Human Centered Design

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Task One: Identifying and Exploring the Need

1. Research Plan and Project Schedule

	Term Two				
	Week 7	Week 8	Week 9		
Lesson 1	Complete mindmaps around the problem	Complete primary research	Create mindmaps summarising research collected		
Lesson 2	Complete a research plan	Complete primary research	Create mindmaps summarising research collected		
Lesson 3	Prepare survey/guiding questions	PMI Evaluative table	Complete design brief		
Lesson 4	Oorganise primary research options	Complete secondary statistical research	Complete design paramateres/criteria for success		
	Term Three				
	Week 1	Week 2	Week 3	Week 4	Week 5
Lesson 1		Ensure all part A evaluation is completed	Begin working on final prototype	Evaluate work to date	Ensure all evaluation is completed
Lesson 2	Finalise Part One (DB and CFS)	Construct sketch models	Continue working on final prototype	Continue working on f.proto	Clean up folio
Lesson 3	Sketch and annotate two possible designs	Continue working on sketch models	Continue working on final prototype	Finish final prototype	Final evaluation
Lesson 4	Sketch another two designs + anno/evaluate	Evaluate Sketch models	Record Construction process + modifications	Evaluate final protype	Submit

Image 1.0: Project schedule outlining aimed completion dates for sections of this project

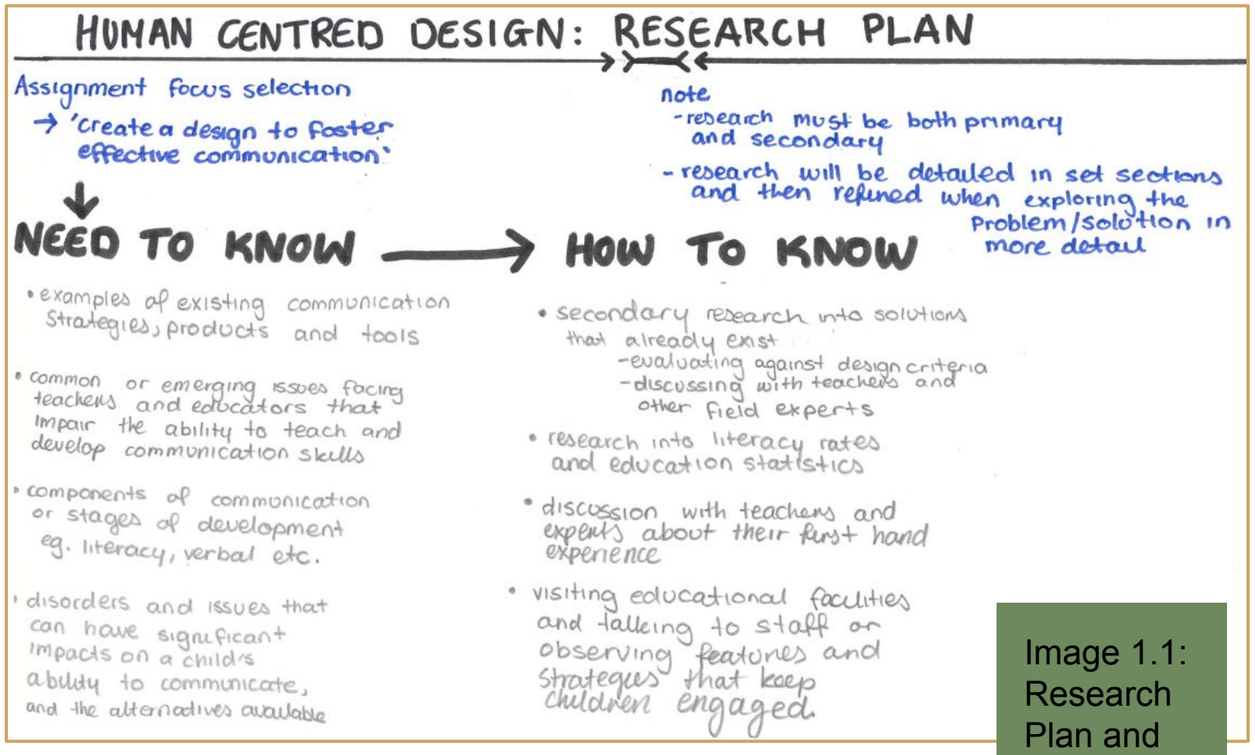


Image 1.1: Research Plan and Project Intentions

To the left in Image 1.0 and 1.1 are the layout and schedule of this project. Img 1.0 is the project schedule, which details the deadlines for each aspect of this project to be completed by in order to ensure the task is completed on time. Img 1.1 is more specific to the research aspect of this task, and hence, sets out the goals of the research. It specifies what needs to be known, and the plans to achieve this. This research will be collected from numerous sources, each with a slightly different angle, focus or perspective as this will add depth to my research.

Evaluation (Week 7): Project and research planning
While not an enjoyable stage in a project, developing a plan and schedule upfront is vital for ensuring success in the long run. I have also decided to set myself a very short time frame. This was purposefully done to ensure that roughly a week in excess is set aside in case any issues arise during the process. As there was an initial project focus, my research questions are quite broad as the area is not yet focused. Instead I have chosen to investigate focus and classroom interactions as a whole, and begin to narrow in response to research findings and points of interest..

