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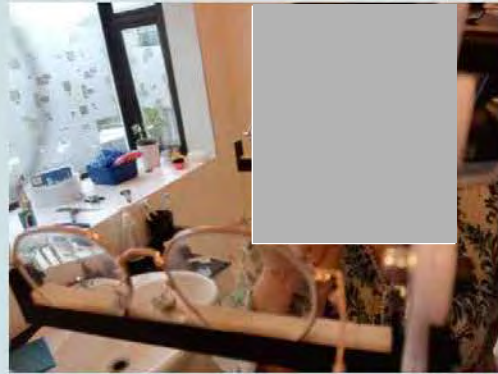
# Scholarship Technology 2025

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## EXEMPLAR

**Scholarship**

## Technology Portfolio 2025: Glasses Holder



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## Identifying a range of contexts

### Children in Hospital

Children and families with children in pediatric care can experience a loss of choice, expression and independence as well as difficulty adjusting to a hospital environment. I'm interested in this context as I and other family members have experienced stays in children's wards, and I would like to

help those who stay have access to better comfort and quality of stay.

Possible issues include the noisiness of hospitals when trying to sleep, which can negatively affect children and parents during recovery, the loneliness and isolation that may be experienced, kids being unable to dress themselves and the general loss of mobility, such as difficulty holding cutlery independently.

Additionally, there can be little space to study/draw in hospital rooms, as well as having limited storage space and the effects on mental health for small children who can find hospitals unfamiliar and intimidating environments, as well as the stress and Pediatric healthcare-induced anxiety and trauma that arise.

From here, I contacted stakeholders in hospitals and the [REDACTED] Pediatric Ward, as well as kid-focused hospital charities. The feedback from wider stakeholders wasn't very cohesive, and I found there didn't seem to be a key issue for me to focus on, as we couldn't see how a materials solution would best resolve the present issues. Therefore, I will not continue with further research into this context as I don't see an opportunity for significant impact.

### Walking & Tramping in New Zealand Bush

Walking and tramping in the NZ Bush is a viable context due to the diverse and fragile ecosystem of the New Zealand Bush. Bush walks and immersion in nature have been proven to calm individuals and improve resilience in everyday life.

Therefore, by developing material solutions for issues encountered in and around, I wish to help create bush exploration that allows for the preservation of these walks for future generations and allows greater accessibility to all to engage in nature.

Possible issues include pests introduced/spread during travel when tourists travel to protected islands and reserves. Giardia-contaminated streams mean drinking water is at risk, and travellers need water reliability.

Additionally, tramping accommodations such as lack of toilets in the New Zealand wilderness, being able to adjust to unpredictable weather events and assessing fitness level for tracks and adding on to the lack of drinkable water, the lack of water fountains and ensuring that taking dogs tramping doesn't endanger native wildlife and birds.

From here, I contacted DOC and tramping websites and received a small range of issues faced while tramping. They responded with a range of suggestions that I incorporated into my possible issues. The issue that stood out to me as an impactful problem was the issue of Giardia.

However, I found that while creating a materials solution for Giardia contamination sounded interesting, there were already several viable options on the market, and there wasn't a gap in the market. I then contacted several NZ tramping and walking sites and groups, but couldn't identify a suitable option that excited me through a materials lens.

### Daily Accessibility

People with accessibility issues are a viable context, as there are many issues that develop that may be overlooked. By addressing these issues with a material solution, people are able to have a higher quality of life. People who struggle with these issues are often some of our most vulnerable or at-risk, such as children, the elderly and the disabled and the opportunity to lower barriers in areas that are often frustrating.

Potential issues include things such as struggling to get dressed independently, as well as relying on others to do basic tasks such as grocery shopping due to reduced mobility through symptoms such as shaky hands, which, when severe, interfere with hobbies such as sewing or drinking coffee, typing and being able to sign one's signature.

Furthermore, there is often a stigma associated, which can lead to suffering in silence, particularly for older people who may feel judged for declining health or changes in their lifestyle. Another issue is adjusting to loss of eyesight, and another often seen in the elderly is difficulty maintaining appearance.

Another area is creating convenient storage, as issues such as chronic pain can make common storage spaces in houses off-limits.

Other issues involve reliance on others/reduced independence, such as difficulty with accessibility to leisure activities, such as tennis and swimming, or going out to meet friends, and showering with mobility issues.

I've also been informed that have been attempted but not completed are taking out heavy recycling bins -particularly up long/steep driveways, and the issue of opening jars, kitchen and kitchen maintenance also appears to be a consistent barrier to independence.

From here, I contacted a range of stakeholders, including rest homes and accessibility charities, as well as possible stakeholders in my own life. Accessibility is deeply important to me as it's something I and people who I'm close with sometimes struggle to reach in everyday life. Improving quality is something invaluable that can be achieved through technology and especially materials technology.

The issue of applying makeup with glasses was a common issue experienced by those with low vision and resonates with me. Furthermore, I believe that a materials lens could be applied here for significant impact, and the gap in the market means a wide range for innovation.

### Chosen Context: Low Vision in New Zealand

Low vision is defined means someone who experiences moderate to severe visual impairment. Low vision means that a person's vision impacts their ability to do everyday things, such as drive or read.

Those with low vision can often develop fatigue easily through straining their eyes, and some experience migraines associated with increased difficulty with sight and perception. Low vision includes those who are

short-sighted and those who are a combination of short-farsighted.

### History of Low Vision in NZ

Recently, New Zealand and many other countries have experienced an increase in the number of people, especially children, who have impaired vision, with an estimated 225,000 New Zealanders projected to qualify as low vision by 2028 for a range of reasons. I myself have a genetic disease which has and will continue to affect my eyesight significantly.

Some, like myself, can use medicine or, like my grandfather, who had cataract surgery, to slow and/or remove the loss of vision. However, for the majority of people with low vision, the complete or functional restoration of vision isn't on the table, and tools such as glasses and contact lenses, corrective contacts (Orthokeratology), are a necessity.

## Statement of intent

Chosen Context: Improving Accessibility, Needs and Issues

### The issue

Applying skincare and makeup with low vision causes difficulties for many people, as there is no current solution on the market for those with impaired eyesight to be able to prepare themselves for events, professional settings and everyday life. This can impact self-esteem, independence and how they are perceived by others.

Applying makeup with low vision is an issue, as it can't be applied with glasses, as they are an obstruction, and if removed, often vision is low enough that precision can't be

reached. Additionally, independence for things such as trimming brows is often not an option, as those with low vision often won't be able to tell how much they've trimmed.

### The Need

The difficulty for those with low vision in applying skin care and makeup, especially around the eye area, which often requires a high amount of precision.

### The Opportunity

For a materials solution which fulfils this need and issue, as well as the gap in the market, to make people's lives easier.

### Retirement Village consultation

I reached out to [REDACTED] Retirement Village and met [REDACTED] (86), [REDACTED] (81) and [REDACTED] who were all retirees who fit the context of having low vision and wearing make-up. I briefed them on the process I was going through, and then I gave them a form I'd created for them to fill in about the potential issue.

They confirmed that this is an issue they've experienced/seen in the wider community, with [REDACTED] stating that both she and her daughter can't apply eye makeup anymore due to their poor eyesight. I also obtained information about the physical environment, storage, social environment and habits related to their glasses and makeup. This was important to obtain as my product will need to accommodate these specifications by these stakeholders to be a functioning product.

After the meeting, I decided to create digital forms to get feedback from a wider range of ages for my possible end users, so that I can perceive how this issue affects different groups of people and better reflect those in the context of low vision. Furthermore, I can now extract the information from my surveys to create initial observations of the physical and social environment, as well as cement the priorities of the materials solution.

## Initial Environmental Considerations

### Initial Physical Environment Considerations

1. Very Important
2. Important
3. Somewhat important

For increased use and mobility, the product could be made to easily carry in stakeholders' handbags so that make-up can be applied with ease, potentially in the car, or touched up in public. However, the majority of stakeholders apply their makeup in their bathrooms and don't indicate that they often apply relevant makeup while outside.

My stakeholders often apply their makeup, especially eye makeup, while looking in a mirror/reflective surface. Therefore, to fulfil the environmental needs, the result should allow looking at the mirror closely and without any restrictions to head movement, such as tilting.

Due to the intended nature of the end product, which could be in contact with the face, the oils and skin of the face

are naturally acidic and therefore the materials used in prolonged contact should not be sensitive to pH. As my technological outcome will, according to stakeholders, be used inside and stored away, it does not require UV damage prevention, any other environmental protection, and should be stable with indoor temperatures in New Zealand.

The storage of the end product is important to my stakeholders, as they store their makeup in drawers, avoiding clutter on their counters. Hence, the packaging and design should be easy to store near their makeup for easy access. As makeup is applied across the face, often powders and substances that stick to the nose rest of the glasses, rubbing away makeup and creating dead skin build up in the plastic pinch nose rest that the majority of my stakeholders use. Therefore, my solution should either be easy to clean or resistant.

As my stakeholders all experience different reasons and prescriptions as to why they experience low vision, my results must not prevent a range of prescriptions from being it. Because there is such a range of glasses, my end outcome would be best to work with the user's existing glasses, as their glasses have the prescription best suited for them.

Adding to this, prescriptions and use of glasses often change over a person's lifetime, and all of my stakeholders have changed glasses at least once or have multiple pairs of glasses, so the resulting product would be best to be flexible with a range of glasses.

Additionally, as there is a wide demographic which I'm trying to cater to, I need to account for a variety of

facial features with my materials solution. This could be achieved through a range of materials and techniques, but needs to be adjustable to account for varying noses, faces, heights, eyelines, etc. As a result, the output should be ergonomic and comfortable for the periods of time stakeholders wish to use it while applying their makeup.

Adding to adjustability, the end product must be able to work with a variety of glasses materials and nose rests. This means being able to support the weight of plastic or metal glasses and allow a range of glasses to rest if the material's outcome rests upon the face. Without fulfilling this, the outcome no longer fulfils the context or the needs of the proposed end user. Durability, my stakeholder feedback highlighted to me the consistency with which they apply make-up, generally checking the daily box. Therefore, to ensure product lifetime, the material needs to be durable to daily use.

Furthermore, there is a range of glasses noses. As my final product is intended to be interacted with by my end user, it needs to be easy to pick up, place and resilient to pressure from hands. Otherwise, if it's fragile, potential users won't use it, as the product lifecycle and ease of use will be affected.

Lastly, the outcome must allow the brushes and tools that my stakeholders use to fit onto their face easily, translating to having enough space between the glasses and face. This is crucial to solving the issue my stakeholders experience, as it allows them to apply their makeup without the obstacle of having their glasses on.

Moreover, as my stakeholders have cited the bathroom as where they'd like to apply makeup, many makeup formulas are liquids, and often people prefer to wash/cleanse their face before applying makeup.

My materials output should be water/liquid resistant, including not discolouring. Furthermore, prescriptions vary depending on either eye in the majority of my stakeholders, and most have a mix of farsightedness and nearsightedness, meaning that the final result should account for the differences in prescription for each eye.

#### Initial Social Environment Considerations

Outside/on the go use being discreet could reduce potential users' self-awareness when using the intended outcome. Yet, as this isn't cited as a heavily desired requirement by my stakeholders, it isn't a prominent issue.

Establishing social acceptance of my end outcome isn't a major issue, as there isn't an established precedent for my product to be compared to; my stakeholders have said they'll be most likely to use it in their own homes, and my context and issues have been met with a positive reaction from key and wider stakeholders.

