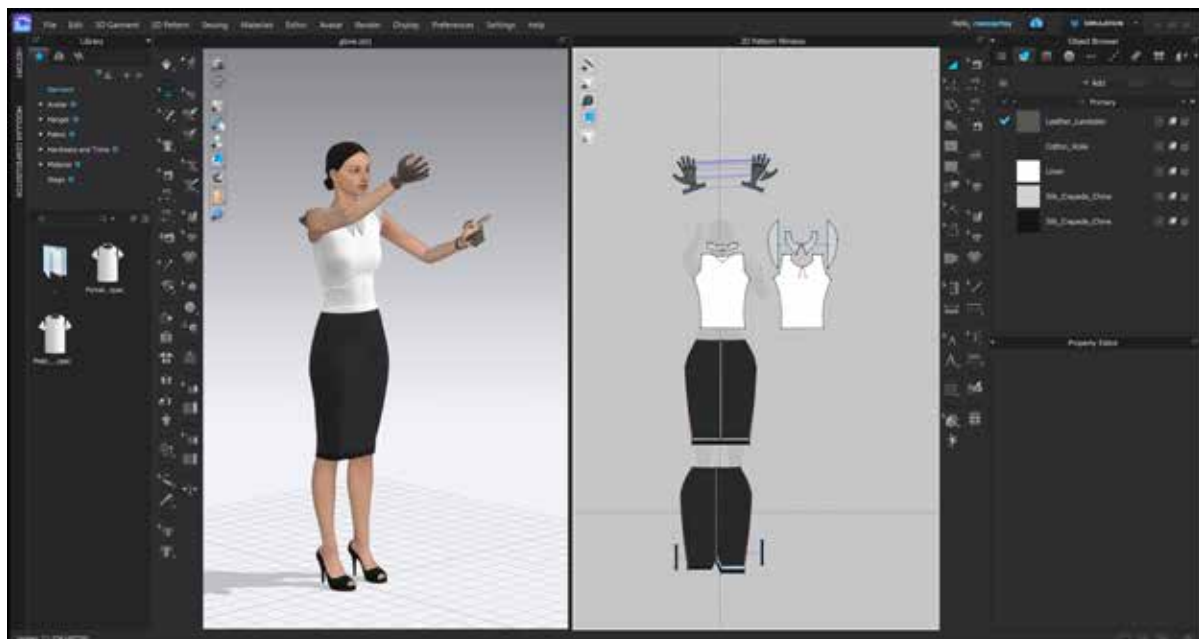
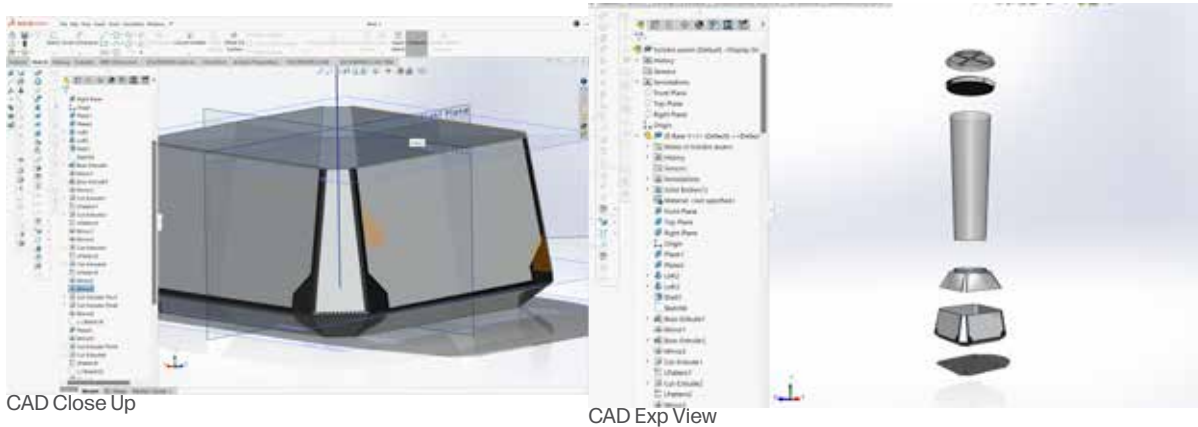
Controller Gesture Interaction Movement Sketch

## 4.7 CAD Development

CAD development was done in SolidWorks 2023 and CLO 3D, on both a component and assembly level. The computer models were created on 1:1 life scale for accuracy and analysis. Keyshot was used on the final model for rendering and animation.

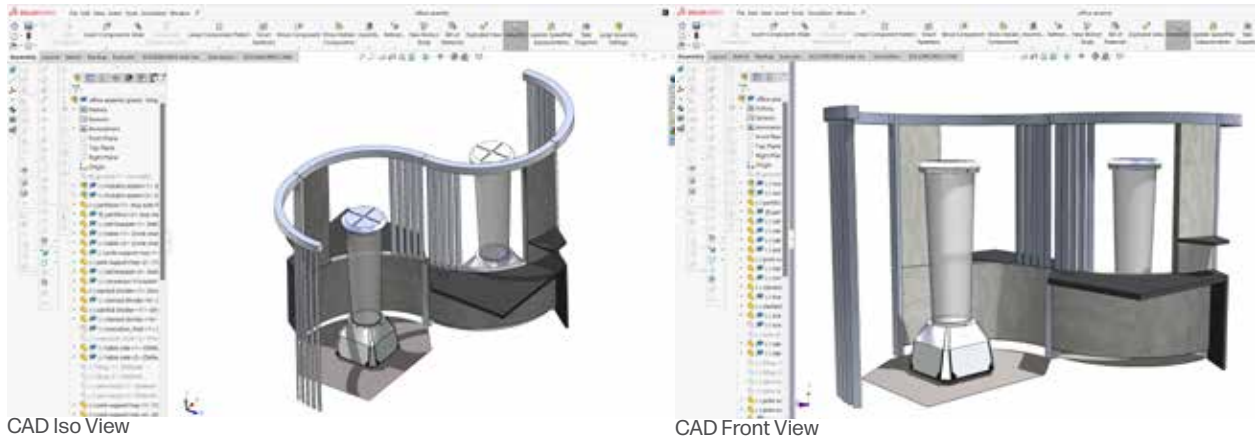
### 4.7.1 Components & Subassemblies

The office, holographic display and glove were made in file assemblies and combined together.



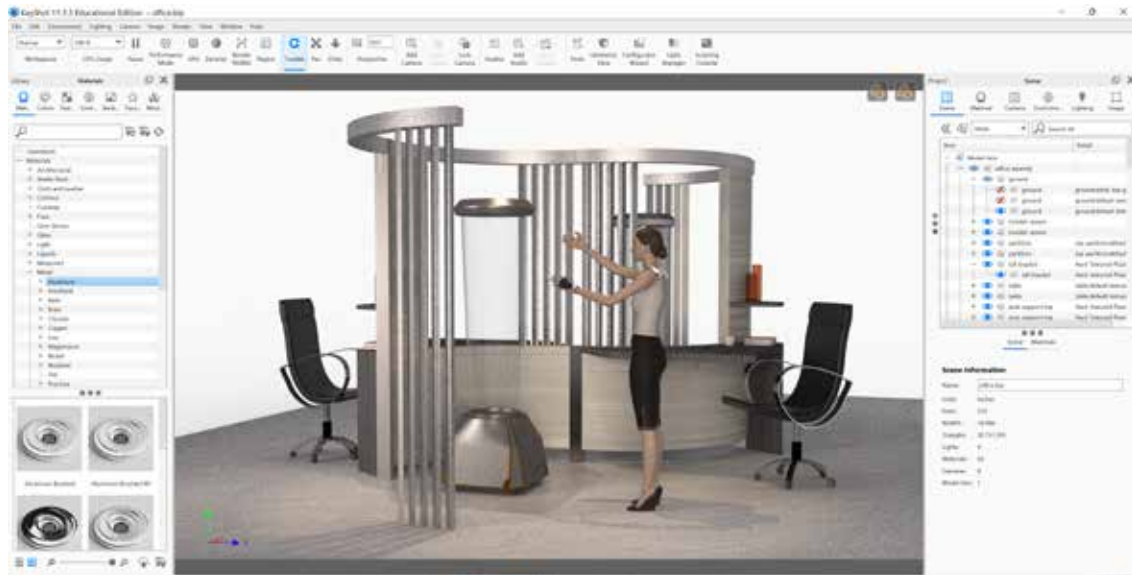
CLO 3D Progress

### 4.7.1 Assembly



CAD Iso View

CAD Front View



Keyshot Progress

### 4.8 Physical Model Fabrication

The model was designed to be made at 1:9 scale, with a variety of techniques for the replication of each part. It includes a person at the same scale.

Table of Model Fabrication Process

Part	Make	Finish
Holokin	3D print via Agile	Sand, paint and glue top to cone.
Computer (top, glass, bottom)	Manufacturing 3D printing services	



Holographics	Glow Sticks	Placed inside the 3d printed clear cone to appear as glowing "holograms"
Table / shelves	Laser cut	Sand / Paint
Office Walls	3D print	Spackle to create rough cement look/ paint and sponge to give a spackled effect.
Human	Laser print	Left raw
Glove	Cloth/ felt	Attached to laser cut human form
Base		



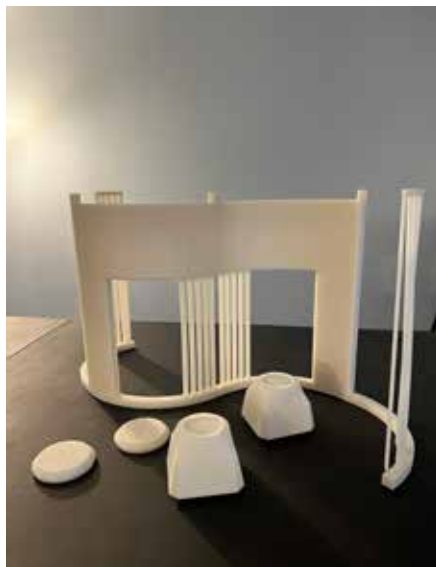
Paint Progress model



Model Progress- Base



Model Progress Office Walls



Raw 3D Print model



Sanding Model

## CHAPTER 5. FINAL DESIGN

### 5.1 Design Summary

The Holokin system is solution-oriented for dyslexic adults in the workplace. It amplifies their skills with holographic 3 - dimensional imagery and a wearable controller. This amplifies their 3d spatial thinking and strengths in multi-sensory learning. This solution takes away the stress of consistently comprehending words on a screen throughout the workday. It also creates a safer work environment by making a solution that includes movement preventing repetitive strain injury and encouraging movement.