An important part of designing with accessibility in mind is that the design is non-invasive. If the outcome is seen as unwieldy or complicated, it prevents the context of improving accessibility from occurring. Therefore, a requirement is a streamlined design that appears easy to use.

Catering to the opinions and styles of a wide range of ages is important, although the product will probably be thought to be used by older women, yet to fully fulfil my context 'Accessibility issues in New Zealand' throughout its design and packaging, I should consult with the preferences of a wide range of stakeholders.

Furthermore, my material outcome should appear comfortable to users as it's intended to rest upon the face. Otherwise, possible end users won't be as likely to use it, as it won't be seen as comfortable. Make-up is often associated with fast fashion, greenwashing, etc. Dodgy broad claims are often circulated online for clickbait, so by creating a genuinely sustainable product, I can cultivate trust and ensure reliability for end users.

Individual perceptions of this device stem from whether you saw it at its intended purchasing place, such as the supermarket/make-up store is important as it helps determine whether or not the tool will be purchased for use. Therefore, the end product could draw on the designs of other makeup tools so that the context for use is apparent.

Establishing familiarity or a common thread when presenting a unique product will reduce buyer hesitation. Furthermore, make-up, especially that aimed at a younger generation, often has a distinctive look to indicate what sort of trends or themes it follows. This gives me the options to try and pair with trends for a quicker turnover or opt for stylistic choices that separate my product from rapidly changing social desires for a longer shelf span.

Stylistic choices for makeup tools are deeply important, as stakeholders desire something that pleases the eye, as when they think about makeup, appearance is important. An important aspect of my end product is that it's perceived as useful; the end outcome needs to clearly communicate how it may positively impact the user. This is important as this isn't an established product and therefore the potential needs to be inherent in the design as an unknown option.

#### Where to from here (Social)

Affirm and specify my considerations for the social environment by reaching out to specialists and wider stakeholders. Finding physical solutions for these issues will be key to transferring these concepts into physical elements in my product design. This will rely on stakeholder feedback, and I plan to create 3 different styles of mood boards based on current makeup tools, so I can learn from my stakeholders what shapes/colours/overall aesthetics they are drawn to and how they perceive these.

Where to from here (Physical): From here, I need to research what specifications are required to meet the needs of this physical environment, and what technological and materials practices could meet the priorities and conditions I've detailed. For example, I may contact a makeup artist to ask what size brushes are most commonly used around the eyes. Additionally, I shall look at existing products on the market, which I can analyse for deeper insight into my own design needs and potential opportunities for a materials solution.

## Initial Product Analysis



### Magnifying Makeup Glasses- Existing solution

The strengths of this existing product are the easy-to-understand design, which adapts the existing and established idea of a glasses frame, building off familiarity. Additionally, the marketing for this and similar products had some virality on short-form media platforms such as YouTube, Instagram and Facebook, which some of my stakeholders and I encountered. For this specific version, there are no other producers in New Zealand, so there's very little competition. In terms of function, the product physically removes the barrier to applying makeup while attempting to preserve vision.

However, there are a lot of weaknesses in this product, such as the set amount of magnifying strengths available. This doesn't account for the needs of low vision, as it magnifies while glasses lenses correct vision defects, meaning that the issue experienced isn't resolved.

Furthermore, with only one lens intended to be switched between eyes, it can't fulfil the wide range of prescription needs due to the difference in sight between eyes. Those with low vision, especially elderly people, can often be a combination of shortsighted in one eye and farsighted in the other.

Even if the magnifying glass was useful for one eye, it could be ineffective for the other, meaning that the user still struggles to apply their makeup. I also received feedback from a stakeholder who had tried using a product of the same design and found that when tilting her head to do her eyeliner, the lens would move, increasing inconsistency in her application of eyeliner.

This product doesn't have a clear product life cycle and cannot be easily recycled. Additionally, it's somewhat costly considering its limited user base for thirty-five dollars, when I found the same option on [redacted] for fifteen.

While looking for similar products, I found that designs and colours are limited to either black or animal stripe frames, all plastic with flat plastic nose rests.

This is a weakness, as when I surveyed my stakeholders, they all had adjustable nose rests. Flat plastic nose rests aren't as accessible because they don't accommodate a range of nose shapes. I, for example, have to use adjustable nose rests due to my smaller nose.

This design choice to have a flat nose piece is probably to have a lower production cost, as the flat plastic nose rest could, for example, be injection moulded with the rest of the frame at once.

"Magnifying lenses enlarge objects for close-up tasks like makeup, but they can distort depth perception and provide a narrow field of view. They're useful for detailed tasks but might not offer the vision correction

needed for glasses wearers. On the other hand, regular prescription glasses correct vision across a wide field but don't magnify specific areas for tasks like makeup application." - [redacted] optometrist at [redacted] Optometry, on the pros and cons of magnifying lenses.

I have the opportunity to create a customizable version so different prescriptions could be inserted, but I believe this wouldn't be an efficient material outcome, as the lenses would need to be custom-made when my end users already have the appropriate lenses in their glasses.

However, this design and these products are proof that this is an existing issue for my chosen context, and also prove that solutions to this issue are underdeveloped, with limited options available online, and none of my stakeholders say they've found something similar in store.

As a result of this wider stakeholder feedback, I've concluded that a better alternative to this product would allow a user to use a magnifying mirror if needed, which is a widely available product if my end users require additional definition. However, the magnifying mirror by itself wouldn't resolve the issue for my potential users.

To conclude, this product helped me recognise the issue of applying makeup while wearing glasses. The product itself isn't a successful solution to the need in the market due to the fact that it isn't accessible to most people with glasses. This opportunity in the market is emphasised by how this existing product has narrowed its

potential user base through its weaknesses. That there was still interest and hype on social media for this type of product helped provide evidence that this is an issue people experience.



#### Foldable Lorgnette- Antique potential

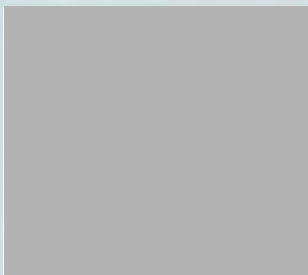
Through analysis of this design, I've found the strengths of the foldable Lorgnette include the fact that the compact design is easy to store, the usage and how to fold it out are intuitive. This could possibly be used to solve the issue facing those in my context, as it may be held at a distance and easily adjusted to the desired eye level, distance, and angle.

Some restrictions on this design as a viable solution are that a hand is required to hold the glasses steadily for a long period of time. This is a barrier as those with low vision, of whom a significant elderly, may struggle to hold the Lorgnette steady, especially for long periods of time. This

would mean that the resulting product would no longer fit the context of daily accessibility.

Due to the fact that these are antiques, they are expensive and not available to the general public. This means there is an opportunity to modernise this design for the current market and develop a way to mass-produce it. Due to the obscurity of the design, there's also a novelty factor, as this design isn't currently available to users on the market, so there's an opportunity to widely distribute this product.

A modernised version of these could be a possible threat, but would still need purpose-built lenses, meaning that the physical attributes necessary wouldn't be achieved, and this isn't a particularly viable direction for design, but it does provide insight into storage solutions and helped me refine my requirements.



Eyeglasses stand holder- Adaptation and inspiration.

This existing product has made me consider the opportunity to adapt it into a hands-free stand. The way the antlers are shaped to open up the frames has inspired me to investigate the potential of a makeup glasses stand. This would provide the ability to rest glasses and extend the height to keep glasses at eye level, allowing sight.

Issues with this design that I'd need to adapt are that the height and angle aren't adjustable, and the shape of the deer would obstruct eyesight for potential users.

Additionally, this product is intended as a statement piece and, as a result, is bulky, and the irregular shape would make it difficult to store in my stakeholders' drawers. As this product is not purpose built it is inflexible, and the materials used would not suit the needs of my physical environment.

While someone could use a stand to see themselves do their makeup in a mirror, it wouldn't be accessible or reasonable for the majority of my stakeholders. Furthermore, glasses often obstruct the view, so this isn't a reasonable threat.

Therefore, taking inspiration from this existing product to develop a purpose-built materials solution as a stand for end stakeholders to place their glasses on while applying makeup is a potential solution I believe I should explore.

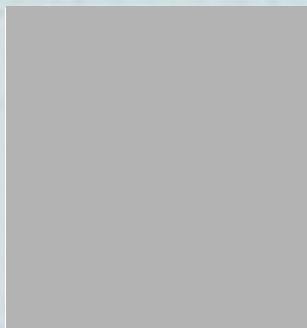


Swimming nose plug- design shape

Swimming nose plugs are a product that is useful to investigate due to their ability to retain grip on a person's nose, their intuitive design, resilient materials (silicone, plastic, wires covered in rubber) that are able to withstand continuous wear and water, fulfilling needs from my physical environment.

The simple design had made me consider how I could alter the existing shape so glasses could be rested upon the arch to create space between the eyes for makeup to be applied. Additionally, the small size of plugs, which are often stored in cases, has helped me think about how I could store my end product.

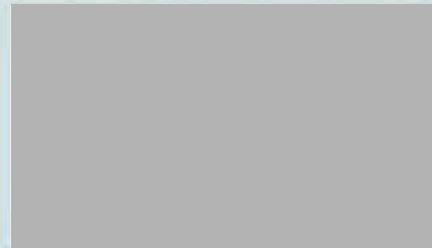
The arch could provide the required height to keep glasses level with eyesight. There's the opportunity to create a height-adjustable version with a glasses rest as a potential solution, though there is the risk that, due to the simplicity of this design that it'd be easier for others to create dupes, which is common in the makeup and beauty industry. Therefore, if I chose to continue with this design, the price, materials, design, and function would need to be able to compete with cheaper copies that have the potential to appear on Temu, Shein, etc.



#### Memory foam strips for face masks

Additionally, I looked into foam mask pads as an alternative to the pads already present on the swimming nose clips, as the nose clips are intended to prevent water from entering their noses and, as a result, may not be comfortable to use while applying makeup.

I was exploring the materials' possibilities when I came across memory foam strips intended to be attached to masks and hold the shape of the user's nose. However, there are potential disadvantages to using memory foam, such as difficulty in cleaning and exposure to moisture. This product presents an opportunity to investigate textile potential in fulfilling the comfort required by my stakeholders.



#### 'Boil and bite' Mouthguards- Ethyl-vinyl Acetate (EVA)

'Boil and bite' refers to the process in which athletes prepare a mouth guard by placing it in boiling water and then setting it in their mouths.

While the design of mouthguards isn't particularly relevant to my issue, the material and process of formation may be able to be used in my potential solution if I find that an on-the-face option, as explored above, is the most suitable for my context. These mouthguards are made of Ethyl-vinyl Acetate (EVA), which is a widely used material. I looked into it due to the attribute of the material to be able to form a shape.

While the foam strips I explored above do have potential, using a component of Ethyl-vinyl Acetate or a material with similar attributes would have a better fit for a wider range of users' faces. This product presents me with the opportunity to investigate how I could

create ergonomics, comfort and stability in my potential designs.

From here, I can take inspiration to help develop my potential outcome, as well as use the existing materials and techniques present in these existing products as a starting point in determining what materials and processes could be used to develop a functional outcome.

By analysing solutions already present on the market, I was able to see the lack of solutions to an issue that has been confirmed as prevalent, and two, understand why and how the solutions aren't adequate for stakeholders' needs.

To continue the technological process, my next steps are to establish the attributes required from the existing physical and environmental conditions. Once I've done that, I can work on producing a range of potential design outcomes which will be influenced by my product analysis.

## Required Physical & Functional Attributes

### Functional Attributes

**Easy to Store-** To reduce clutter and conserve space, my stakeholders would prefer to be able to easily store the end product in their bathroom drawers. A potential solution for this is a case or folding mechanism.

**Ease of Cleaning-** The product should be easy to clean to retain hygienic properties and remove makeup residue. Potential solutions include

using materials that can be easily wiped down with a wet cloth/makeup wipe or possibly applying a protective coating to the product.

**Water/liquid resistant-** My end product should be resistant to liquids, as my stakeholders apply their makeup in their bathrooms and don't want the product to degrade or discolour. Possible solutions are the same as ease of cleaning.

**Appeals to a wide age range-** Consider the aesthetic preferences of a wide range of age groups. This could be achieved through packaging, design, neutral colours, or a range of stylistic options.

**Ergonomics and comfort-** To allow proper use and positively impact my stakeholders, the technological outcome must be comfortable to use. Possible solutions include testing and trialling how the end product can be held, manoeuvred, and drawing inspiration from existing technological outcomes.

**Used with a mirror-** The essential function of my product is that it allows users to look in the mirror/reflective surface while doing their eye makeup with clear vision, as they can keep their glasses on. Possible solutions include my end product working with the existing glasses.

**Suitable for those with low vision-** Must be accessible to those with low vision and their requirements. Therefore, I should conduct trials with those with low vision, consult optometrists in my design, etc.

**Adjustability-** To best fit the range of variables such as eyeliner, mirror height, etc. My end product should be

able to be adjusted in both angle, height, and any other factor that could impact the accessibility of the materials outcome. This could be solved through materials such as memory foam, boil and bite materials, or using adjustable wires.

#### Physical Attributes

Ph resistant- A physical attribute of my outcome is that it is resistant to the pH and oils of the skin, as it will be in contact with the skin and face. This could be solved by making sure the materials I use aren't sensitive to the natural acidity and oils on the face, by consulting with an optometrist, make-up artist or other expert.

Material Durability- The durability of the end product needs to be resilient enough to stand up to daily use and wear to create a valuable product for my stakeholders. Potential solutions include stress testing materials and consulting materials specialists on the best-performing materials for my specifications.

Sustainable materials- This is an important attribute due to the greenwashing associated with the beauty industry. Consumers are conscious about what materials are used and where they are sourced from. Potential solutions include a product lifecycle plan, recyclable materials, and working with recycled/off-cut materials.

Appealing Design aesthetic- The outcome should be physically appealing to my stakeholders, as makeup tools are associated with appearance. Stakeholders want a material product that appeals to their aesthetic values.

Visual similarity to existing makeup tools- Working off the form and shape of existing makeup tools to encourage potential users to try out a new product. This is important due to the anxiety and doubt around purchasing an item that doesn't have established social proof yet.

Universally compatible with different glasses- The result must be compatible with the range of glasses established on the market for it to be a viable solution for my context. I could achieve this through trialling and testing, as well as consulting with glasses manufacturers on the meaningful differences between different frames, lenses, nose rests, etc.

Space-To provide a solution to the problem of not being able to apply makeup while wearing glasses, there must be sufficient space between the glasses and the face for brushes, lashes, eyeliner, etc. to be applied. Potential solutions include a stand for users to look through, a lengthener on the nose.

## Outcome to be developed:

The outcome to be developed will fulfil the required attributes and environmental specifications to provide a solution to the issue of not being able to apply makeup with glasses on in the context of low vision and accessibility.

My outcome will develop alongside stakeholder feedback from both target users and specialist technologists to ensure the end outcome fulfils my stakeholders' needs. It could potentially be a material outcome that sits upon the nose, allowing the

glasses to be moved further away from the face or a stand which can be placed in front of a mirror on which glasses may sit and the height of which may be adjusted to fit the user's eyeline.

## Outcome justification:

This outcome should be developed due to the lack of a suitable solution on the market and the confirmed demand for a product that fulfils this issue from a range of stakeholders. This is a problem for people with low vision, as affirmed by my conversations with stakeholders, as it impacts their quality of life and independence, and it becomes a barrier to ordinary life. A beneficial outcome will also reduce the time taken to get accurate and satisfactory makeup outcomes.

## Initial Brief

My timeline for the project is the end of term three. This has been directed by my teacher as the allotted time to develop, test and trial my result in its social and physical environment. The result will be used where people wish to apply their makeup while retaining their vision, typically in their bathrooms, and will allow them to look into their mirrors to put on eye makeup with their existing glasses.

People who use my product are in the context of people with low vision who wish to improve their day-to-day accessibility and are likely to be older women. The purpose of my outcome is to improve the quality of life and independence for those with low vision. I will achieve using a range of technological processes and materials to determine and develop the best

materials outcome alongside a range of stakeholders.

The functional attributes of the technological outcome should be that it's easy to store and clean, waterproof, appeals to a range of ages, is ergonomic and comfortable, is used alongside a mirror, adjustable and creates sufficient space between the glasses and the face.

The physical attributes of the final product must be that it's pH-resistant and suitable to be on the skin if intended to be on the face, made from durable and sustainable materials/processes, have an appealing design/aesthetic, be visually similar to existing makeup tools, and be compatible with existing glasses. Based on these attributes, I will be including the critical aspects of usage with a mirror, providing enough space between glasses, compatible with existing glasses and easy to store and clean.

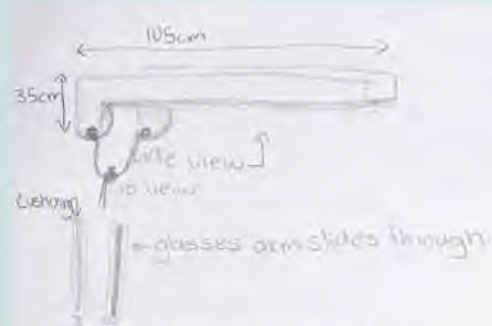
### Required Attributes

- Easy to Store
- Easy to Clean
- Ph resistant
- Material Durability
- Water resistant
- Sustainable materials
- Universally compatible with glasses
- Usable with a mirror
- Appealing Aesthetic Design
- Visual similarity to existing tools
- Space created between the face and the glasses
- Appeals to a wide age range
- Be ergonomic and comfortable
- Suitable for those with low vision
- Adjustable

# Initial Ideation

## Initial Ideation #1

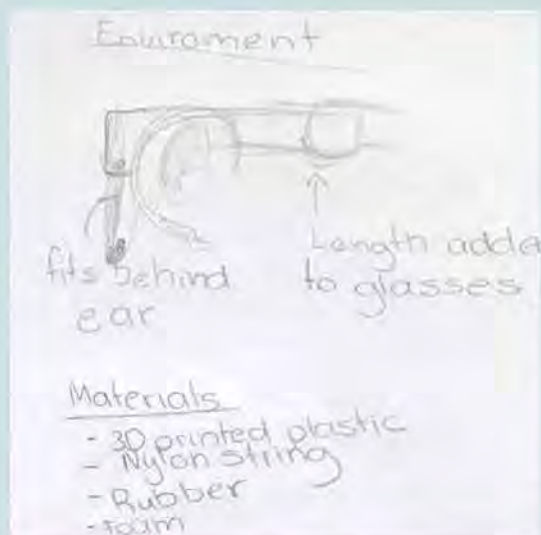
This initial idea stemmed from the existing glasses' legs and the sports strap I had worn around my glasses to keep them on when I played netball. The page below shows that there were two hollow glasses' arms joined at the back by an adjustable drawstring. The hollow arms were meant to extend the length of the user's existing glasses, which would sit inside them. The potential advantages were intended to be the ability to be easily transported and highly adjustable to a person's head, and to use their existing eyewear. The design was also lightweight to reduce any potential for the wearer. There was also the ability for this to be used without a counter or with minimal space in one's bathroom.



### Pros and Cons (Immediate)

- Cons:
- possible tip due to curve of glasses arm
  - Not being to fit different widths of glasses arms
  - Too loose/not much of prevention for head tilting angles
  - The two separate pieces might be too flimsy and can slide with the drawstring
  - The drawstring isn't very clean design
- Pros:
- Goes from original design of glasses and sport tie and strings
  - easy to store and transport

'The instability and unreliability of the arms, if they're always moving, could lead to deterioration. People's head sizes are very different, so the adjustability would have to be very large and could be unrealistic. The anti-clockwise torque required for the glasses to stay upright wouldn't be present'-



Critical reflection: This design has helped me assess the stability of having a design on the human head and rethink how useful it is to refine the design to be universal to the human head isn't something I want to spend my time on, with the time constraints I have to produce my prototype. This is because I want my final product to be as ergonomic as possible, and developing stability of this design could mean compromising on my desired attributes due to a lack of time. My other designs are more viable for a range of reasons, including their durability, conceivability, aesthetic and compatibility.

When talking with [redacted] we discussed ways to potentially optimise the design by incorporating elements of the lorgnette I analysed in existing products, or opera glasses, but we couldn't find a solution that could fulfil my core required attributes to the extent my other initial designs could.

From here, I'm going to take my feedback-developed observations around this idea and make sure that my other initial ideas don't have similar weaknesses when it comes to stability and practicality. Something about this design I want to take further was how lightweight and simplified the functional aspects of the design were, meaning it was pretty easy for potential end-users to understand the sketches.

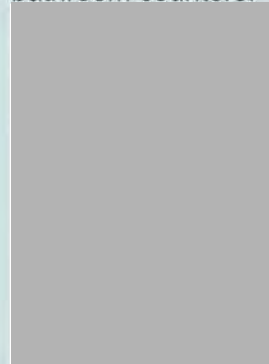
#### Initial Ideation #2

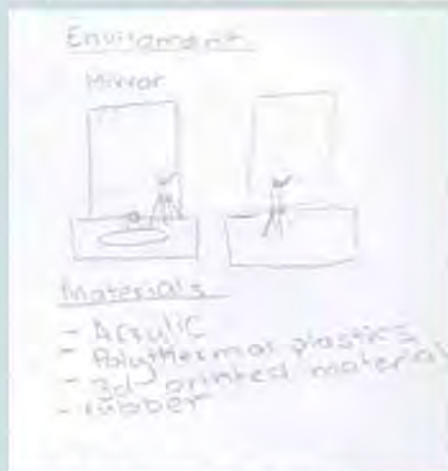
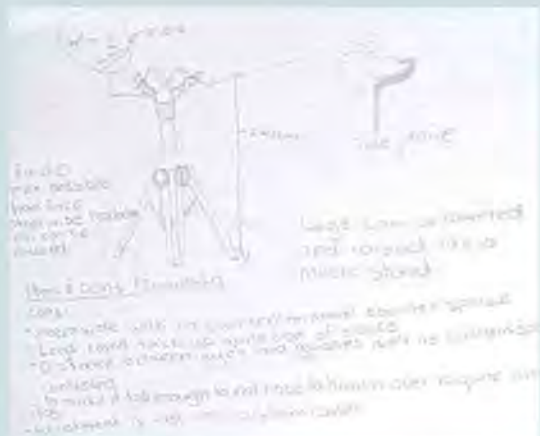
Idea number 2 was inspired in part by tripod legs and how adjustable they are. The design above depicts being able to rest the glasses on top of a tripod with a glasses rest. However, there were several major environmental factors that meant that this potential design wouldn't be able to fulfil my required functional and aesthetic attributes. The drawings above depict the difficulties of fitting the design around a sink, and could mean that users have to strain their eyes at awkward angles to try and see through, affecting accessibility.