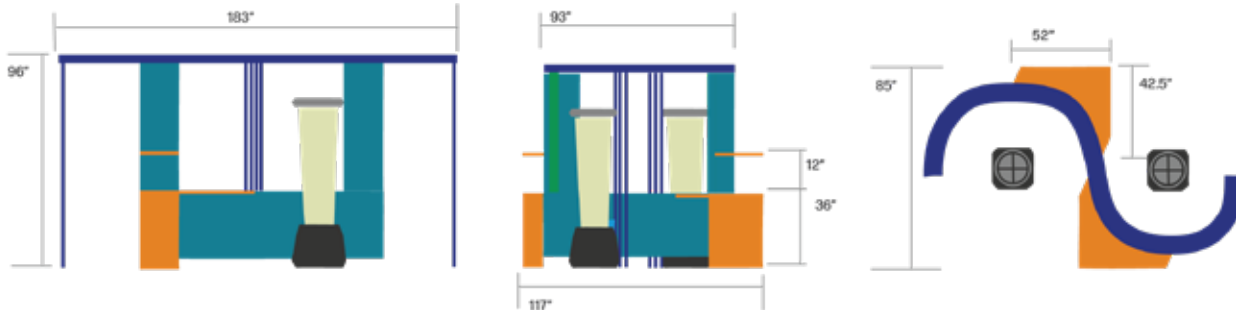
#### **Key benefits:**

- Utilizes 3-dimensional spatial thinking and visualization strengths of a dyslexic
- Intuitive control non reliant on memorization
- Multi-sensory approach with haptic feedback increasing memory functions
- 360-Degree workspace
- Provides sitting & standing usage preventing repetitive motion injury.
- Takes away the stress of constantly comprehending words on a flat screen

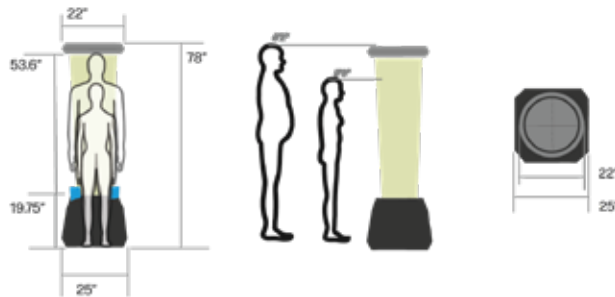
## 5.2 Design Criteria Met

### 5.2.1 Full Bodied Interaction Design

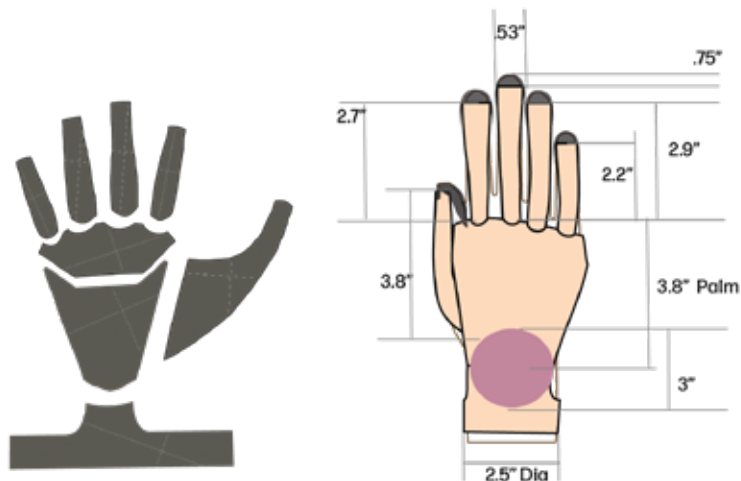
#### Office Space



#### Holokin



#### Glove



Schematic Infographic

#### GUIDE

##### Office Space

- Desk
- Partition
- Frame

##### Holokin

- Glass
- Top
- Base

##### Glove

- Cloth
- Finger Tip
- Electrical housing

### 5.2.2 Materials, Processes and Technology

The final solution will be made of both innovative and sustainable materials that are affordable and longlasting. The office space will be recycled aluminum and geopolymer

cement. Processes for which can likely be both stock parts for the metal frame and custom models for the cement pouring which will then be finished with. The holokin will also be constructed of recycled aluminum and black glass accents. with a glass holographic screen reflector. The glove will made of Pinatex and aluminum electronic housing.

### 5.2.3 Design Implementaion

The Holokin would likely be made in bulk after initial prototypes are created. Considering the amount of custom molding that this project would require, bulk orders make more sense to make use of the molds. Prebought electronics and materials would make up the cheaper parts of the project, while the most expensive parts would be the custom electronics such as the powerful projectors and software, as well as the haptic sensors in the glove.

Table of Cost Implementation

	<b>Process / Manufacturing</b>	<b>Cost Estimate for Bulk Order</b>
<b>Holokin</b>		
Recycled Aluminum Base and Top	CNC Manufacturing	depend on vendor
Electronic Components	Combination of custom functioning parts and prebought parts installed into custom housing	Pay both vendors and engineers
Glass	Custom molded in two halves , fused together and installed	Pay mold makers and raw glass material
Floor stoppers	Prebought and installed	
<b>Office</b>		
Geopolymer Cement	Custom mold, dyed cement and cement pouring	Cost for custom mold and labour of cement pouring
Recycled Aluminum	Combination of stock and custom H connector bars	
<b>Glove</b>		

Pinatex	Sewn together with pattern. Original Grey Pebble and Charcoal color.	roughly \$80/ square meter on official Pinatex website
Electronic Components	Combination of custom functioning parts and prebought parts installed into custom housing	

### 5.3 Final Renders

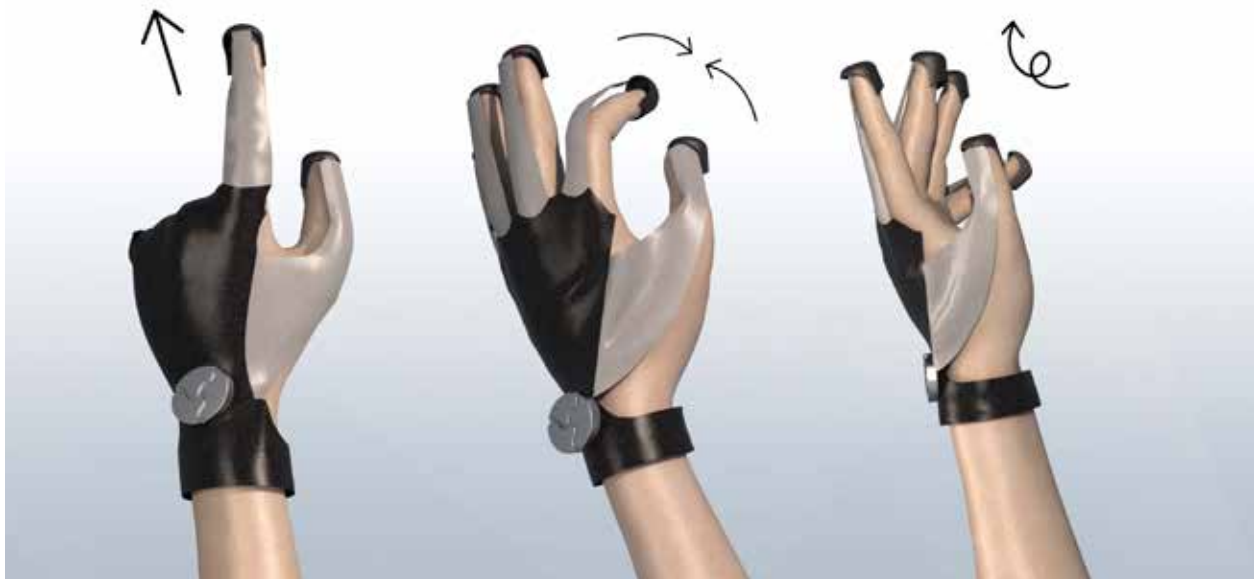


3D Holographic Computing



Sit, Stand, Flow Interaction infographic

## INTUITIVE GESTURAL CONTROL



Hand Gestures

HAPTIC SENSORS SEND  
VIBRATIONS THROUGH FINGER TIP  
WITH INTERACTION



Haptic Feedback

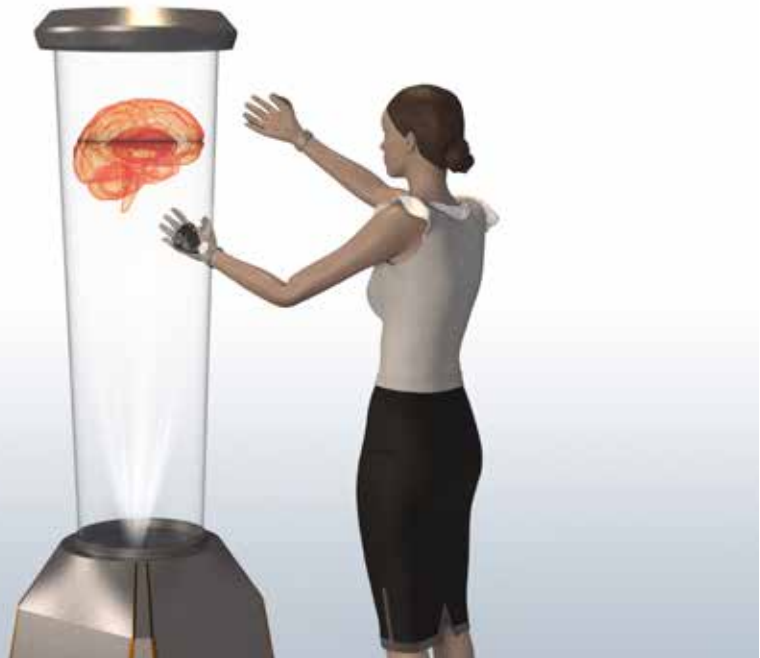


**OFFICE  
INTEGRATION**



Office Integration

**ENHANCING 3D  
SPATIAL THINKING**



Enhancing 3D Spatial Thinking

**5.4 Physcial Model**



Front Physcial Model



Low Angle Physical Model



3/4 Physical Model



Side Physical Model



Close up top base- Physical Model

### 5.5 Technical Drawings

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Holokin	refer to Holokin BOM	2
2	Office Structure	refer to Office Structure BOM	2

**TITLE:** Holokin

**MATERIAL:** refer to BOM

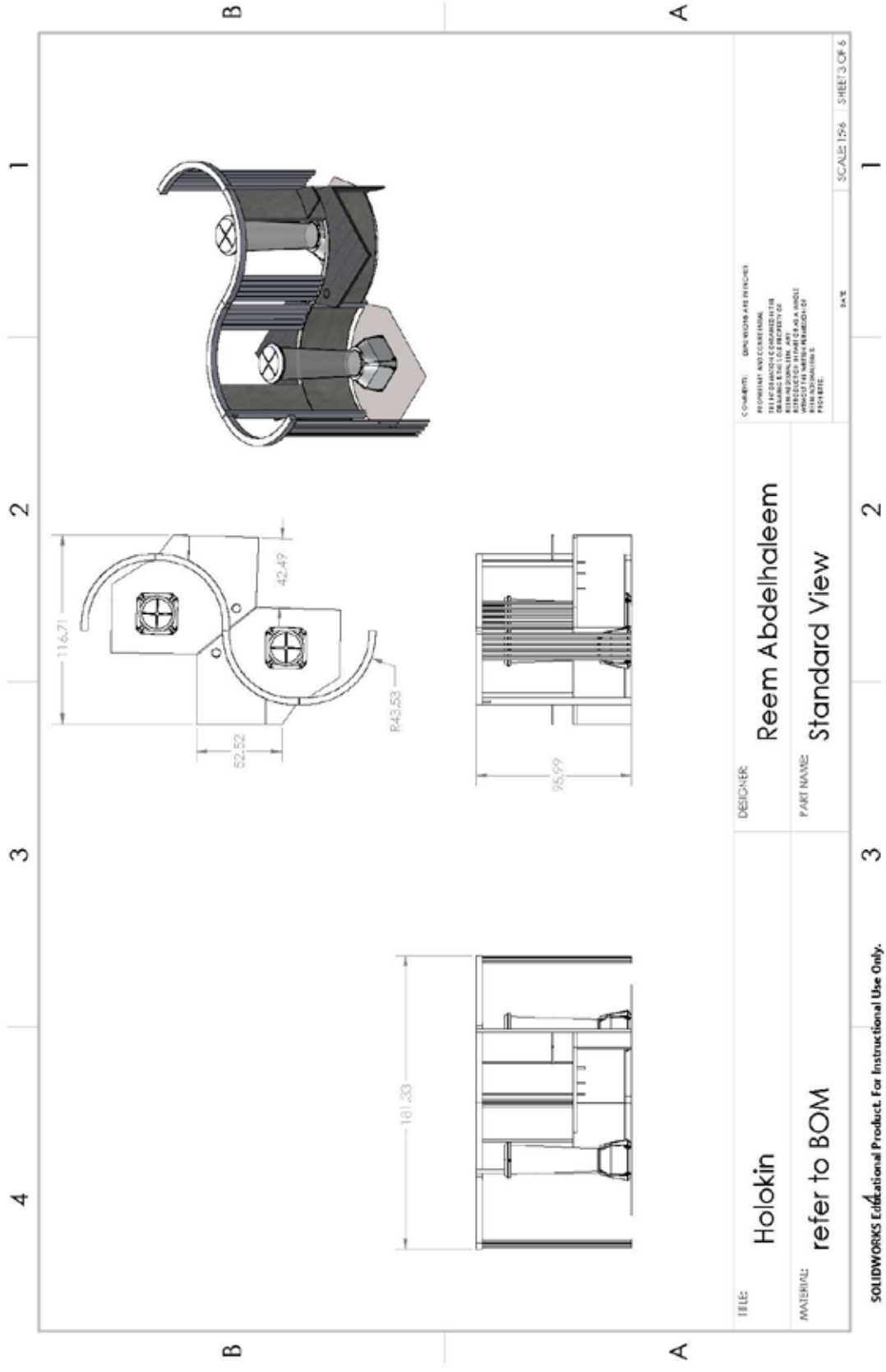
**DESIGNER:** Reem Abdelhaleem

**PART NAME:**

**NOTES:** DIMENSIONS ARE IN INCHES

**PROPRIETY AND CONFIDENTIAL:** THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF THE DESIGNER. NO PART OF THIS DRAWING OR INFORMATION IS TO BE REPRODUCED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF THE DESIGNER. VIOLATION IS PROHIBITED.

DATE: \_\_\_\_\_ SCALE: 1:48 SHEET 2 OF 6



B
A

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Partition	4" Poured Geopolymer Concrete/ Stained cool brown / levelled & smoothed	1
2	Partition	4" Poured Geopolymer Concrete/ Stained cool brown / levelled & smoothed	1
3	Top Partition	4" Poured Geopolymer Concrete/ Stained cool brown / levelled & smoothed	2
4	Tall Bracket	3/8" Extruded Recycled Aluminum / Polished silver matte	2
5	L Bracket	3/8" Bent Recycled Aluminum/ screwed to Table and Partition	8
6	Table	1" MDF / laminated	2
7	Table Side	1" MDF / laminated	2
8	Under Shelf	1" MDF / laminated	2
9	Pole Support Top	3/8" Extruded Recycled Aluminum / Polished silver matte	4
10	Connector H-Bracket	3/8" Extruded Recycled Aluminum / Polished silver matte	1
11	Slanted Divider	3/8" Extruded Recycled Aluminum / Polished silver matte	10
12	Stand	1/8" plastic non slip rug / grey	2

B
A

**TITLE:** Holokin

**MATERIAL:** refer to BOM

**DESIGNER:** Reem Abdelhaleem

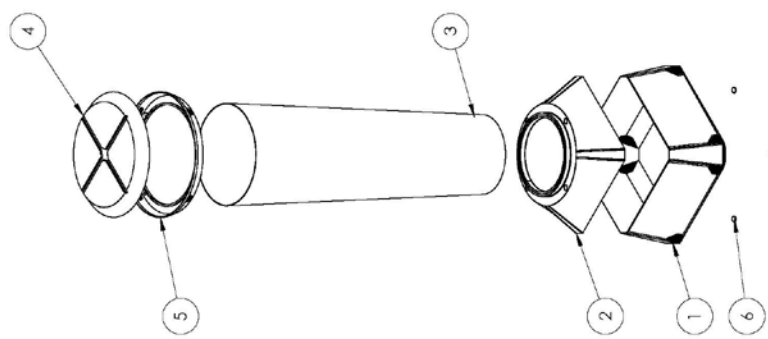
**PART NAME:** Office Structure

1
2
3

SCALE: 1:48
SHEET 4 OF 6



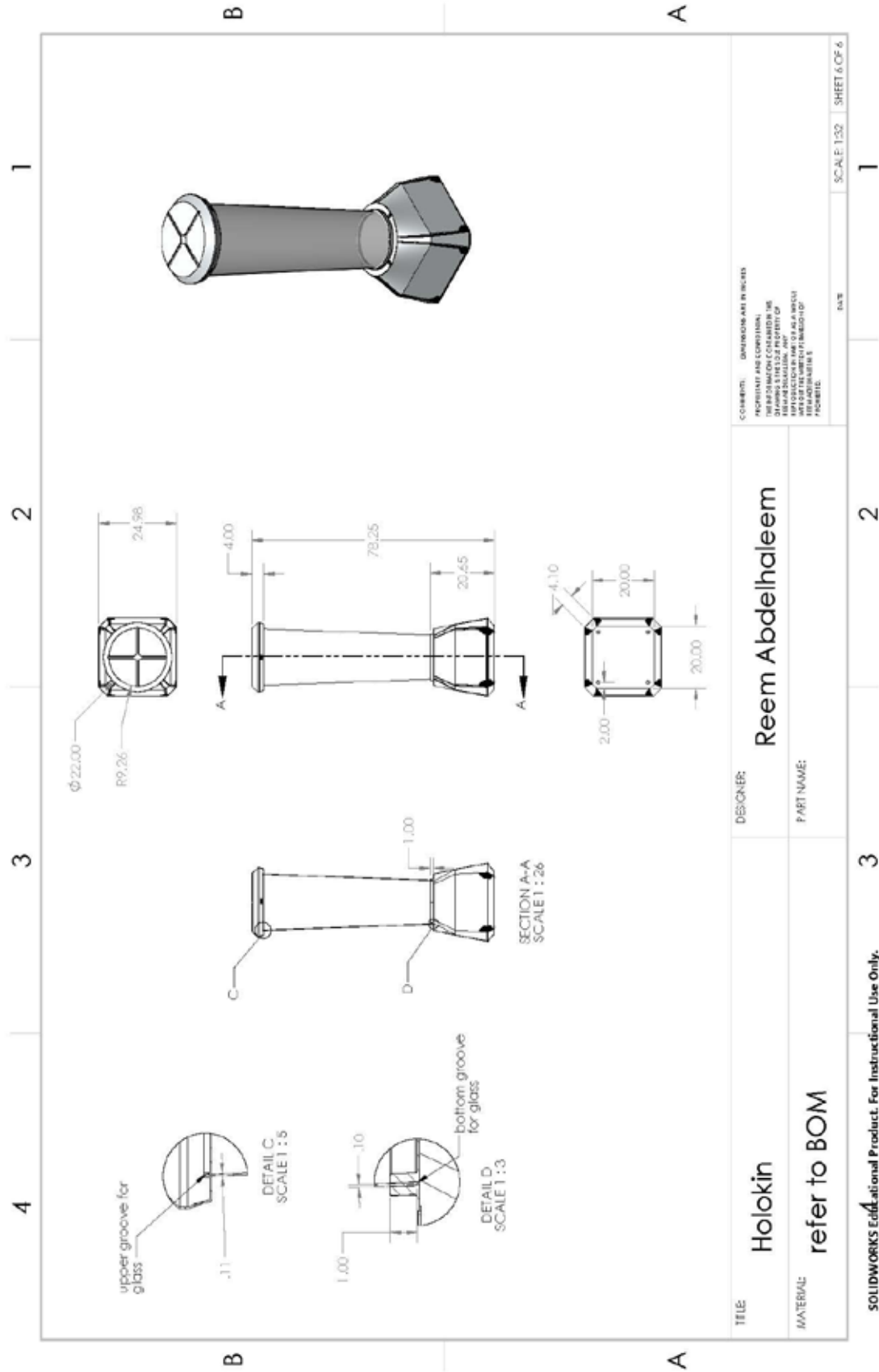
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Base 1	1/8" CNC Recycled Aluminum / Polished Soft Matte Silver and Black	1
2	Base 2	1/8" CNC Recycled Aluminum / Polished Soft Matte Silver and Black	1
3	Glass	1/8" glass	1
4	Top Upper	1/8" CNC Recycled Aluminum / Polished Soft Matte Silver and Black	1
5	Top	1/8" CNC Recycled Aluminum / Polished Soft Matte Silver and Black	1
6	Floor Stoppers	0.15" Hard Plastic Floor stoppers/ Matte Black / screwed into top	4



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TITLE: **Holokin**  
 MATERIAL: **refer to BOM**  
 DESIGNER: **Reem Abdelhaleem**  
 PART NAME:





<p>COMMENTS: DIMENSIONS ARE IN INCHES                  PRESENT AND CONTAINING THE INFORMATION CONTAINED IN THIS DRAWING IS THE PROPERTY OF THE DESIGNER AND NO REPRODUCTION OR TRANSMISSION IN ANY MANNER IS FORBIDDEN.</p>	<p>DATE: _____</p> <p>SCALE: 1:52</p> <p>SHEET 6 OF 6</p>
<p>DESIGNER: <b>Reem Abdelhaleem</b></p> <p>PART NAME: _____</p>	<p>SCALE: 1:52</p> <p>SHEET 6 OF 6</p>
<p>TITLE: <b>Holokin</b></p> <p>MATERIAL: <b>refer to BOM</b></p>	<p>SCALE: 1:52</p> <p>SHEET 6 OF 6</p>
<p><b>SOLIDWORKS Educational Product. For Instructional Use Only.</b></p>	



## 5.6 Sustainability

### Office

The office enclosure of the system can be manufactured from simple metal bending and bonding techniques. Fabric will then be upholstered to the frame using plant based biodegradable fabric such as hemp. The simple exposed design can also make it easier if the user needs to replace certain parts without disassembling or buying a new system. The desk will also be made from reclaimed wood that is left unlaminated.

### Technology

The Holokin computer will be a combination of metals and plastics for inner and outer. The outer shell will be aluminum CNC manufactured for a polished look. Aluminum is lightweight, durable and recyclable. The glass screen will be formed from C2C certified Float Glass. Inner components will be electrical metal and plastic pieces.

### Glove

The glove will be fabricated with a combination of soft and hard components. The glove will be Piñatex which as a leather alternative made from cellulose fibres extracted from pineapple leaves, PLA, and petroleum-based resin. It is strong durable and water resistant. The hard components will include ABS (Acrylonitrile butadiene styrene) for the hard plastic fingers and Bluetooth connector. Additionally, the band will include a magnetic strap for adjustability.



Pinatex Fibres

## 5.7 Branding

The branding for the Holokin system follows the style aesthetic with its dynamic yet rectilinear style. The font is “uniwars” and is orthogonal and neoteric. the color palette is a contrasting blue and orange that signifies both change and trust. the logo of an ellipse with diagonal lines symbolizes light coming from a source like that of the hologram display.