My own bathroom doesn't have a counter below the mirror, and this tripod design wouldn't work unless you had a counter below the mirror. This problem is exacerbated by the fact that

even if a counter is below a mirror, it often has a sink in the centre, meaning the tripod would have to be able to fit on the side, creating unpredictable constraints for the physical environment.

This also greatly limits the versatility of the design, as it wouldn't be useful if you didn't have a mirror with a counter. Additionally, the way tripods and other stands work is that height is adjusted by the legs sliding in and out, which could obstruct a lot of space on small bathroom counters.





My technology stakeholder, [REDACTED], agreed with my concerns and suggested that I move on to designs we found more technologically feasible.

Furthermore, the range of height at which it would be comfortable to look through the glasses placed on top would have to be very large, as bathroom counters are often just above waist height. This would mean that the design would be very impractical to store and develop, as well as adjust due to the scale.

When consulting my possible end users, they believed that this wouldn't be very aesthetically pleasing due to the large legs looking bulky and the complicated arrangement, and

recommended making a more refined and lighter design.

They also affirmed my concerns about counter space, height and visibility issues, structural weakness, and limited location, saying that they'd want something that 'packs up' easily as they would want to travel with this product.

As a result, I can see that my outcome needs to be more practical, with structural integrity and versatility.

### Initial Ideation #3

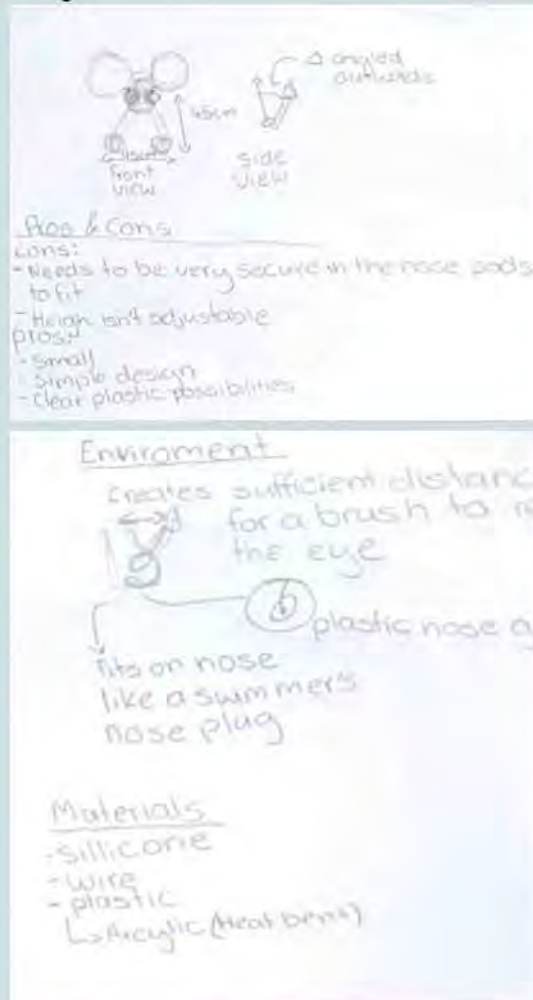
The frame of this design was inspired by the swimmer's nose plugs, and the mount at the end took inspiration from the shape of the glasses rest, which I analysed. The idea involved the swimmers' nose pinch from which an angled and raised frame, on which an area where the glasses could be pulled out to would rest, on, which would create enough space for make-up to be applied without hitting the glasses.

While I initially saw potential in this idea and was the origin point of this concept, when I consulted with my possible end users and a design stakeholder, [REDACTED]

Both parties pointed out significant issues in the design. One of my potential end users said that they quoted, 'I find this will be fairly limiting...because it depends on your nose size really.' Their biggest issues were the difference in nose shapes and sizes, limited head movement, and potential fit and comfort issues.

While I was able to see how I could improve the way to fit the piece to a larger range of noses without compromising much of the design

(such as flexible wires), the other issues were where I encountered significant barriers to producing the design.

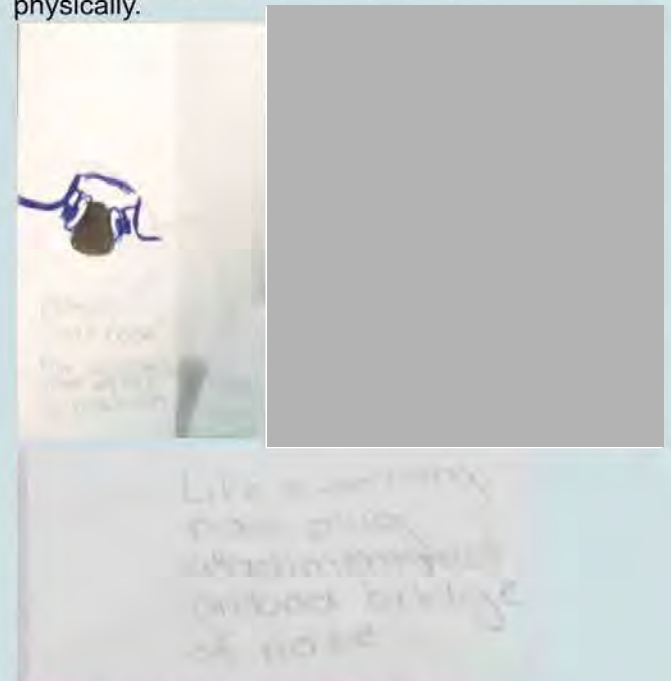


As my design stakeholder said, 'Swimming nose plugs work because of the tension in the clip and the friction of the end pieces, both holding them in place.' Cushioning or other ways to reduce the tension on the nose would also reduce the stability of the nose bridge; furthermore, because of the oil and dampness on the nose, cushioning wouldn't be very hygienic.

Swimmers' nose clips - the inspiration for this design and how the mechanism

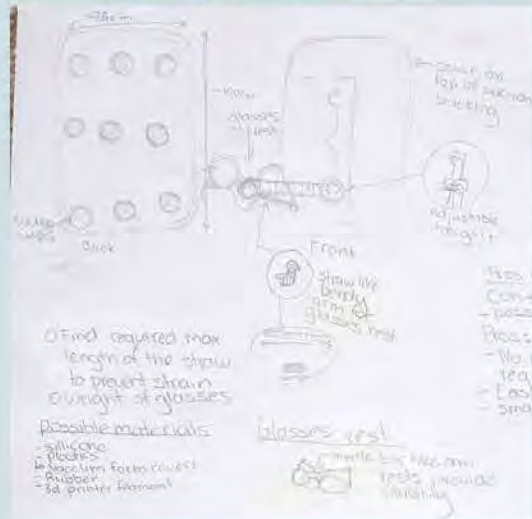
would work - are known to leave bruises on the nose and have to be sized to prevent pain. Bruising would be a barrier to use, as my outcome is aimed at people who want to use makeup to achieve an aesthetic effect, and bruising would disrupt this.

Also, causing any sort of minor injury to users is an acceptable factor in my technological outcome. My design stakeholder also struggled to see the feasibility of the design due to the tilt aspect and proposed that I try drawing the design out on photos of people to get a better feel for how it would work physically.



My materials technology stakeholder suggested I "find some type of computer-aided design with the head profile," if I wanted to continue this design. I experimented with modelling software, but in the end concluded that the design as I had originally conceived wasn't physically possible, and an achievable design wouldn't be functional for my stakeholders.

The back of this design stemmed from the sticky silicone phone cases that were popular online a while ago, which allowed users to stick their phones to mirrors for hands-free selfies and the suction cups on the end of the ropes on bath sponges.



Where to from here

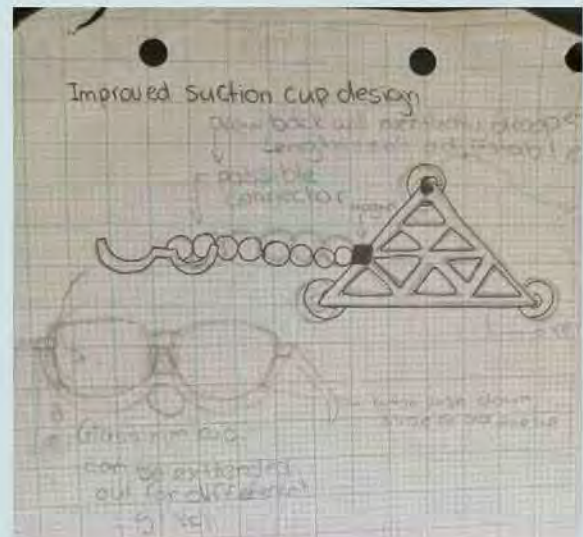
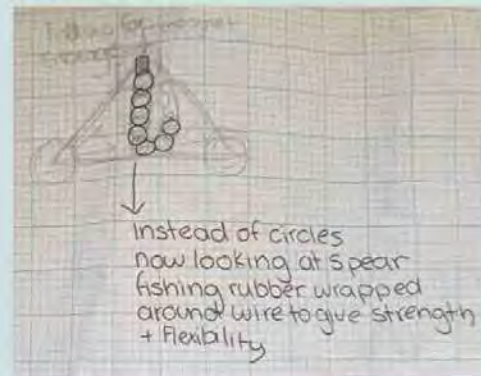
Through consultation with a range of stakeholders, I've decided to begin functional modelling with a focus on my suction cup design.

My key focuses will be the frame, the arm and the rest that the glasses lay on, as well as finding the best possible scale and materials I have access to. I'm also going to look at how I can minimise my products' impact on the environment through materials used, repairability and manufacturing processes.

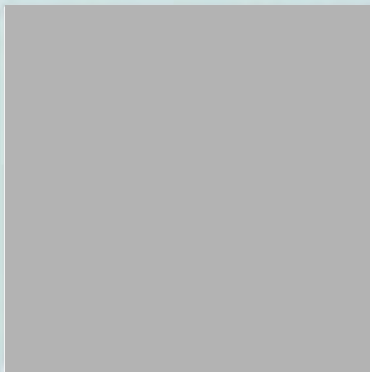
To begin with, I'm going to create a redraw of my suction cup design in accordance with the suggested triangle shape and other alterations by [redacted] before showing the revised version to the Knightsbridge residents (my potential end users).

#### Revised Suction cup ideation #1

This idea featured 3 points of contact with the mirror using suction cups behind a triangle frame with triangle cutouts. There's a small magnet on one of the points of the triangle and one in the middle of a side. These magnets were there so that the arm could be taken from the middle placement, which would be for use and attached to the triangle point so that it would fit easily into packaging and be easy to store for end users.



I then showed this idea to stakeholders to get their opinions and suggestions for how this design could be refined and improved. My materials technology stakeholder, [redacted] and I discussed the advantages and disadvantages of the bubble arm (inspired by flexible hose grips) I had originally conceived.



Although we agreed that the large, easy-to-grip flexibility would mean that my final technological outcome would be more accessible, [redacted] pointed out something I hadn't considered, which was the fact that over time, the bendy part would droop.