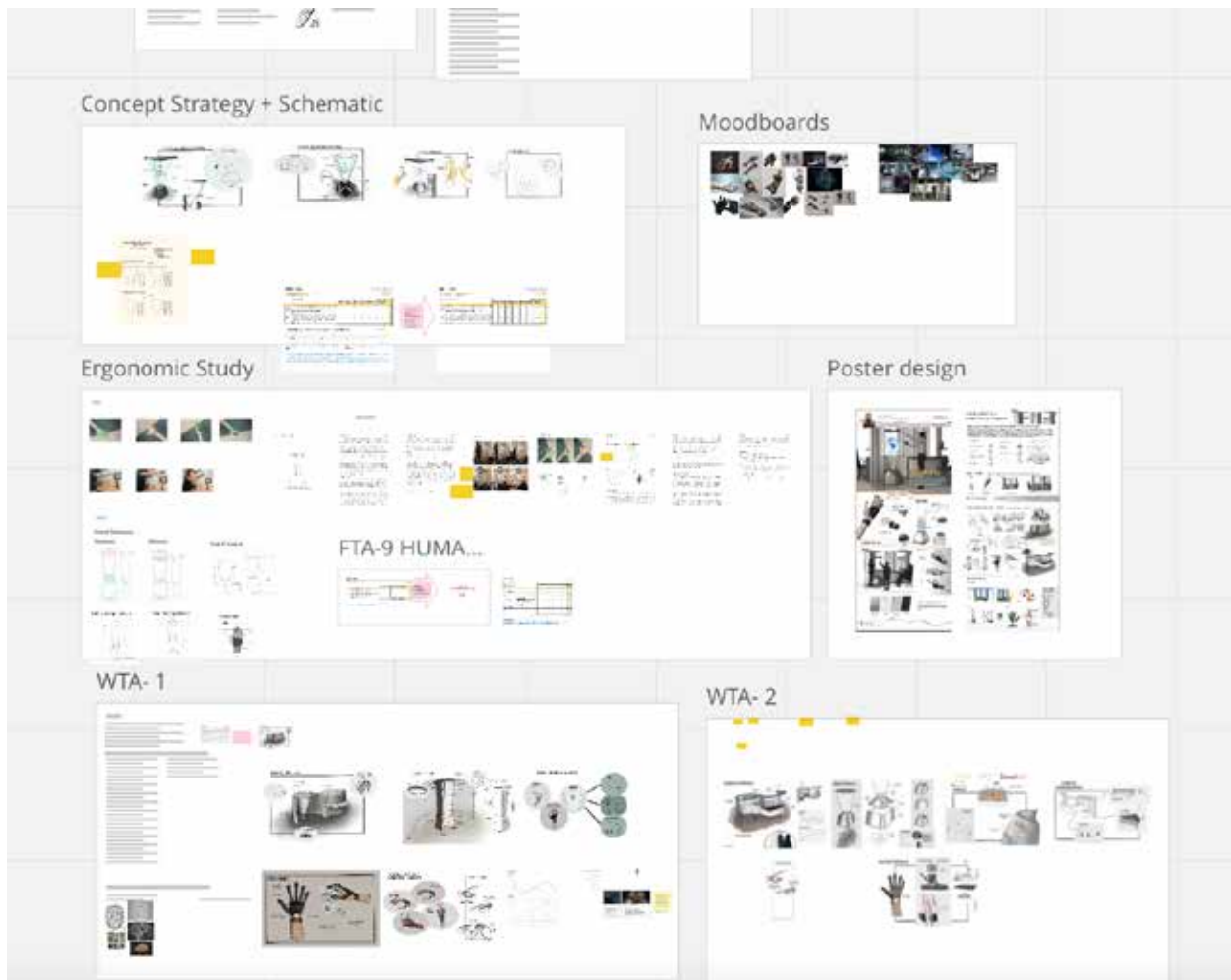


**HOLOKIN** 

The name “Holokin” came from the greek words “holos” meaning “whole”, and “Kinesis” meaning to move. It is a representation of both the movement of the wearable controller and the holographic images displayed.

## CHAPTER 6. CONCLUSION

Over the course of this thesis, an innovative office solution was created for dyslexics in the office. The project goals have been achieved by designing a product that utilizes the strengths of dyslexics, minimizes their struggles, and has workplace integration, intuitive use, and beauty. This is just the starting point for the advancement of what should be ongoing research and study of how technology, specifically 3-dimensional technology, can assist dyslexic adults. While Holokin is future aiming, it is also forward hoping for the evolution of this concept to one day be a reality.



Project Miro Board

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# apendix

## A Discovery

### Preliminary Research

Reem Abdelhaleem

September 12, 2022

IDSN 4003

Thesis topic: Dyslexic Children

### Part 1: Topic Area Inquiry

**Review 1:** Literature Search

**Search engine:** Humber Libraries

**Keywords used in search:** "Dyslexia"

**Apa citation:** Marks, R. A., Eggleston, R. L., Sun, X., Yu, C.-L., Zhang, K., Nickerson, N., Hu, X.-S., & Kovelman, I. (2021). The neurocognitive basis of morphological processing in typical and impaired readers. *Annals of Dyslexia*, 72(2), 361-383. <https://doi.org/10.1007/s11881-021-00239-9>

### Abstract

Morphological awareness, or sensitivity to units of meaning, is an essential component of reading comprehension development. Current neurobiological models of reading and dyslexia have largely been built upon phonological processing models, yet reading for meaning is as essential as reading for sound. To fill this gap, the present study explores the relation between children's neural organization for morphological awareness and successful reading comprehension in typically developing and impaired

readers. English-speaking children ages 6-11 (N = 97; mean age = 8.6 years, 25% reading impaired) completed standard literacy assessments as well as an auditory morphological awareness task during functional near-infrared spectroscopy (fNIRS) neuroimaging, which included root (e.g., PERSON + al) and derivational (e.g., quick + LY) morphology. Regression analyses revealed that children's morphological awareness predicted unique variance in reading comprehension above and beyond demographic factors, vocabulary knowledge, and decoding ability. Neuroimaging analyses further revealed that children with stronger reading comprehension showed greater engagement of brain regions associated with integrating sound and meaning, including left inferior frontal, middle temporal, and inferior parietal regions. This effect was especially notable for the derivational morphology condition that involved manipulating more analytically demanding and semantically abstract units (e.g., un-, -ly, -ion). Together, these findings suggest that successful reading comprehension, and its deficit in dyslexia, may be related to the ability to manipulate morpho-phonological units of word meaning and structure. These results inform theoretical perspectives on literacy and children's neural architecture for learning to read.

## **Introduction**

The goal of reading is to comprehend meaning from text. However, for children with dyslexia, deficits in single-word reading may impede the ability to extract units of meaning, leading to impaired reading comprehension. Over the past several decades, we have gained substantial insight into the neurocognitive differences underlying dyslexia, most notably in phonological processing. However, much less is known about the role of morphological awareness, or children's sensitivity to units of meaning, in readers with dyslexia. Accordingly, the present study investigates the role of morphological awareness both behaviorally and in the brain of young learners across a wide range of reading ability. We ask two main questions. First, how does morphological awareness contribute to reading comprehension in children with and without reading impairment? Second,

how is the brain basis of morphological processing associated with skilled reading comprehension?

Morphological awareness may be understood along a developmental continuum from implicit knowledge of morphemes, and how meaningful units combine to make words, to an explicit understanding of morphology over the course of schooling (Carlisle, [12]). Prior to formal literacy instruction, children recognize morphemic regularities and can manipulate morphemes in speech (Berko, [6]). This tacit or implicit awareness deepens children's word knowledge, connecting mental representations of sound, print, and meaning, and facilitating easier word recognition (Nagy et al., [54]). In more mature readers, tacit morphological awareness may act as the foundational knowledge that supports more explicit literacy strategies such as morphological analysis and decoding (Levesque et al., [46]). The present study examines children's implicit morphological processing and its relation to reading comprehension skill

## **Conclusion**

The present study sheds light on the association between morphological awareness and reading comprehension, and the neurocognitive mechanisms underlying this association, in typical and impaired readers. Our findings add to a growing body of knowledge indicating the importance of morphology for successful reading. We provide some of the first evidence of distinct neurocognitive processes underlying free root and derivational morphological processing in developing readers of English, and reveal an interaction between morphological processing and reading skill. Our findings indicate that better reading comprehension is associated with increased activation in left hemisphere brain regions associated with language processing and speech-to-print mapping. These findings not only underscore the importance of morphological awareness for successful reading development, but highlight the specific importance of derivational morphology for reading comprehension in English.



**Summary Statements- Literature Review #1**

1. Current neurobiological models of reading and dyslexia have largely been built upon phonological processing models, yet reading for meaning is as essential as reading for sound.

2. Neuroimaging analyses further revealed that children with stronger reading comprehension showed greater engagement of brain regions associated with integrating sound and meaning, including left inferior frontal, middle temporal, and inferior parietal regions

3. For children with dyslexia, deficits in single-word reading may impede the ability to extract units of meaning, leading to impaired reading comprehension.

4. The present study sheds light on the association between morphological awareness and reading comprehension, and the neurocognitive mechanisms underlying this association, in typical and impaired readers. Our findings add to a growing body of knowledge indicating the importance of morphology for successful reading.

5. Our findings indicate that better reading comprehension is associated with increased activation in left hemisphere brain regions associated with language processing and speech-to-print mapping. These findings not only underscore the importance of morphological awareness for successful reading development, but highlight the specific importance of derivational morphology for reading comprehension in English.

## Review 2: Secular Search

**Search engine:** Humber Libraries

**Keywords used in search:** “Struggles with dyslexia”

**Apa citation:** Marks, R. A., Eggleston, R. L., Sun, X., Yu, C.-L., Zhang, K., Nickerson, N., Hu, X.-S., & Kovelman, I. (2021). The neurocognitive basis of morphological processing in typical and impaired readers. *Annals of Dyslexia*, 72(2), 361-383. <https://doi.org/10.1007/s11881-021-00239-9>

Children each learn and develop at their own pace, and reading is no different from other skill building. It's common for kids to find reading challenging at one point or another. But if learning to read becomes an ongoing struggle that leaves a child falling behind his peers, it's possible that he has a learning disorder known as dyslexia.

### What Is Dyslexia?

Dyslexia might best be described as an unexpected difficulty learning to read. Children with dyslexia struggle with phonology, or the recognition and manipulation of sounds in language. Dyslexia affects a child's ability to decode words – to break them down into constituent sounds, or phonemes, and then to sound out novel words. That makes it hard to recognize words, to retrieve words, to read, to write and to spell. Some children with dyslexia just have problems quickly retrieving words.

The result is a discrepancy between ability and achievement: a child who is struggling with reading despite having the intelligence to be a much better reader. A dyslexic child isn't lacking in intelligence, and isn't necessarily failing in school, since some kids with dyslexia, by putting in a great deal more effort than their peers, are able to keep up with their work, at least in the first few grades. However, it often becomes impossible for them to keep up by about third grade, when they are expected to be able to read fluently – quickly, easily

and automatically.

While they may learn to read and compensate for reading weakness in other ways, children do not outgrow dyslexia.

### **Summary Statements- Secular Review #2**

1. Children with dyslexia struggle with phonology, or the recognition and manipulation of sounds in language. Dyslexia affects a child's ability to decode words – to break them down into constituent sounds, or phonemes, and then to sound out novel words.

2. While they may learn to read and compensate for reading weakness in other ways, children do not outgrow dyslexia.

3. Dr. Sally Shaywitz, co-director of the Yale Center for Dyslexia and Creativity, estimates that 80 to 90 percent of children who struggle with learning disorders have dyslexia – as many as one in five children.

4. A young child with dyslexia may:

- Have trouble learning simple rhymes
- Be speech delayed
- Have a hard time following directions
- Have difficulty with short words; repeat or leave out words like and, the, but
- Have trouble differentiating left from right

In school, kids with dyslexia are likely to:

- Have significant difficulty learning to read, including trouble sounding out new words and counting the number of syllables in words
- Continue to reverse letters and numbers when reading (read bear as dees, for example) after most kids have stopped doing that, around the age of 8
- Struggle with taking notes and copying down words from the board

- Have difficulty rhyming, associating sounds with letters, and sequencing and ordering sounds
- Have trouble correctly spelling even familiar words; they will often spell them phonetically (cmpt instead of camped)
- Lack fluency in reading, continuing to read slowly when other kids are speeding ahead
- Avoid reading out loud in class
- Show signs of fatigue from reading with great effort

5. A dyslexic person who has word-finding difficulties can have trouble with their expressive language,

6. Some signs of dyslexia are evident in preschool-age children. Preschool evaluations can focus on phonological awareness and word retrieval. However, Dr. Cruger recommends waiting until children are around six years old to pursue an evaluation, when they have received formal reading instruction. If at that point a child is still struggling to recognize rhymes, common letter clusters or simple words, she should be checked out.

7. A program appropriate to a child with dyslexia might include these features, says Dr. Cruger:

- Multi-sensory instruction in decoding skills
- Repetition and review of skills
- Intensity of intervention—that is, more than being pulled out of class once a week for extra help
- Small group or individual instruction
- Teaching phonological skills
- Drilling sight words
- Teaching comprehension strategies, to help kids derive meaning from what they're reading

8. Reading programs that have been shown to be effective for kids with dyslexia include:

- The Wilson Method
- The Orton-Gillingham Approach
- Preventing Academic Failure (PAF)
- The Lindamood-Bell Program
- RAVE-O

9. Dyslexia's impact on day-to-day activities – playing board games, following directions or even reading clocks accurately – can cause kids to feel self-conscious and avoidant. Helping your child understand her learning disorder can give her the tools she needs to manage her dyslexia – both academically and emotionally.

## **Step 2 : Major Issues/ Challenges**

Review 1: Literature Search

Search engine: Google

Keywords used in search: "Dyslexia"

Apa citation: Dyslexia basics. International Dyslexia Association. (2021, March 23).

Retrieved September 18, 2022, from <https://dyslexiaida.org/dyslexia-basics-2/>

What is dyslexia?

Dyslexia is a language-based learning disability. Dyslexia refers to a cluster of symptoms, which result in people having difficulties with specific language skills, particularly reading. Students with dyslexia usually experience difficulties with other language skills such as spelling, writing, and pronouncing words. Dyslexia affects individuals throughout their lives; however, its impact can change at different stages in a person's life. It is referred to as a learning disability because dyslexia can make it very difficult for a student to succeed academically in the typical instructional environment, and in its more severe forms,

will qualify a student for special education, special accommodations, or extra support services.

What causes dyslexia?

The exact causes of dyslexia are still not completely clear, but anatomical and brain imagery studies show differences in the way the brain of a person with dyslexia develops and functions. Moreover, most people with dyslexia have been found to have problems with identifying the separate speech sounds within a word and/or learning how letters represent those sounds, a key factor in their reading difficulties. Dyslexia is not due to either lack of intelligence or desire to learn; with appropriate teaching methods, students with dyslexia can learn successfully.

How widespread is dyslexia?

About 13-14% of the school population nationwide has a handicapping condition that qualifies them for special education. Current studies indicate that one half of all the students who qualify for special education are classified as having a learning disability (LD) (6-7%). About 85% of those students have a primary learning disability in reading and language processing. Nevertheless, many more people—perhaps as many as 15-20% of the population as a whole—have some of the symptoms of dyslexia, including slow or inaccurate reading, poor spelling, poor writing, or mixing up similar words. Not all of these will qualify for special education, but they are likely to struggle with many aspects of academic learning and are likely to benefit from systematic, explicit, instruction in reading, writing, and language.

Dyslexia occurs in people of all backgrounds and intellectual levels. People with dyslexia can be very bright. They are often capable or even gifted in areas such as art, computer science, design, drama, electronics, math, mechanics, music, physics, sales, and sports. In addition, dyslexia runs in families; parents with dyslexia are very likely to have children with dyslexia. For some people, their dyslexia is identified early in their lives, but for others, their dyslexia goes unidentified until they get older.

What are the effects of dyslexia?

The impact that dyslexia has is different for each person and depends on the severity of the condition and the effectiveness of instruction or remediation. The core difficulty is with word recognition and reading fluency, spelling, and writing. Some individuals with dyslexia manage to learn early reading and spelling tasks, especially with excellent instruction, but later experience their most debilitating problems when more complex language skills are required, such as grammar, understanding textbook material, and writing essays.

People with dyslexia can also have problems with spoken language, even after they have been exposed to good language models in their homes and good language instruction in school. They may find it difficult to express themselves clearly, or to fully comprehend what others mean when they speak. Such language problems are often difficult to recognize, but they can lead to major problems in school, in the workplace, and in relating to other people. The effects of dyslexia reach well beyond the classroom.

Dyslexia can also affect a person's self-image. Students with dyslexia often end up feeling "dumb" and less capable than they actually are. After experiencing a great deal of stress due to academic problems, a student may become discouraged about continuing in school.

### **Summary Statements:**

1. Dyslexia refers to a cluster of symptoms, which result in people having difficulties with specific language skills, particularly reading.
2. The impact that dyslexia has is different for each person and depends on the severity of the condition and the effectiveness of instruction or remediation. The core difficulty is with word recognition and reading fluency, spelling, and writing. Some individuals with dyslexia manage to learn early reading and spelling tasks, especially with excellent instruction, but later experience their most debilitating problems when more complex language skills are required, such as grammar, understanding textbook material,

and writing essays.

3. Other problems experienced by people with dyslexia include the following:
  - Learning to speak
  - Learning letters and their sounds
  - Organizing written and spoken language
  - Memorizing number facts
  - Reading quickly enough to comprehend
  - Persisting with and comprehending longer reading assignments
  - Spelling
  - Learning a foreign language
  - Correctly doing math operations

4. Most people with dyslexia need help from a teacher, tutor, or therapist specially trained in using a multisensory, structured language approach. It is important for these individuals to be taught by a systematic and explicit method that involves several senses (hearing, seeing, touching) at the same time. Many individuals with dyslexia need one-on-one help so that they can move forward at their own pace.

## **Review 2: Peer - Review**

Search engine: Humber Libraries

Keywords used in search: "Dyslexia Struggles"

Apa citation: Hebert, M., Kearns, D. M., Hayes, J. B., Bazis, P., & Cooper, S. (2018). Why Children With Dyslexia Struggle With Writing and How to Help Them. *Language, Speech, & Hearing Services in Schools*, 49(4), 843+. <https://link.gale.com/apps/doc/A569202576/PPCM?u=humber&sid=bookmark-PPCM&xid=449b4e33>

Purpose: Children with dyslexia often have related writing difficulties. In the simple view of



writing model, high-quality writing depends on good transcription skills, working memory, and executive function--all of which can be difficult for children with dyslexia and result in poor spelling and low overall writing quality. In this article, we describe the challenges of children with dyslexia in terms of the simple view of writing and instructional strategies to increase spelling and overall writing quality in children with dyslexia.

**Method:** For spelling strategies, we conducted systematic searches across 2 databases for studies examining the effectiveness of spelling interventions for students with dyslexia as well as including studies from 2 meta-analyses. To locate other instructional practices to increase writing quality (e.g., handwriting and executive function), we examined recent meta-analyses of writing and supplemented that by conducting forward searches.

**Results:** Through the search, we found evidence of effective remedial and compensatory intervention strategies in spelling, transcription, executive function, and working memory. Some strategies included spelling using sound-spellings and morphemes and overall quality using text structure, sentence combining, and self-regulated strategy development.

**Conclusions:** Many students with dyslexia experience writing difficulty in multiple areas. However, their writing (and even reading) skills can improve with the instructional strategies identified in this article. We describe instructional procedures and provide links to resources throughout the article.

Students with dyslexia often also have writing difficulties. This is not surprising, as reading is theorized to be a central component of writing in some cognitive models of writing development (e.g., Graham, 2018; Hayes, 1996). The writing difficulties of students with dyslexia can be partially attributed to their reading difficulties and can manifest in many ways in their writing, such as poor spelling, poor legibility, lack of diverse vocabulary, poor idea development, and/or lack of organization.

Dyslexia and writing difficulties co-occur for two overarching reasons. First, reading and writing rely on related underlying processes (Graham & Hebert, 2010, 2011). For example,

dyslexia involves difficulties related to processing phonological information needed for decoding words, whereas writing requires encoding phonological information when writing words. Because the disability impacts the underlying process for both the reading and writing systems, the prevalence of writing difficulties for students with dyslexia is not unexpected. Second, reading is a subskill required throughout the writing process. Writers often need to read source materials before writing their own text and also need to read and reread their own writing to diagnose text problems, such as spelling errors, grammar errors, and disorganization (Hayes, 1996). The presence of reading difficulties complicates this task, especially if students have poor handwriting skills that make it even more difficult for them to read their own writing.

### **Summary Statements:**

1. In the simple view of writing model, high-quality writing depends on good transcription skills, working memory, and executive function—all of which can be difficult for children with dyslexia and result in poor spelling and low overall writing quality.

2. Through the search, we found evidence of effective remedial and compensatory intervention strategies in spelling, transcription, executive function, and working memory. Some strategies included spelling using sound-spellings and morphemes and overall quality using text structure, sentence combining, and self-regulated strategy development.

3. The writing difficulties of students with dyslexia can be partially attributed to their reading difficulties and can manifest in many ways in their writing, such as poor spelling, poor legibility, lack of diverse vocabulary, poor idea development, and/or lack of organization.

4. For example, dyslexia involves difficulties related to processing phonological information needed for decoding words, whereas writing requires encoding phonological

information when writing words. Because the disability impacts the underlying process for both the reading and writing systems, the prevalence of writing difficulties for students with dyslexia is not unexpected. Second, reading is a subskill required throughout the writing process.

## B Contextual Research (User)

### User Profile Report

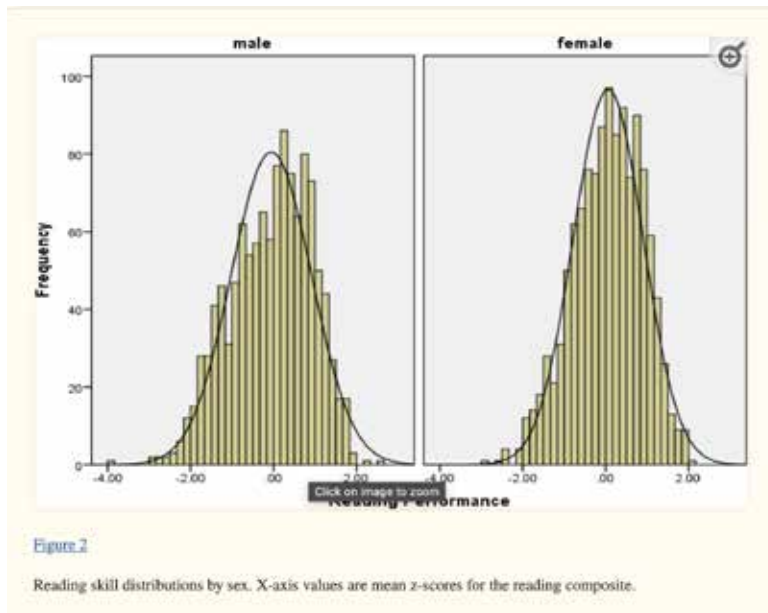
Primary	Dyslexic adults in the workplace
Secondary	Coworkers, private users
Tertiary	Managers, buyers, third party

### Demographics

Age & Gender

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5438271/>

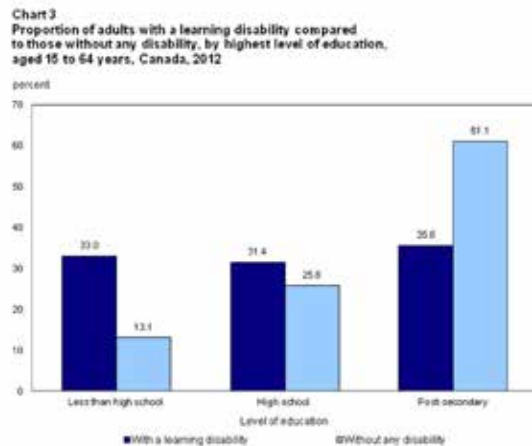
Males have a higher diagnosis rate than females. This is subject to many factors however.



## Education

A portion of adults with a learning disability has lower rates of post-secondary education.

They also have more difficult educational experiences on average.



**Table 2**  
Effect of disability on educational experiences for adults with a learning disability, aged 15 years and older, Canada, 2012

Effect of disability	Percentage
Took longer to achieve current level due to disability	64.6
Took fewer courses due to disability	63.5
Choice of courses/career influenced by disability	63.4
People avoided/excluded you in school due to disability	57.5
Bullied at school because of disability	49.8
Changed course of studies due to disability	49.0
Education interrupted due to disability	47.4
Attended special education classes in regular school	47.2
Discontinued education due to disability	41.4

**Note:** Learning disabilities includes those in school within the last 5 years and had disability while in school.  
**Source:** Statistics Canada, Canadian Survey on Disability, 2012.