This would affect the usability of my design and its product lifetime, as the arm was supporting the main function of my outcome. Therefore, the product lifetime would be limited, and I wouldn't be able to fulfil my stakeholder needs. As a result of our conversation, I decided to research alternative arms.

I also explored with him the different forms I could use to make up the triangle shape, such as tubes or a flat design. We resolved that it'd be best to try an initial design on the 3D printer.

We also discussed what the best type of triangle would be for my design and concluded that, as far as we could, it wouldn't impact the physical function of the end outcome, so I could trial what type would work best in the physical and social environments.

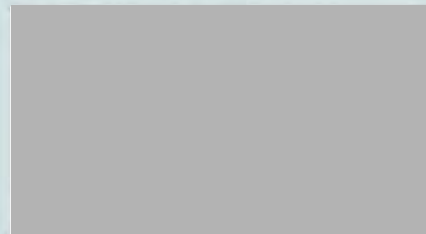
## Research

I decided to explore what was available in the market for the base-related arm.

The existing reference for this idea was from one of the ladies I was consulting at [redacted] retirement home, who suggested that I look at the coils on old telephone wires as an alternative to the bubble arm when looking at the initial design.

Then, when consulting my materials stakeholder, my teacher, and two other students who'd worked on projects that required flexibility, they recommended I look into spearfishing wire. I then considered making a rubber tube in which the spear fishing wire would provide the flexibility.

However, the flexibility of the spear fishing wire still posed the issue of how to prevent drooping, as the design is still vulnerable to gravity, as it's one continuous line of wire. Additionally, the malleability of the wire has a downside, as being packed in a bag or a suitcase, as my end user stakeholders cited as useful, might deform the wire due to the weight on top and limited space.



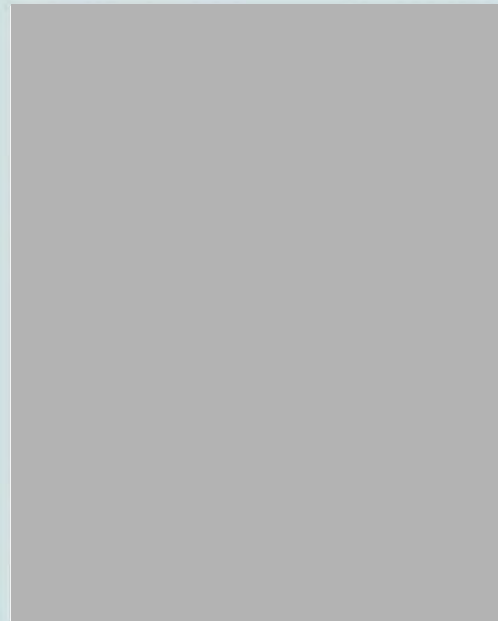
My materials stakeholder then suggested I explore concertina designs, such as those seen in the lamp above.

His reason for the recommendation was that, because of how the joints connected, the main disadvantage of prior arms, the gradual degradation (drooping), as the joints are connected in a way that prevents wear, and prevents deformities caused by gravity, etc.

This would be better than a straight arm as it could easily fold back when pushed, meaning that easy storage is still fulfilled in my requirements. I was personally a little overwhelmed by how to convert a design in lamps into a smaller version that I could conveniently remake in a limited time frame, especially as I haven't had prior experience with 3D printing moving parts, and 3D printing would be the most efficient.

I did consider laser cutting, but previous experience with the acrylic I had readily available informed me that the laser-cut acrylic is very brittle, and I doubt its ability to be a reliable test for the mechanics of a concertina. I was also struggling to find any prior examples of laser-cut concertina lamps. However, through my research, I found that concertina lamps were also called scissor lamps and was able to find multiple examples of 3D printed objects using a similar scissor principle. Similarly, I was able to find quite a few examples and tutorials about how to use laser-cut MDF and plywood.

In the end, I decided that the concertina wasn't the best outcome, as there were too many constraints on the adjustability of the outcome. The concertina-style arm would be restricted in angle in a way that means the final product wouldn't be able to meet physical and functional attributes.



After I'd explained the reservations and how the concertina didn't fulfil the required attributes, my materials stakeholder recommended I look at how sun umbrellas are tilted with knobs and see if I could adapt this.

As part of my research into 3D concertina lamp-like designs, I saw some designs for 3D articulated lamps and decided to look more into these. The knob articulations are similar to the sun umbrella knobs my teacher recommended for ease of use and accessibility.

The knob design allows a lot of adjustability for the angle and height, although it will need to be resized and adjusted to work best with glasses.

As the design has been used to support the weight of light bulbs through testing, I can confirm whether the design will support a pair of glasses. The bulkiness of an articulated arm does mean I may have to reconsider the positioning of the frame.

After consultation and research, I'm going to proceed with the final idea. This is because the issues present in the Spiral and Concertina idea are prevalent enough that they significantly prevent my technological outcome from fulfilling the functional need to be adjustable.

Additionally, existing products of the articulated lamp and sun umbrella have the potential to meet my brief optimally and can be easily altered, as the lamp already exists in 3D form.

Therefore, my next steps will be printing the lamp form and assembling it to get a sense of the scale and how I need to adjust the design.

While I initially had planned on using magnets, there were more constraints on the size, strength and material as well as shipping and cost, than I had accounted for. Additionally, as my design developed and the original arm I had conceived was deemed no longer suitable, the magnets no longer suited the alternatives I was considering.

One alternative my materials stakeholder encouraged was a similar clip on how LEGO figures hand clip onto circular tools.



However, in the end, after testing and trialling, I concluded with the help of stakeholder feedback that building a thread into the frame would be the best way to achieve stability while still being easy for users to deconstruct. This would also expand the points of adjustability potential users receive, as they would be able to alter the angle where the first point of contact is

between the arm and the base, improving the accessibility and adjustability of the user experience.

## Functional Modelling

### Material

I chose to do the majority of my functional modelling in PLA due to key factors. These were the cost, time and functional requirement constraints I was under. PLA is relatively cheap, and 3D printing meant that while a prototype of a piece was being printed, I could work on another element or research. At this point, PLA met all of my required attributes, and I would test its resilience to force and water to make sure of its suitability for my prototype.

For manufacturing the end product on a larger scale, I would want to use a filament with better recyclability/biodegradability, such as pure PLA without additives, recycled PLA filament, or sugar cane/corn starch-based filament, to minimise my product's wide-scale impact on the environment once the product life cycle is over. However, following the zero waste hierarchy for



the smaller scale prototypes, I follow the reduce principle and use what is already available to me. This is

because I can't justify purchasing filament for when I'm still experimenting and have yet to create a final product, especially with the time constraints for shipping and the limited budget I have on filament that may or may not work.

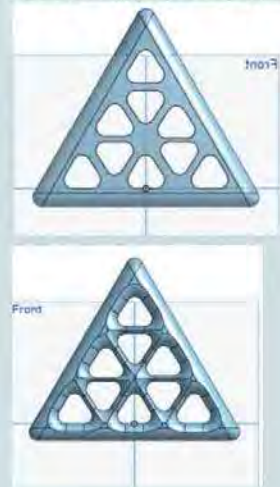
However, when manufacturing on a larger scale, once my prototype is complete, I will have the time to test different filaments and work with manufacturers to prevent my outcome from falling into the recover value and dispose categories. For my end product to meet my sustainability requirements, I should try and make my end outcome as circular as possible.



The initial frame took several tries to produce CAD on Onshape, and I learned a lot about the process of extrusion, as I struggled to create a uniform pattern of removed triangles. I also found that a tube idea wasn't going to be effective as a result of the extra time it took to learn on Onshape, when it wouldn't fit well on a surface.

I also found that the frame was unwieldy, and while I'd originally believed that a larger frame would be easier to use, the excess weight combined with the fact that the arm didn't need such a large base of support meant that to create a suitable outcome, the sizing would be decreased.

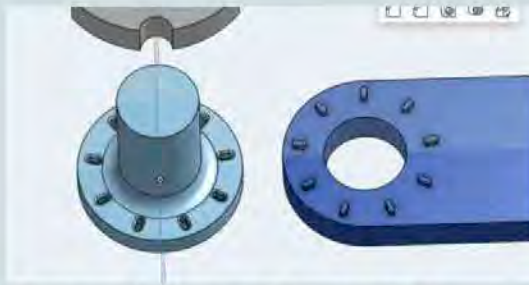
#### Another try at removals



While I was planning to conduct strength testing, my materials stakeholder informed me that since a triangle was the strongest shape and the pressure applied by the suction cups would be spread out, a strength test wouldn't be very informative. I found the weight of this proto-triangle to be very easy to adjust, as next time I would probably leave only the corners filled in so that the suction cups would be covered. This is in part due to the new arm I'm developing, which may be centred depending on how it goes.

I found an existing file for a thread and screw design that allowed users to adjust the dial to achieve their desired angle.

The grinding of the teeth wore down the piece, as I want this piece to have a lifetime-long usage, so adjustments I'll make to extend the lifetime include making a smoother slope to the grooves. Especially with the nut, I found the ease of use to be quite low; it required quite a bit of strength to turn the nut.



Made on CAD and tried using Helix Design to create interior and exterior threads for my test nut and bolt. The bolts on the actual project are going to be embedded in the frame and the arms for ease of production, conserving material, creating a seamless aesthetic, and making a durable product.

However, this does mean that if a bolt is damaged, it may be harder to replace than if the bolts weren't embedded. This is an acceptable compromise as embedding bolts improves overall endurance and usability in the end product.

I had never done 3D modelled threads before, and while I tried using the exterior thread tool, I was confused as to how to replicate the process for an interior thread. My teacher, my materials stakeholder, recommended I look at CAD tutorials involving the helix shape and experiment with outcomes to see what type of thread gave the best results. I also learned how to chamfer to give the piece better mobility and fit.

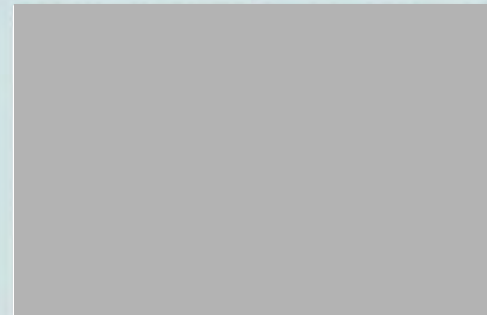
#### Thread & nut attempt

Used a chamfer of 1mm, helix with a pitch of 0.5mm

For the nut, it needs to be ergonomic to be accessible; therefore, on the second try, I hollowed it out to make it

lighter and easier to move and warped the grooves to make them easier to turn.

While talking to my materials stakeholder about how my design could be refined before being sent out to stakeholders, he suggested that I look at ball socket joints along with the thread designs to give the length adjustability needed in my design.



I contacted an optometrist in Newmarket and received specialist feedback about sizing from [REDACTED], a dispensing optician who included her opinion on the average sizes and range that I could need to account for in the supporting section of my design and imagery to better illustrate what the terms meant.

I also consulted with [REDACTED] from [REDACTED], who said that the average eye size for women's frames is 54mm with a thickness of 4-5mm. This collaborates with Narelle's information, who also included that average eye size ranges from 46mm to 54mm, but can be as small as 40mm and as big as 60mm. Furthermore, that thickness can be much thicker on acetate frames as opposed to aluminium frames.



With this information, I now know how wide and long the mount should be to achieve my attribute of having a universal fit with any pair of glasses, and that the glasses placement should be lined with some form of cushioning or foam to allow space for different fits of glasses.

Additionally, after talking to [redacted] from [redacted] and doing my own research, I found that the average thickness of a bathroom countertop is about 450mm, but ranges from 400mm to 500mm in New Zealand.

This means that if the distance from which my users reported that they can see away from their glasses averages 40-60mm for ages 14+, there needs to be a minimum distance covered of 250mm, as my potential users reported that they wouldn't mind leaning forward, as many of them already do so when applying eye makeup. Therefore, implementing the ball hinge idea as suggested by my teacher could help give an adjustable length, or the concertina arm ideation could come in handy.

While a stakeholder suggested that my final design could be used while traveling and different countries may have different thicker counters in front of mirrors, to create a functional outcome I will have to create a compromise between fulfilling this

attribute of creating space between the face and glasses and the design being easy to store, having an appealing design, and the overall stability of the design as the design can't extend too far out and be at risk of tipping over.

## Revised designs

a)



This design featured a range of arms and grips, with the central body featuring the cut-out design that I had previously worked on. The second arm (circled in red) was originally to feature the concertina pull-out which gives the extra length needed if used with a mirror behind a kitchen sink, but can be folded back when a shorter length is needed.

Additionally, the benefit of the concertina is that it provides length while being easier to pack away, fulfilling the attribute of ease of storage.

There are four suction cups in this design to provide extra support, as this design has a lot of movement occurring on the right-hand side. These are suction cups with a clamping feature, as recommended to me by my materials stakeholder, [redacted]

The arm thread is built into the design between two endpoints, and as the triangle can be rotated by lifting off and resticking, the arms can emerge from the left and right sides.

b)



The base triangle is smaller and, as a result, can be thicker without being at risk of having too much weight.

Along with my designs, I also gave my potential user stakeholders a paper version of the arms with pins for them to assess the length, width and use of joints. There were concerns about thickness and reach.

The consensus was that my stakeholders preferred the second design but wanted a smaller base due to concerns around a larger base providing unnecessary weight and obscuring the line of sight.

Ultimately, though having 3 points of adjustability as in design a) would deliver better adjustability, it wasn't to such a degree that I could justify the decreases in other physical and functional attributes, such as ease of use, or how the increased bulk would limit the range of physical contexts my outcome would be suitable for.

## Developing final design

While originally I'd intended to use a concertina/scissor hinge design,

further research found a more suitable alternative in the LH hinge (pictured below).

This originated in the scissor hinge design. The LH hinge does not require the complicated sliding insides or two free-moving joints that exist in existing concertina designs, and the original creator developed the design specifically for CAD and 3D printing production, making it uniquely suitable to the skills, materials and technological processes I have.

However, the original hinge design was made for lid decks and, as a result, extends upwards instead of horizontally, so my design will require a significant redesign to best meet the functional attributes my outcome must reach to be suited to the physical environment of bathrooms.



Materials stakeholder feedback, [redacted] recommended that the base should be 6-8mm, and I should try and produce as many elements as possible in a flat pack style to maximise material efficiency and cost per piece. Producing elements on the CNC instead of 3D printing would significantly decrease the time needed to create a functioning outcome, as the CNC operates on a larger and more

precise scale than a laser cutter or 3D printer.

Additionally, [redacted] recommended that I test using aluminium due to its light-weight properties, price point, and how aluminium creates a rust-resistant barrier when exposed to water, air, etc., making it uniquely suited to the needs of my physical environment.

## Final Brief

### Issue

People with low vision often struggle to apply makeup/conduct skincare around their eyes due to dependence on eyewear, which is obstructive. This can impact self-esteem, independence and social perception.

Conceptual statement: To deliver a product for consumers which resolves the issue, meets the physical context of usage with mirrors, make-up products and bathrooms and the social context of make-up and product perception and the larger context of low vision in New Zealand and meets the physical and functional.

### Product Attributes & Functional Specifications

Weight- due to the nature of suction cups, the total weight of my outcome must be under 300g for me to be sure that the cups won't significantly wear over time and that the product remains viable for as long as possible. Also, the design must be light enough to be lifted by those with weaker wrists, upper body strength, due to the target audience having a higher median age. Furthermore, several stakeholders have expressed interest in travelling

overseas with a product like mine, and excessive weight would inhibit this.

Physical Size- As stated in my research from specialist stakeholders, the outcome must be compatible with the sizing ranges for bathroom counters (thickness), potential mirrors and a wide range of eyewear. The outreach length of the outcome must meet at least 200mm as full outstretch to account for potential counter thickness, be 155mm wide with some leeway for differences in glasses sizes, and the total combined width of the assembled outcome must be no larger than 250mm, with contact point areas no larger than 100mm tall and 120mm wide.

Easy to Store- Should take up a small to medium drawstring bag when packed, max 300mm<sup>2</sup>.

Easy to Clean- through materials research, I've found that the materials of my outcome prototype, aluminium and PLA, are suitable and while not stain resistant, all make-up products are able to be adequately cleaned with items users are likely to have on hand, such as make-up wipes.

Water & PH resistant- Needs to be able to withstand minimal residue, which is slightly acidic, basic due to household cleaning supplies and human skin pH. Additionally, withstand the humidity of New Zealand bathrooms and be resilient in mild steam exposure.

Sustainable materials & durability- Aluminium is a highly recyclable material, and with my design, the aluminium aspect would be able to be easily separated from the rest of the design for easy recovery and recycling.

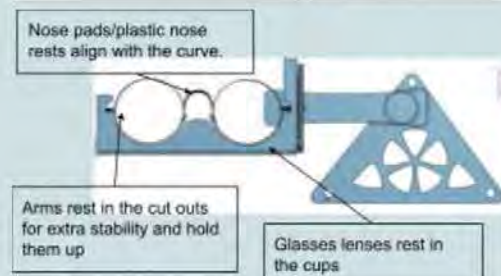
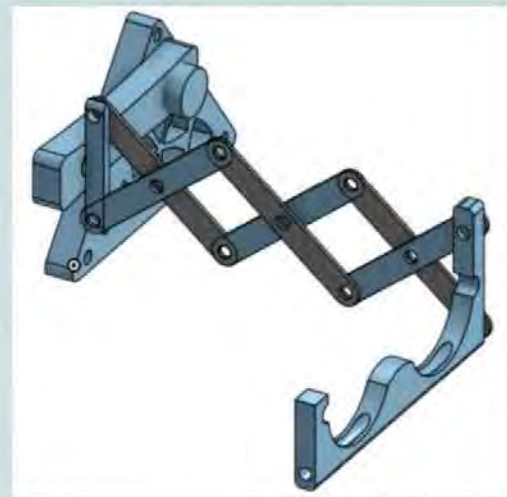
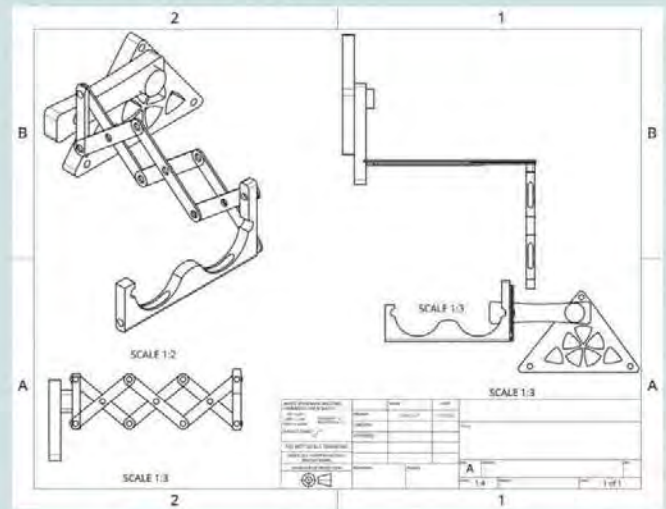
Visual similarity to existing tools- My final design should create visual similarity and connection with the wider purpose of the design, alongside purposeful packaging and simple marketing to help decrease possible consumer apprehension.

Space created between face and glasses- My design sufficiently creates space between the face and the glasses, particularly through the adjustability of the concertina/accordion/folding aspect, which allows the glasses to rest, to be pushed back or pulled forward to meet that 60-40mm gap from the glasses that allows vision to still appear clear.

Appeals to a wide age range- By consulting a range of glasses-wearing adolescents to elderly people, I have to ensure that my outcome doesn't alienate an age group while building in features that appeal to each age group's potential users.

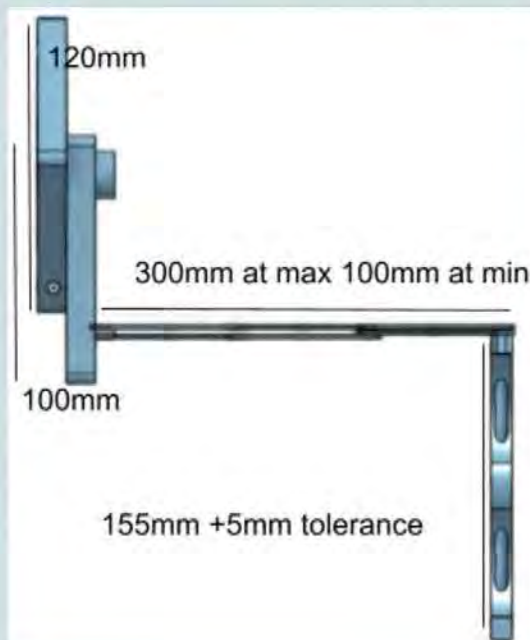
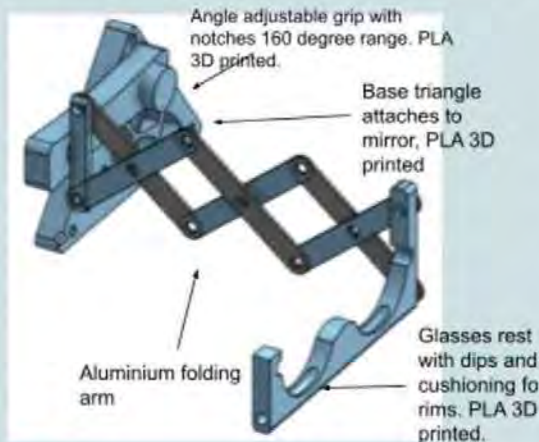
Adjustable- Adjustability is built into my final design by combining design aspects of previously analysed products with a focus on their adjustable aspects.

## Final Conceptual Design





Suction cups attach to mirror at the three points with clamps for improved suction



Stakeholder comments I received:

"The small grip looks better to me, they seem more approachable"- [redacted] potential final user, 14yrs old

"That looks really good [in response to the final design]"- [redacted], possible end user, 15yrs old

"You should be really proud of your outcome so far. Next steps are functional modelling. You should be able to produce this really quickly."-

[redacted] Technology Stakeholder.

"I think the stretch out part should be able to go out further, but I don't know if it'd still be stable." - [redacted], target user, 70yrs old

"I think in your final design you may want to increase the cup that the glasses sit in to further up around the sides, or a way that a clip can come up and over the nose area to hold the glasses securely."-

[redacted], Materials Technologist.

#### Comparison to the Final brief

My final design will meet the specifications for a weight of under 300g by using lightweight materials such as PLA and aluminium, as well as optimising the dimensions of my final design to minimise bulk.

In terms of adjustability, I am confident that after consultation with a range of stakeholders and significant research that my outcome has achieved a compromise between adjustability and my other functional attributes.