## Income/ Employment

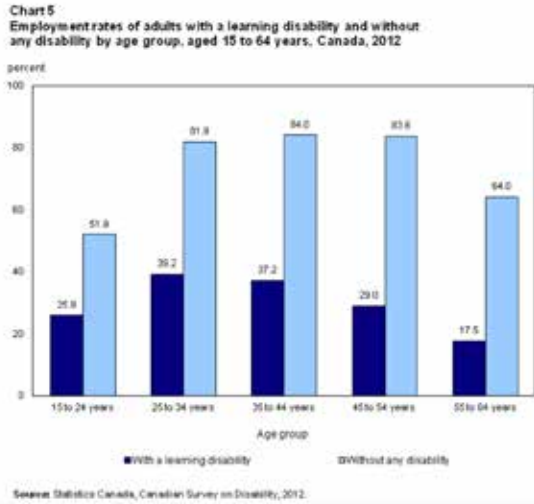
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5438271/>

Adults with a learning disability have lower employment rates on average than those without. This spans all age groups.

## Income

### Personal income for working-age adults

Working-age adults (aged 15 to 64) with a learning disability<sup>8</sup> reported a median total personal income<sup>9</sup> of approximately \$12,200—less than half that of those without any reported type of disability (\$31,200). Adults with a learning disability were more likely to rely on government transfers.<sup>10</sup> Among adults with a learning disability who received government transfers, the median transfer income was \$9,470, over five times the amount for those without any disability (\$1,650). Furthermore, 63.4% of adults with a learning disability received more from government transfers than they did from employment income, while this was true for only 18.7% of those without any disability.<sup>11</sup> Among those with employment income, median employment incomes for adults with a learning disability were less than half for those without any disability (\$15,900 and \$34,100 respectively).



**Cognitive Aspect**

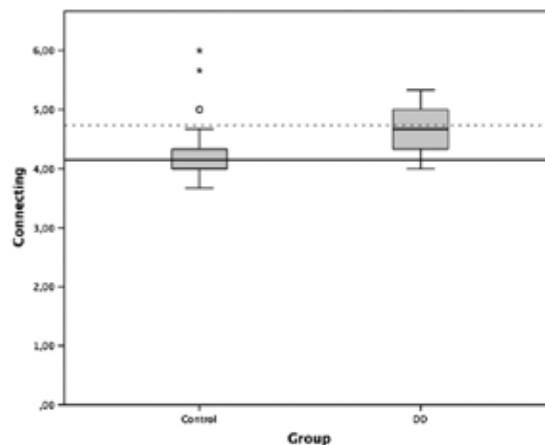
Cancer, A., Manzoli, S., & Antonietti, A. (2016). The alleged link between creativity and dyslexia: Identifying the specific process in which dyslexic students excel. *Cogent Psychology*, 3(1), 1190309-. <https://doi.org/10.1080/23311908.2016.1190309>

This study highlights that dyslexics have higher levels of creative thinking. Specifically in having a higher propensity for the unusual combination of ideas.

The mean scores differed between the two groups only in the C (i.e. Connecting) scale, in which students with DD ( $M = 4.62, SD = .43$ ) got statistically significant higher scores than those of the control group ( $M = 4.29, SD = .53; t_{(3)} = -2.10, p = .04$ ). Excluding from the analysis three outliers from the control group, the difference between the groups appeared to be even stronger ( $t_{(3)} = -4.19; p < .001$ ). As it is showed in the box plot (Figure. 1), most participants in the clinical group scored below the mean of the control group; Moreover, about 50% of the students with DD got a score 1.65 SD above the mean of the control group.

**Figure 1. Study 1: Box plot representing the individual scores in the connecting scale.**

Notes: The bottom and top of the box represent the first and third quartiles, while the band inside the box the median. The ends of the whiskers represent the minimum and maximum of all of the data. Outliers are plotted as individual points. The solid line indicates the control mean (excluding outlier values) and the dashed line the chosen deviance threshold (1.65 SD above the control mean).



**User Profile**

<b>Personality</b>	
Optimism	low
Creative	high
Focus	low
Work Ethic	high
<b>Demographics</b>	
Age	22-26
Gender	Female
Culture	White
Educational	High School Diploma ; Technical Diploma
<b>User Behaviour</b>	
Job Type	Technical
Hobbies	Creative
Income Level	\$47,000 CAD

**Persona:**

Name: Rachelle Peterson

Age: 25

Job: Cabinet Designer

Income: \$ 47,000

Education: technical diploma

Relationship: single

Location: Toronto

Main hobby: guitar

**Profile:**

Rachelle Peterson is 25, caucasian, and post-secondary educated. She has been working full-time as a cabinet designer. She enjoys musical activities in his free time such as playing the guitar and being in a band with his friends.

Rachelle enjoys being social in his free time and pursuing hobbies. She tutors guitar lessons and hopes to one day be an entrepreneur starting his own business. Her full-time

job at a custom cabinetry company takes up most of his time but does not fill his passions. Rachelle has struggled to feel he would have a typical successful career path like his peers.

## C Feild Research (Product)

### Holographic Technology Research

The Holokin works is based on a combination of both old and new methods of technology. The basis for the technology is to be far-reaching and project about 10 years into the future. With the growing development of current AR, VR, and holographic technology, through research, it seems that interactive holograms may not be too far into the future. However, how fast they will be implemented into mainstream workspaces may take longer.

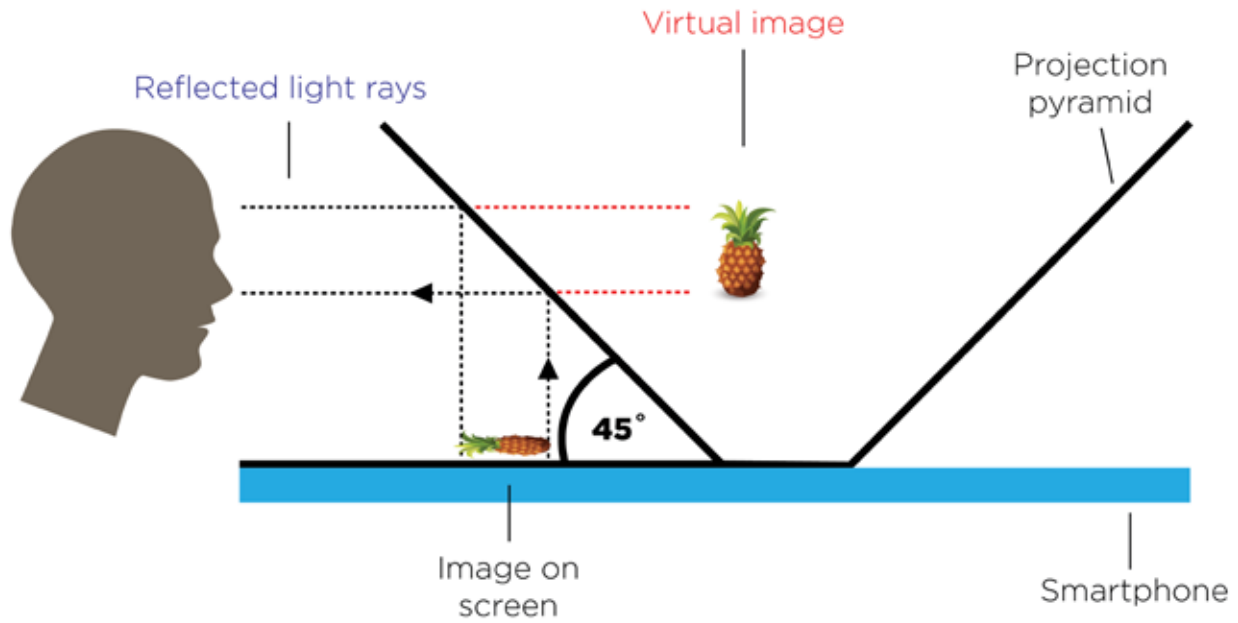
The Holokin holographics work by projecting pre-distorted images through a glass screen to create a peppers ghost effect. Originally innovated in the 19th century by John Henry Pepper, the peppers ghost illusion works “when a real or recorded image is reflected in a transparent screen at a 45o angle, viewers see a reflected virtual image that seems to have depth and appear out of nowhere.” (Pepper’s Ghost: Hologram Illusion. Science World. (2022, June 13).) This method of creating holographic does not require AR or a flat screen. It is a true “hologram”. A variety of glass shapes can create the illusion such as ones with corned edges or round fishbowls. The cone shape was chosen for the final solution because it has no edges that would interrupt the user’s view of the hologram.

In addition to creating a hologram, the 360-degree experience is created with head tracking systems located in the top aluminum housing of the Holokin. The head tracking ensures that the distorted images being projected can match the user’s eye level and follow along with 360-degree use. However, this also means that only one person will have a pure image of the hologram at a time because the projectors can only project one image



perspective at a time. This can be a positive aspect for privacy reasons but be problematic if teamwork is required.

To incorporate the wearable controllers into the usage, the cameras located at the top would double function to track the hand movements in coordination with the holographs.



Peppers Ghost Diagram



Illustration of an animated pepper's ghost hologram on a tablet computer.

## D Approval Forms & Plans

### Thesis Topic Approval

# IDSN 4002

SENIOR LEVEL THESIS ONE

Humber ITAL / Faculty of Applied Sciences & Technology

Bachelor of Industrial Design / FALL 2022

Catherine Chong / Frederic Matovu

#### THESIS TOPIC APPROVAL:

<b>Student Name:</b>	Reem Abdelhaleem
<b>Topic Title:</b>	How may we maximize the work of dyslexics in the work place?

#### TOPIC DESCRIPTIVE SUMMARY (PRELIMINARY ABSTRACT)

Dyslexia is a life long neurological condition that makes literacy tasks challenging. For adults in the work force with dyslexia, performing literacy heavy jobs is extremely laborious and difficult. This can lead to mental health stressors, feeling alienated from co workers, and fear of being discriminated. Under the Ontario Charter of Rights everyone has the right to the tools to do their job correctly. This makes the goals of this study essential to society and persons. And as a society enabling people with proper literacy makes engaged citizens and prosperous communities. On an individual scale, enhancing literacy can help dyslexic individuals become more successful in their goals. User research will include interviews, visual studies and quantitative research of both persons and the traditional workspace to design the most optimal product. A one to one scale model will ensure the ergonomics and use of the product is ideal for the dyslexic audience. A solution for dyslexics will be developed to reduce their difficulties so that their natural strengths can come to light.

**Student Signature(s):**

*Reem Abdelhaleem*

**Date:** 27 / 09 / 2022

**Instructor Signature(s):**

*Catherine Chong*

**Date:** 07 October 2022

Thesis Design Approval

**IDSN 4502**  
SENIOR LEVEL THESIS TWO

Humber ITAL / Faculty of Applied Sciences & Technology  
Bachelor of Industrial Design / WINTER 2023  
Catherine Chong / Fredric Matovu

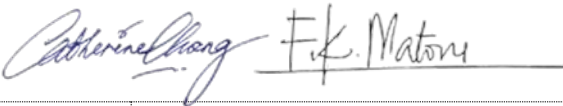
**CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION**

<b>Student Name:</b>	Reem Abdelhaleem
<b>Approved Thesis Title:</b>	Dyslexia & Innovative Workspaces

**THESIS PROJECT – DESIGN APPROVAL FORM**

<b>Design is reviewed and approved to proceed for the following:</b>	<input checked="" type="checkbox"/> <b>CAD Design and Development Phase</b>
<b>Comment:</b> Continue design refinement in CAD development, need to iron out detailing and product's features, pay attention to surfacing, components, and assembly methods for design feasibility. Viable holistic design thinking in conjunction with considerations into sustainability aspects. CAD development must be at least 75% complete for review before approval for fabrication.	

<b>Design is reviewed and approved to proceed for the following:</b>	<input checked="" type="checkbox"/> <b>Model Fabrication Including Rapid Prototyping / 3D Printing and Model Building Phase</b>
<b>Comment:</b> Waiting for CAD development review (as of Feb-21).  CAD progress well, design completed, continue detail refinement, once refined, fabrication of model can begin.	

<b>Instructor Signature(s):</b>	
	
<b>Date:</b>	07 March 2023

TCPS-2-CORE

PANEL ON  
RESEARCH ETHICS

*Navigating the ethics of human research*

TCPS 2: CORE 2022

## *Certificate of Completion*

*This document certifies that*

**Reem Abdelhaleem**

*successfully completed the Course on Research Ethics based on  
the Tri-Council Policy Statement: Ethical Conduct for Research  
Involving Humans (TCPS 2: CORE 2022)*

**Certificate # 0000840758**

**8 September, 2022**

TCPS 2 CORE Certificate

## Research Plan & Advisor Initiatives

### Research Plan & Advisor Initiative

Reem Abdelhaleem  
4002 IDSN  
Catherine Chong  
18 / 10 / 2022

#### Introduction

The purpose of this research plan is to investigate and identify my user, and their ecosystem. Through literature reviews, interviews, and surveys I will gather information to set the groundwork for a strong platform to find holes in the industry and ideate solutions. The advisor initiative is to gain professional and expert opinions to authenticate my research and guide my project. Gaining industry opinion can ensure my solutions are validated in research and real-life pain points of users.

#### Research Plan

The research plan is based on finding information on dyslexia found both on Humber Libraries and the internet including both peer and non-peer-reviewed literature. Associations such as the IDA (International Dyslexia Association) and dyslexic teaching method academies such as the Orton- Gillingham Academy have been accredited with knowledge and experience of how the dyslexic brain works will be used to find the science behind my project. Many accredited dyslexia teaching method websites such as Orton Gillingham, also have lists of experts accredited in teaching dyslexics.

These teachers will have inside knowledge of the specific pain points of the user, and be my method for qualitative research. Advisors should have experience in the field of dyslexia, either teaching or studying. Through interviews with these advisors, I plan to deepen my research

with more niche questions and a distinct focus. In addition to interviews, a survey will be conducted to gain a wider understanding of user-profiles and pain points. 1:1 interviews will be used to gain a more targeted and more thorough understanding of the user, in contrast to the wide results of the survey.

Preliminary research will conclude in week 7 of the project timeline, however, it will continue to be refunded as the project develops in further stages. Advisors will continue to be consulted and depending on the direction of the solution, more benchmarking will be done. Post preliminary research, journey maps, and empathy maps will be created to extract the important points from the research and create user profiles.

**Advisor Initiative**

I currently have two confirmed advisors for this thesis as laid out in the chart below. Through a prepared interview with my first expert, Cheryl Urbanczyk, I was able to find my second advisor, Valdine Bjornson. I hope to have ongoing contact will both throughout the project timeline.

Name	Experience	Status	Links
Cheryl Urbanczyk	-International Dyslexia Association (IDA) Teacher Education Program Accreditation -Orton-Gillingham Academy, Fellow-in-Training -Ontario Principal's Council Special Education for Administrators -Professional Development Provider - dyslexic child - Private tutor/ vice principal	Confirmed	<a href="https://learnliteracy.com">https://learnliteracy.com</a>

Name	Experience	Status	Links
Valdine Bjornson	-founded the Reading and Learning Clinic of Manitoba. -Is accredited with the International Dyslexia Association (Structured Literacy/Dyslexia Specialist), -permanently certified Reading Clinician through Manitoba Professional Certification with Manitoba Education and Training. -wrote a thesis Dr. Björnson's Doctoral Thesis - Reading Difficulty in Manitoba.	Confirmed interview : October 4 2022 8 pm EST	<a href="https://sites.google.com/site/valdinebjornsonreadingpower/home">https:// sites.google.com/ site/ valdinebjornsonre adingpower/ home</a>

### Conclusion - Summary Statement (Research / Advisor)

In conclusion, my research has the current support of two expert advisors who have decades of experience in the field. With their guidance and insight, I can validate my research and ideations with confidence. My work with them will be ongoing throughout the duration of the thesis.

## E Advisor Meetings & Agreement Forms



**IDSN 4002 /4502**  
SENIOR LEVEL THESIS ONE & THESIS TWO

Faculty of Applied Sciences & Technology  
Bachelor of Industrial Design / FALL 2022 &

### INFORMATION LETTER

**Research Study Topic:** Dyslexic Adults in the Workforce

**Investigator:** Reem Abdelhaleem / 647 545 7602 / artsyreem@gmail.com

**Sponsor:** Humber ITAL, Faculty of Applied Sciences & Technology (IDSN 4002 & IDSN 4502)

#### Introduction

My name is Reem Abdelhaleem, I am an industrial design student at Humber ITAL, and I am inviting your participation in a research study on various problems that dyslexic adults in the workforce deal with. These problems include reading comprehension, ability to keep up in the work place, memory, and self esteem. Literacy is a right that adults need in order to succeed in the work place and out. The results will be contributed to my Senior Level Thesis project.

#### Purpose of the Study

This study is being conducted as an aid in designing a work tool for adults in the workforce that is capable of enhancing the users ability to perform work tasks in the office and keep up with literacy based duties. The product designed will use the special strengths of dyslexics while minimizing the hindrances of their difficulties. In addition, this study wants to raise the self esteem and confidence of those with dyslexia in the workplace. This study is primarily based on understanding ergonomics, human interaction design activities, and user experience aspects of the research area.

#### Procedures

if you volunteer to participate in this study, you agree to be voice recorded digitally for further research assessment. You will be asked questions about your personal and professional experiences and knowledge in the field of dyslexia, and dyslexic adults.

#### Confidentiality

Every effort will be made to ensure confidentiality of any identifying information that is obtained during the study. In the case of being recorded visually, your face will be masked /blurred or hidden. The information and documentations (photographs) gathered are all subject to being used in the final presentation of the study.

#### Participation and Withdrawal

Your participation in this study is completely voluntary and you may interrupt or end the study and the session at any time without giving a reason or fear of being penalized.

If at any point during the session, you feel uncomfortable and wish to end your participation, please let the moderator know and they will end your participation immediately.

#### Humber Research Ethics Board

This research project /course has been approved by the Humber Research Ethics Board. If you have any questions about your rights as a research participant, please contact Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, [Lydia.Boyko@humber.ca](mailto:Lydia.Boyko@humber.ca)



Informed Consent Form



Faculty of Applied Sciences & Technology  
Bachelor of Industrial Design / FALL 2022 &

**IDSN 4002 /4502**  
SENIOR LEVEL THESIS ONE & THESIS TWO

**PARTICIPANT INFORMED CONSENT FORM**

**Research Study Topic:** Dyslexic Adults in the Workforce

**Investigator:** Reem Abdelhaleem / 647 545 7602 / artsyreem@gmail.com

**Courses:** IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, Cheryl Urbanczyk have carefully read the Information Letter for the project 'Dyslexic Adults in the Workplace', led by Reem Abdelhaleem. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact Reem Abdelhaleem at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

**Consent for Publication: Add a (X) mark in one of the columns for each activity**

ACTIVITY		YES	NO
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Review	I give consent for review by the Professor	<input checked="" type="checkbox"/>	<input type="checkbox"/>

**Privacy**

All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Reem Abdelhaleem and Prof. Catherine Chong or Prof. Frederick Matovu may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, [Lydia.Boyko@humber.ca](mailto:Lydia.Boyko@humber.ca) or « insert student Name /Phone Number /Email Address ».

**Verification of having read the Informed Consent Form:**

I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.



Faculty of Applied Sciences & Technology

Bachelor of Industrial Design / FALL 2022 &

**IDSN 4002 /4502**

SENIOR LEVEL THESIS ONE & THESIS TWO

**PARTICIPANT INFORMED CONSENT FORM**

**Research Study Topic:** Dyslexic Adults in the Workforce

**Investigator:** Reem Abdelhaleem / 647 545 7602 / artsyreem@gmail.com

**Courses:** IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

**valdine bjornson**

I, \_\_\_\_\_, have carefully read the Information Letter for the project 'Dyslexic Adults in the Workplace', led by Reem Abdelhaleem. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact Reem Abdelhaleem at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

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**Privacy**

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I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, [Lydia.Boyko@humber.ca](mailto:Lydia.Boyko@humber.ca) or « insert student Name /Phone Number /Email Address ».

**Verification of having read the Informed Consent Form:**

I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

## Full Interview Transcripts

### Interview transcript Cheryl Urbanczyk

**Sunday, September 25 2022**

Reem:

What is your name and experience in the field?

Cheryl:

My name is Cheryl Urbanczyk, I have a vast experience from a few angles. First as the parent of a child with dyslexia, I am a teacher and now vice principal, so I have experience throughout public education. And I also have experience as some one who has done extra training and certification to train students with dyslexia and train teachers and those whoa re interested to support students with dyslexia.

Reem:

What are the current top 3 challenges in the field?

Cheryl:

First one would be awareness, most people haven't heard of learning disabilities, they think it's just switching letters back and forth. Like b as d- but they don't understand the actual mechanism by which it occurs and how it impacts leaning to read.

Second one is how reading is taught in schools- because its taught in a way that does not support students with dyslexia at all. It assumes children will naturally learn how to read instead of being explicitly taught.

Third one would be supports for students with dyslexia, not enough supports for students or adults in the work place. In Ontario under the human rights code, people with differing

abilities should have their needs met in school and work place.

Reem:

“What are the top three challenge of those that struggle with dyslexia are?”

Cheryl:

“First one would be with large volumes of reading. If students with dyslexia get proper teaching and remediating, they can read and they can read at grade level, the problem is it's every slow, very labored and takes much longer to read, then it would a neurotypical counterpart. The causes issues because if you are confronted with large volumes of info it can take you 2 times 3 times as long to read it as someone else. That has to do with the brain, it's working at a different pace tis not linked to intellect. Second issue would be having to memorize lots of basic information. Dyslexics are often challenged with memorized basic facts, like addition facts, low level memorization is a challenge, so if there is ways to support that would be great. Memorizing letter strings is often challenging. The third challenge which kind of incorporates the first two, not having supports in place to utilize strength and support them with challenges. Because dyslexics bring many strengths but if supports are in place to help with volumes of reading or help with other aspects, the strengths the dyslexics have can be put in place.”

Reem:

What are the current ways dyslexics cope with those - either ways they are taught or cope themselves?

Cheryl:

In term so equality of reading- text to speech but it still takes longer than silent reading. In schools sometimes what happens is you just do less. But if you do less you bare

still not - you will be missing out on learning or missing vital information to move to the next level. Let's say a neurotypical student is expected to read 10 pages in 10 minutes and the dyslexic student reads less in 10 minutes they miss out on whatever was in those pages. Sometimes they just don't want to because the reading is so challenging and hard. I've seen students come up with their own ways and they vary from individual but they involve a lot of stress because they know they need these mechanisms to do every thing.

Reem:

In terms of ways dyslexics are currently taught what is the most common way these are taught?

Cheryl:

A method called whole language which just assumes if you read to children, make a print rich environment and there are books around, hear a lot of stories they'll just learn to read ON THEIR own and works for the vast minority instead of the majority of students. Because there is no explicit teaching, kids are left to teach themselves and it often doesn't work out very well for them.

The Orton Gilliam method is the best way, where you clearly and explicitly state, what each step of the reading process is so there is no guess work so students have skills and strategies instead of just guessing- it is a completely different approach but it is very successful.

Reem:

What are the current opportunities in the field to help dyslexia- room for improvement perhaps?

Cheryl:

Ensuring that dyslexic strengths are utilized. Every child has a mixed bag of things they are maybe not the best at and talents they have, and things they like- because schools focus so much on reading writing and math, and those are not the typical strengths of dyslexic - we need to have lots of opportunities to express their strengths. The other would be how can we support dyslexics moving from high school to university and into work place. A lot of interest right now in terms of the Ontario right to read report in schools- but not so much in supporting dyslexics adulthood, university or in workplace. The third would be lots of awareness raising, so people and general population have lots of awareness about it.