The final design is easy to store because the arms can be lifted off the thread, the concertina arm squished down with the glasses holder folded on top, and the square. These can all fit in the drawstring bag that would come

with the outcome, allowing for easy storage and packing.

My final design received positive feedback across all ages, as this design appealed to them in some form. This is seen in the use of a simple adjustment system, as the feedback received from older potential users was that they preferred larger grips.

As seen in the feedback box above, younger potential users really liked the flower cut in the base and felt it made the design not only modernised but also cute.

The general feedback I received from my [redacted] village stakeholder group was positive, but a stakeholder did struggle to understand the placement of the final design, and there were concerns about stability if bumped, which I have taken into consideration through my design process.

The final design's arm surpasses the specified 200mm reach by 100mm, resulting in a 300mm arm when fully extended, and the glasses holder is exactly 155mm wide and meets the specified contact areas.

In regards to the sustainability of my final design, I've discussed in my research that PLA, while recyclable, in a New Zealand context, there isn't really an avenue for that to occur.

That's why, although PLA is best able to meet my needs for my prototype, I'd be interested in exploring mould-based production with bamboo or sugarcane-based plastic, which would also allow more control over the sourcing practices around my material. The materials I'm using in combination with my production practices and

design allow durability and easy replacement of parts, allowing a better product life cycle.

While water and pH resistance aren't highly important attributes, it's still important that my final design can hold up to light cleaning fluids (often basic), the oils on the user's hands and the moisture and humidity present in the physical environment of the bathroom. There, I've chosen aluminium and PLA as materials in my outcome.

Aluminium is very water resistant, while PLA is somewhat water resistant, due to the physical context being more about residual water/moisture exposure than actual submersion, these aspects are adequate. Aluminium can be eroded by strong acid, but as my final design doesn't involve any contact between the face and the final design, it's not a concern.

By drawing from an existing range of adjustable furniture, such as sun umbrellas, lamps, and common mechanisms that would already be present in a potential user's lived experience, my outcome is intuitive and unintimidating. This is important as my outcome is unique, which, while carrying impact and innovation, can also be intimidating.

Additionally, by consulting with my materials stakeholder about the opportunity in optimising for a majority flatpack design, my design to some degree emulates Ikea and the simple approach of other flatpack brands, which develop purposely neutral furniture with emphasis on function.

My final design space is between the face and the glasses, particularly through the folding arm, meaning the glasses' rest may be pushed back or

pulled forward to meet the 60-40mm requirement without impacting the 200mm to pass the countertop thickness.

Overall, my design is suitable for those with low vision due to its adjustability, accessibility, design and size, allowing ease of use, comfort and interaction with users. My next steps are to advance into producing an outcome by meeting the specifications of the brief above.

## Evaluating Materials/Components to determine their suitability

MDF commonly consists of wood fibres bound together by resin glue. Through my research, I've found that this means that MDF is vulnerable to breakage due to a lack of grain, with a tensile strength of 18 MPa and through prior experience with the material, I know that MDF is vulnerable to moisture and will swell over time if left in humid environments.

Additionally, my end-user stakeholders reported that they didn't find the outcome aesthetically pleasing. My testing and trialling of MDF lack the strength needed for my product to be functional for an appropriate life cycle.

MDF can be filed, but the MDF available to me cannot be laser-cut or CNC'd due to the toxic fumes that are emitted by how the MDF is manufactured. Instead, it needs to be machine-cut or otherwise manufactured.

Aluminium has a tensile strength of about 90 MPa for pure aluminium, and this can increase up to 700MPa due to what alloys included within the metal. Aluminium has the potential to be very flexible with a flexural strength of 70MPa to 700MPa. While flexural strength isn't the most important attribute for a material to be suitable for my physical environment, when combined with other properties of aluminium, such as its lightness and corrosion resistance, it's definitely a very suitable material for my brief.

I could also potentially bend, laser cut and machine Acrylic sheets for my outcome. However, due to prior experience with the material, I'm aware that thinner acrylic laser cutting sheets can be very brittle and prone to breakage. They aren't particularly strong, with a tensile strength of around 75 MPa. They have a flexural strength of 115 MPA. Acrylic offers a wide range of colour choices and opacities. Acrylic can be sensitive to UV exposure, which wouldn't be common in the physical environment of a bathroom.

From here, I consulted with my materials stakeholder, [REDACTED] about which materials to use, and he suggested I trialled using the CNC to cut the aluminium joints. Therefore, I took the files for the outcome I created and, with alterations to become more stable by better distribution of weight, by creating better support around the joints I was ready to cut.

He suggested the CNC as it's able to sometimes cut thin aluminium, meaning it's the most suitable machine at school for uniform pieces, as our laser cutter cannot cut aluminium, and I do not have the prior knowledge and

skills to create the pieces by hand. Additionally, [redacted] suggested that by making the processes scalable machinery my outcome would be easier to scale up and manufacture.

## Trialling Practical techniques and processes to determine their suitability

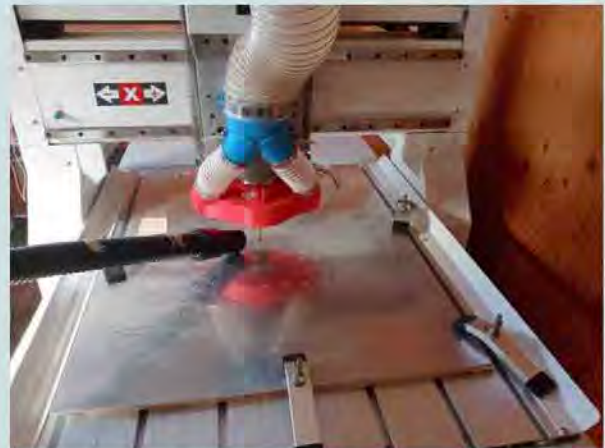
Attempted CNC production of aluminium for joints, and it went poorly. This was because the machine was unable to go deep enough or smoothly due to the physical qualities of Aluminium and clearly struggled to cut, resulting in ragged

edges and an incomplete cut that was completely unusable for my outcome. After showing the result of this trial material, my stakeholder, [redacted]

[redacted] and wider Materials Stakeholder, [redacted], both

suggested that I should get the aluminium laser cut by an outside manufacturer as the laser cutter at school wouldn't be able to do so. [redacted] recommended reaching out to One Stop Cutting Shop for the final cut.

Therefore, I've found that using the CNC machine to cut aluminium is not a suitable process for creating my outcome, and I will not use it to produce a prototype.



Therefore, while I'm testing and trialling the mechanical and component aspects of the joints, I decided to use MDF as that can be laser cut at school, and though it's not suitable for my outcome, my stakeholders confirmed that it's a suitable stand-in. I created the laser cut file on Onshape, but created another in TechSoft for better accuracy.

However, in my first cut, we realised that the diameter of the central holes for the joints was too large and wouldn't be suitable for bolts at 10mm. I had mistakenly made a 10mm diameter instead of a 5mm, and we had to cut again with the smaller circle for my outcome to be achieved.

As a result of the MDF version, I realised that I can't have two open ends as the distance between them changes, and this was a flaw with my final design. After talking to my classmate and wider stakeholders,

she recommended that I cut two fixed points so which resolved the issue.

My next step is to make the parts that connect to my MDF on Onshape so that I can print them out and trial them.

Assembly was somewhat difficult due to the tight fit and small size around the screws, so instead of using a wrench and/or pliers as suggested by my Materials Stakeholder, I placed the segments in a vice grip and screwed them to achieve the desired tightness as suggested by . The only downside to the vice process was that, as I needed a certain amount of give around each joint, I had to approximate how many turns were needed, which may pose difficulty later on.



Completely outstretched, the arm covered a distance of 300mm, meeting the requirements of length and distance, and when compressed, measured a little over 50mm in length and under 100mm in height. The transitions between lengths are easy to do, but I do have some concerns about the bolts loosening over time and becoming unstable; however, according to my materials stakeholder, due to the use of the nylon lock threads, this is unlikely to happen.



Another issue with this trial is how the piece droops slightly. This could impact my functional outcome if not addressed, as the end needs to be able to bear weight, and the sloping shape puts pressure on the arm. After consulting with a technology teacher, he said that to prevent the drooping, he recommended that I have indents engraved so that the bolts sit better within their holes to prevent the droop.



Next, I created a glasses holder model to get a better idea of what measurements I would need. I made a max fit non-hollowed glasses holder 3D print. The 3D printer worked very well, delivering a smooth, seamless print despite the fact that the printer at one point ran out of filament and had to be replaced with another colour.

No printing structure was difficult to remove, even around the tighter gaps,

and it didn't affect the physical appearance or functionality of the print.

By comparing a standard pair of women's frames to the max fit, I found that instead of using the pincer, which would mean that the holder would not be a universal fit, I could bring the side longer, hollow them out for larger lenses to slide into and then have a slightly angled scalloped pattern.

Additionally, I found that the nose piece was too wide and instead of imitating the thickness of the nostril, for the best fit, the piece should be as thick as the nose bridge.



However after consulting with my technologies stakeholder and testing and trialling with a range of sized glasses we found that the scalloped edges would limit the sizes too much and instead for my final prototype I'll make a tray type, with which my fabrics stakeholder, I talked to, [redacted] said that the cushioning would create enough friction to stabilise the glasses without being too heavy.

So my next step with this section will be to test a tray design with the revised measurements from the glasses model on Onshape and then print it in PLA to

test the form and make any adjustments.

Chose to use acrylic to make the arms, as although I wanted to use a laser cutter to cut aluminium from the one-stop cut shop, the quote from them was \$400 minimum fee plus \$50 for the pieces, meaning \$450 total. I also looked at other shops in Auckland and was quoted upwards of \$90 (tax included) with an estimated weight of 70 grams total.



This confirms my hypothesis that aluminium would be ideal for a commercial outcome, as it's lightweight, sustainable, and can efficiently manufacture large quantities. However for my prototype as I'm creating a one off, I'm not able to achieve quantities that would make the per unit cost cheaper and because of this price barrier after talking to my materials stakeholder, [redacted] he recommended that I use acrylic as a stand in for the prototype, as it would have similar functional properties to Aluminium which would allow me to fulfil my functional aspects if not my social ones.

Onshape was appropriate to use as it's the 3D modelling software I'm most comfortable with, and it's suitable for creating 3D prints. There's also TinkerCad, but it's more simplified and doesn't have the more technical tools available. Fusion 360 is also a platform I could use, but it's too taxing on my computer to be able to run it reliably.

I've had difficulties exporting files from there before, and it's more focused on use with CNC machining, and as seen in my trialling, CNC machining is not suitable for this prototype.

Using a laser cutter was the most suitable choice for equipment as it let me reduce material wastage by positioning the arm pieces together, and since my arm pieces are small, I was able to use a sheet that had already been worked on, further reducing wastage (Fig. 1). The laser cutter also works quickly, and I was able to create the file in Onshape and then take the DXF. Into TechSoft to cut on the laser cutter, meaning it prevented mistakes in transferring the designs or messing with the scale.

Fig (1)



Because I'd done testing and trialling with the MDF arm pieces, I knew that I could laser cut less complex materials such as acrylic at school and that I could create the arm pieces while I waited for the rest of the piece to 3D print. Additionally, I knew to include the washers due to this prior trialling and testing to protect the material beneath, especially as the acrylic I'm using in the prototype is easier to scratch.