Reem:

Going off what you said about it in workplace any other comments to add?

Cheryl:

I must be honest and say I don't have much information about that area but if assume just like in school where students need support with large volumes of reading or writing. There are computer programs for kids but I don't know what exists for adults and things for people to use at work so their skills can shine through.

Reem:

Any impact with new technologies in the field of dyslexia you see currently:

Cheryl:

In terms of new tech, app based games for kids. Speech to text and text to speech but that's been around for a while- I'm assuming it's gotten better.

There is a pen people use, where you swipe it over a sentence and it kind of reads it out

loud somehow.

Reem:

Any final thoughts on the topic?

Cheryl:

It is very important topic because dyslexia is quit common in the general population. International Dyslexic Association, estimates between 15-20 percent. So in every class of 20 that's 2 students which is a relatively high percentage.

### **1:1 User Interview Transcrip : User**

Reem:

When where you diagnosed with dyslexia?

Cristian:

For me, it was grade 2, my parents started to realize from a reading perspective that it seemed to be I was behind a little bit. Now the school system really did not help. They where under the impression that I was told that "boys develop a little bit later than girls, don't sweat it, let's just see how it plays out". But for me I remember coming home and just being really upset, as a young kid, I would come home and cry, because its A- embarrassing and B- your just not at the same level as everyone else in the class. So my parents decided to go and test me outside the school board on their own and then yea, it was that summer, of grade 2. So the time I was in grade 3 I was just starting to have my diagnosis and figuring out how that affected my learning and how I needed my teachers to basically teach me a way I was going to retain information.

Reem:

Did your dyslexia impact the field you decided to pursue?

Cristian:

Um, defiantly! I think it did in a very positive way. I have been very fortunate where my parents have been very involved A - at the very start making sure that I get my diagnoses but then throughout the whole journey understanding again that I learn differently. It's not something that's really talked about or nearly as much in the education system - is everyone learns completely differently but gets a generic education. And so that becomes very tricky for a lot of kids and very discouraging. A lot of kids have that moment - I hate school, I'm bad at school and that sets them down a pathway and closes a lot of doors. I was very fortunate that was not the case from. Ever since a very young age it was figuring out how I learned and a big part of that was realizing ima very visual and audible learner. So um I'm not a person to take notes during your lecture I'll just sit there and listen to it and watch it and preferably if their is pictures on the board, or anything I could connect those pictures too visually that was very helpful. And so I knew this going into high school. I also enjoyed my art classes a lot in elementary school so when I went into high school, and had the opportunity to take some electives, I took some more art classes but then some tech classes. That is where I found my strike I think and then from their I did some research into watts kind of a technical way of applying these arts and these design skills that I require. Because I'm a very visual learner I also have a very good understanding of 3D space, which comes in handy as an industrial designer. So yea it's just realizing how you learn as an individual and what career is going to cater towards that. Not necessarily because you need the career to cater towards you but are you going to get ;the most enjoyment from. Once I found the program [industrial design], right form the beginning, it was a very good fit so I'm very fortunate. I know some people have some trouble with post secondary, and finding their way. But I think that directly correlates to the fact that they don't really know themselves or they don't know how they learn. So for me it was very positive experience.



Reem:

Did you inform your workplace about your dyslexia? If so how did they react or support to you?

Cristian:

Through schooling, that was a big part of learning how to advocate for myself in the classroom, and going up to the teachers at a young age. I remember it being very intimidating, talking to an adult being like "this is what I have this I what I need, legally you this be supplying me this- or this is how its gonna go". Which didn't always go over well, which also made it very tricky. It helped me develop as a persona a lot. It gave me a lot of communication skills, a lot of confidence- not at the beginning, I mean it was a long journey- but the reason I tell you this because it translates to post secondary. Which is a little bit more up to you- you have your accommodation letter and you can send it to the teacher or it is sent to the teacher, and then its up to you if you want to go up and tap to them. For me its really case dependent - because I have so many tools that assist me - its not something that hinders me as much anymore in my day- to- day. It's obviously really prevalent but it's not something that other people will notice is the way I should put it. If that's the case- I don't go out of my way to say anything to people.

Going back to your other question because I picked the industry that I did, there is even less scenarios in which it really would be showcased as a problem. What I mean by that - is if I'm sketching, ideating, doing cad, doing research, interviewing people, communication skills for me I a strong point as well - so all that stuff is not a problem at all, its my skillset. There is very few times- where if its crafting an email - that might take me a little bit longer than the next guy. Or if your are putting together. Report where it might be kind of noticed, but I just kind of play it by ear. So to answer your question- I did tell my workplace but it was fairly casual when it came up. I think we where doing something where the department was getting to know each other- we where doing a fun team building

game, on a Friday. It took that opportunity to share that fact. The whole department and both my employers were quite surprised, which I guess is a good thing. And I mean because they were surprised and it doesn't necessarily affect the day to day- that was where it was- so they knew of it, there was no further conversation after that. But again if I did require some assist or want some help or wanted something provided to me in the workplace, as far as a tool or that's concerned- I'm defiantly not the person to shy away from that. Part time jobs - never. Mainly it was schooling where that way of leaning didn't really work for me- so I did need or require a few more tools- so I was sure to be confident, inform the teachers and get the tools I needed.

Reem:

Did you receive any out of school tutoring or training? Or was all your education from the public system?

Cristian:

No, it was all out of public. I never had an English tutor- I had a math tutor at some points but not often. My parents were diligent at helping me with homework. My younger brother who also has dyslexia as well he had an English tutor but its one of those things where you can try and develop that skill set to a certain extent and then a part of it is what you're born with or how your brain works. Now I did use a lot of tools, I had - is still do have - an iPad. And that assisted me quite a bit through school. Nowadays I only really use it to digitally sketch but back then I would use it as a big tool. And also the school provides you technology themselves which was brutal- they suck! Like Kurzweil, and Dragon- they were just like terrible reading and writing software- just never really worked. Once the iPad came around I was using that to take notes- it would record classes for me and I could go back and I could click on the note I made and it would go back to that point in the recording. I could use dictation, so I could just dictate into the iPad and it would write out for me. There

was a reading app that I had, that would scan documents and read it back to me. So like I became really diligent with that. And the lady that I got my testing for - the psychologist- she was the one that informed us of these tools. So to answer your question I didn't do any schooling outside the public system - but what I did do was the testing. That was key.

Reem:

Does your dyslexia hinder you in your work?

Cristian:

For the most part no. its tricky because I'm not like severely dyslexic- I haven't had a moment at lest that I can't essentially tackle myself. So if I am reading something, a standard or a procedure sent from an engineer- you got words in there that are absolutely ridiculous. But I mean anything where that's the case - its as simple as copying and pasting the word into google. Again living in 2022, this technology just makes this so much better. So for the most part that's the steps, if I'm reading a big document or I'm writing a test procedure, or writing a report or email - I think all it does it that I just take my time with it and I take a little bit more time than someone who that is their skill set. But I've never had it actually hinder me or ever also come back where anyone has noticed or come back to bite me as far as negatively. So for the most part its quite good. And then as I said as well a big part of that is the industry I decided to go into.

Reem:

What do you wish your work place had to help you or better support you?

Cristian:

I think that becomes very company specific. For me I'm pretty self sufficient- so its not so much of a problem- and I had a lot of these tools accessible to me before coming in. But for me I also work at a start up - so it can be tough to get any funding - really to do anything. Because you are pinching pennies to release a product and get into the market.

I would be more hesitant for example if I wanted to get some software to help me read - Grammarly Premium. If I was at a big corporation I would really think twice "this is the situation I'm in, this is what I require" often times if you are at a big company that's not a problem - they'll get you what you require. That becomes tricky when you're at a start up company or a small company.

Reem:

Does dyslexia impact your self esteem about success or success in the work place?

Cristian:

Yea - uh no. Definitely the opposite for me. Like I said I credit it to what has allowed me to understand how I learn and what my skill set is. the way I look at it already- I compare myself to my peers- there's so many people that I knew in high school, this isn't a knock on them but I was forced to go through this process much earlier in life- which is again why in a weird way I feel fortunate. But like a lot of people they're lost - they'll take very generic university programs or they'll take business of commerce because that's what their parents told them to do. And now as I graduate and I walk out of school with a job I'm seeing so many people from my home town they are just very very lost. Again that's a matter of them figuring out their own path, their own learning and what is going to be a career for them. So from that standpoint I already feel more fortunate and that gives me more confidence. But what its forced me to do is understand what I am good at. What that allows me to do is push - put myself in positions where i'm promoting or using those skill sets more often. So again that why I picked the program, that's why I am the career I am. But it goes deeper than that, as far as even the opportunities you chase when you're in the job. For me my communication skills as far as verbally and the hard skills I've learned from the program has helped me be a very good presenter. So then I take those opportunities

when I can where I can showcase those skills and usually tats recognized and that produces opportunities and what not. It's allowed me to get the job that I'm in today and keep the steps in the right direction as far as career is concerned.

It's given me a lot more confidence. Which I know is not the case for a lot of people. I had friends and I saw a lot of kids when you are going through the schooling system and you are part of that core room or whatever room you wanna call it- but there is a lot of kids that I would watch it do the exact opposite and give up.

Reem:

Do you have any cooccurring learning disabilities such as ADHD?

Cristian:

Yes I do- which from my understanding is a common thing. Just to give you some insight as well my younger brother who also has dyslexia, also has ADHD. I personally do not have ADHD, I have like a whole breakdown that they do with these test where like I'm more gifted on that kind of visual communication side of things- but then my working memory is where I struggle a lot. It when you are in the process of working on multiple things at once that's where my memory it fails me. So if I have multiple things going on at once- i'll look at lets say a number and ill turn to my laptop to write it down and I will have already lost it. That's why math not great for me - it also plays a role in English and spelling. That and my short term memory is not that great whereas my long term is much better. I don't have another disability but I know those are the things I struggle with.

## F Other Supportive Data

### Ontario Human Rights Commission: 13. Duty to Accommodate

Literacy directly benefits the individual allowing them to have a higher self-image, as well as society by creating knowledgeable and educated citizens. Under the Ontario Human Rights Commission, there is a “duty to accommodate”. Which ensures all employers have the legal obligation to accommodate those with disabilities. Working towards solutions that can help employers and persons do that is vital and will help fulfill that right.

“ Under the Code, employers and unions, housing providers and service providers have a duty to accommodate the needs of people with psychosocial disabilities to make sure they have equal opportunities, equal access and can enjoy equal benefits. Employment, housing, services and facilities must be designed inclusively or adapted to accommodate people with psychosocial disabilities in a way that promotes integration and full participation.

The OHRC’s Policy and guidelines on disability and the duty to accommodate, Human Rights at Work and the Policy on human rights and rental housing[164] provide in-depth guidance on accommodating the needs of people with disabilities and other Code-protected groups in employment, housing and other areas. The purpose of this policy is to apply these principles specifically to people with mental health and/or addiction disabilities” (13. duty to accommodate).

### 13.2 Inclusive Design

The policy also specifically points out “inclusive design”. This emphasizes the importance of designing for those with all abilities and with the principal of neurodivergence.

“Ensuring integration and full participation means designing society and structures for inclusiveness. Inclusive or “universal” design emphasizes barrier-free environments and equal participation of persons with psychosocial disabilities with varying levels of ability. It is a preferred approach to removing barriers or making “one-off” accommodations, which assume that existing structures may only need slight modifications to make them acceptable” (13. duty to accommodate).



**Ontario**  
**Human Rights Commission**  
**Commission ontarienne des**  
**droits de la personne**

## Reference

13. duty to accommodate. 13. Duty to accommodate | Ontario Human Rights Commission. (n.d.). Retrieved April 15, 2023, from <https://www.ohrc.on.ca/en/policy-preventing-discrimination-based-mental-health-disabilities-and-addictions/13-duty-accommodate>

## THE AUTHOR

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