The trial arm didn't work due to the gear teeth being too large, and the printer interrupting the thread of the arm. However, the thread of the base worked, so my technology stakeholder,

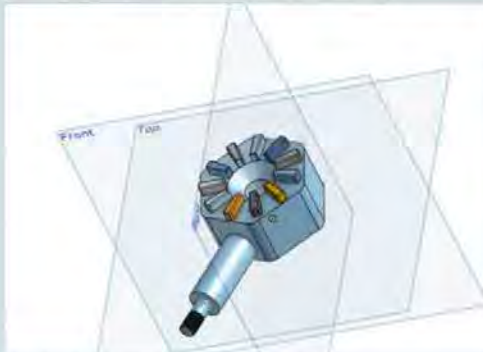
\_\_\_\_\_ suggested that we try printing it standing up instead of landscape, like how my base had been printed.



After consulting with my materials stakeholder, \_\_\_\_\_ about the suggested changes by \_\_\_\_\_ he disagreed and said that preventing the droop wouldn't be by creating an indent for the bolts but by creating a uniform overlay.

He also recommended using nylock bolts to prevent the bolts from unscrewing over time. Through my prior testing and trialling, I found that while nylock bolts were harder to screw on than regular bolts, they were much harder to unscrew and wouldn't come off without force due to the nylon thread within.

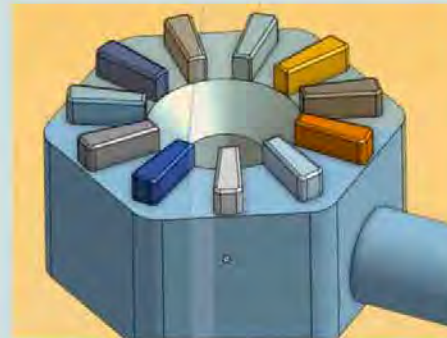
The base printed well, and I found that the holes I'd inserted made the arm easier to twist on, as my stakeholders had suggested. My technology stakeholder suggested that the thread be only partial so that the pieces could slide better, and it worked a lot better as it reduced unnecessary friction.



However, as I was testing the trial base, the thread broke off into the cap. After consulting with my technology stakeholder, [redacted] on what went wrong, we concluded that the base hadn't had enough infill to withstand the twisting mechanism.

Therefore, we decided to print the final prototype base with a higher infill, so that it would be more durable and resilient. This would, however, also make it heavier, so I didn't increase the infill for the rest of the build, which wouldn't experience as much pressure.

After talking to a classmate about the issue of the gears of the arm not sitting in place of the base, he suggested that, because of the bevel in the base, I needed to create a hollow bevel in the arm so that the pieces sat flush, and this improved the rotatability.



## Trialled the prototype in Situ to gain evidence regarding its Fit for Purpose

Usage video:

[https://drive.google.com/file/d/1Bf\\_Od7NRHd7J7qvb0C3VDoEZNwd2f3c3/view?usp=drive\\_link](https://drive.google.com/file/d/1Bf_Od7NRHd7J7qvb0C3VDoEZNwd2f3c3/view?usp=drive_link)

I trialled my prototype with a range of surfaces and in different bathrooms and had several possible users attempt to apply eyeliner and/or mascara, depending on what was preferred.

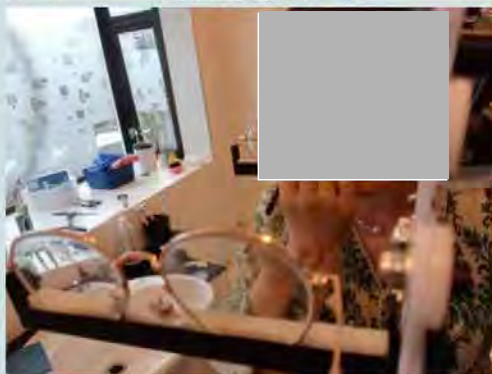
The video above depicts usage where the device is first applied to a bathroom mirror, then adjusted before the glasses are inserted in the glasses holder, and eyeliner is able to be applied hands-free with sufficient space.

The prototype met the 300g weight limit, but unfortunately, due to the rotation, it sometimes tilted when laid on a table, resting due to the weight tipping to the side. This could be remedied by shifting the arm shift in the centre and the side to create balance in weight, and making the

cut-outs on the opposing side.



Furthermore, in the trialling in the physical environment, there wasn't as much of a need to adjust on the base as anticipated. The scissor arm's positioning was only able to maintain stability when they were on the shorter end of its extension and started tipping forward at approximately 200mm.



This means that the functionality could be improved by shifting from a focus on adjustability at the base angle and instead focusing on the stability at the scissor arm angle.

The distance covered surpassed the required 200mm at 300mm fully extended, which, when trialled, passed

objects placed in front of mirrors such as towel racks and sinks.

According to the brief for my prototype to be functional, it needs to be hands-free and reliable, and this lack of stability and rigidity means it is neither.

The prototype cannot be disassembled with ease due to the fragility of the 3D parts. To combat this, my technology stakeholder suggested that I use internal threads and not threads that are 3D printed, as these are weaker and make the design more fragile.



The change from aluminium to acrylic hasn't particularly affected the function of the prototype, but it has affected the prototype's lifetime, resilience, and lifecycle of the prototype, as PLA is less durable than aluminium.

This is seen in the video where I'm able to pull out the scissored arm even though it's been a month since it was created.

Therefore, in order to better suit the social environment, I'd use aluminium as it is similarly lightweight but more capable.

When it came to cleanability, the PLA was able to be wiped clean easily with a towel or makeup wipes, but due to

how the 3D printed parts were manufactured, they were full of tiny surface texture that meant any glitter or residue from eye shadows, concealer, etc. that got in there was very hard to clean out.

Because we weren't able to disassemble the product without it likely breaking, I was unable to package it. I did draft a drawstring bag for the measurements, but found that even if it were disassembled, the base, especially, was too bulky to be able to fit easily into a travel bag and that a case with spaces could be better for transport.



Another change I would make to improve the functionality of the prototype is to make cams that pressed the suction cups down to ensure a stable stick you needed to push down firmly for about five seconds, which some of the younger and older triallers struggled with.

Cams, as suggested by [redacted] would mean that each suction cup could be pushed down individually with very little force and would stay firmly in place.

Foam piece allowed for smaller glasses and thicker glasses models, but the thickness made it a little tricky to insert.



This was affirmed by six stakeholders from the [redacted] rest home I visited, who tried out their own glasses on the holder and found the slot with the foam freestanding in the centre difficult to manoeuvre, but needed it to keep their glasses stable, or removed it due to the thickness of their glasses.

Several women affirmed that despite the lack of resemblance to makeup-related products already in the market the product's aesthetics would be at home in their bathrooms, and [redacted], who was my contact at the rest home, said that while a less chunky design may be easier to store, the way that I'd softened the angles of the pieces made it look rather timeless.

Additionally, it reportedly felt fragile and bent easily, and couldn't be removed from its placement without excessive force, which could eventually damage the holder.

This meant that it wouldn't be able to fulfil my attribute of being able to be disassembled and fit into a carry bag. My technology stakeholder suggested that to improve strength and durability that in the corners of the design, I add a web-like structure, like the drawing below.



As a result, I concluded from my findings that I achieved the objective of a universal fit but still had room to improve the user experience.

For example, a lining could be a better alternative, and it was suggested that I make the glasses holder wider so that it could be lined with foam similar to memory foam, so that it creates the impression of the user's glasses over time, to reach better universal compatibility.



In conclusion, my current prototype is functional and fit for purpose. This is because while it can be used to carry out the action of applying make-up hands-free free it doesn't fulfil enough of the required attributes to go to market yet.

In trialling my product, decent social acceptability from older women who were my target group; however, these were the retirement home women who'd been my stakeholders throughout the year.

When shown to my grandmother, who'd suggested the idea, she found that it helped fulfil what she'd been looking for, but felt quite foreign compared to what was already available.

When shown to the younger stakeholders (mixed genders, teenage years 13+), they thought it looked cool but found its purpose confusing, suggesting that an instruction manual

with clear pictorial diagrams would be good if they purchased my outcome.

With the adjustments suggested by stakeholders and the data received from the trials, the end outcome would be able to meet the final brief as well as resolve my issue of daily accessibility when it comes to the context of low vision in New Zealand.

#### Personal Statement

Throughout the year, my skills in manufacturing have had to adapt quickly, and I've learned how to adapt to supply issues, communicate my ideas effectively, and develop positive, long-lasting stakeholder relationships. In reflection, I think I could have made my required attributes list less vast and been more explorative with what threads I used, such as trying out internal threads to improve stability and product lifetime. Overall, I'm proud that I've been able to produce an outcome that my stakeholders found suitable and was functional, if not a viable product.

## Scholarship

**Subject:** Technology

**Standard:** 93601

**Total score:** 15

| Q | Score | Marker commentary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | 05    | <p>This project developed an outcome for the authentic issue of creating a bathroom pivoting glasses holder for use in front of a mirror for the vision-impaired, made from mixed-resistant materials.</p> <p>The final outcome was well-designed and utilised a range of techniques to develop a stable and adjustable glasses holder that assists the vision-impaired in applying makeup.</p> <p>There was relevant, deliberate, and considered decision-making around the materials used and the techniques and processes employed during development.</p> <p>Authentic stakeholder involvement enabled effective decision-making.</p> <p>The outcome clearly met the brief requirements, with these features featured in the commentary throughout the project.</p> <p>There was evidence of ongoing relevant testing and evaluation throughout the process. The holder was tested in situ by six elderly stakeholders.</p> <p>The technological practice employed and the outcome produced demonstrate an elegant synthesis of knowledge, skills, ideas, and methods that drive and complete the project. The report is concisely written.</p> |

|   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | 05 | <p>There was evidence of systematic development. Markers were confidently able to see the process and understand why decisions were made.</p> <p>Stakeholders played a vital role in the development process. Because they were genuinely invested in the outcome, their feedback was ongoing, authentic, and meaningful and was reflected in the final outcome.</p> <p>Throughout the process, clear next steps and areas for improvement were identified. Analysis throughout the report was relevant and purposeful, and concise in nature</p> <p>There is sufficient evidence of functional modelling, including relevant testing and evaluation of techniques, processes, materials, and mock-ups, which enabled informed decisions during the project development process.</p> <p>Both subjective and objective tests were explained and utilised appropriately, and as a result of this testing, markers felt confident that the outcome would be realised in due process.</p> <p>The report was generated with the end-user requirements in mind. It was easy to access and interpret.</p> <p>Feedback was sought from stakeholders, which justified its fitness for purpose in the broadest sense.</p> |
| 3 | 05 | <p>The report demonstrated a clear narrative from start to finish. The candidate demonstrated sufficient reflection on key decisions throughout the process.</p> <p>There was consistent, clear evidence of the candidate's thinking about the process and outcome.</p> <p>A sufficient level of relevant reflection and evaluation is evident throughout: always clear and concisely written. This enabled the candidate to make informed and reasoned decisions, modifications, and adaptations during development as issues arose. At the end of the project, the candidate reflected on the overall success of the outcome.</p> <p>The markers were able to understand why the candidate made the decisions they did.</p> <p>There was evidence that candidate reflection informed their decision-making and subsequent selection of materials and techniques.</p> <p>The end result was a bathroom glass holder made from mixed materials that was functional and ready for use.</p>                                                                                                                                                                                                                       |