2. Possibilities of the Project: Primary Research

Research is a key aspect of all design projects, as it is essential in informing key components of the design, from specific features, to more generally guiding the project towards relevant issues. The focus of this particular project is to conduct significant research into the needs of teachers and students, especially around early communication.

While research itself is important, so are the areas from which the information is obtained. For my primary research, I have chosen to have detailed conversations with teachers who work with young children, as well as exploring facilities designed for childhood education.

My first point of research was Kirsten Prefer. Kirsten is a teacher at Orana Steiner School in Canberra, and works specifically with special needs students in small groups or individually. She has been a teacher for many years now and due to her specialisation in this area, has explored many different tools and approaches for working with additional needs children.

Fortunately, Kirsten was willing to give up a portion of her time for me to ask questions about the issues she faces as a teacher, some of the strategies she uses and where she feels educative tools are falling short in terms of communication. The information I was able to gather from Kirsten was incredibly comprehensive and was recorded in the visual notes below. Furthermore, Kirsten and I plan to regularly communicate throughout this project so that she is able to serve as an external point of evaluation.

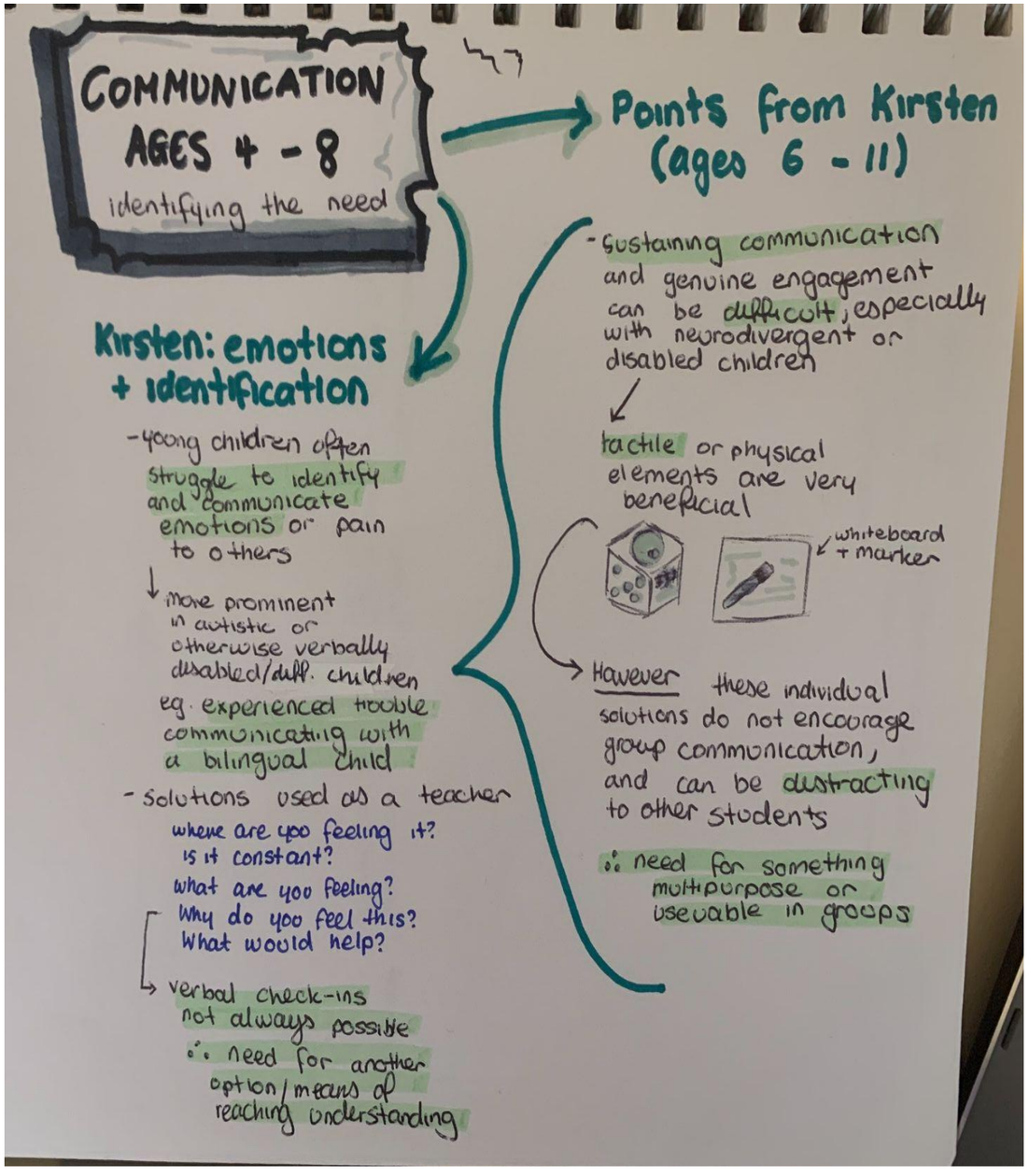


Figure 1.0: Kirsten Discussion Need Mindmap

Evaluation (Week 7): My discussion with Kirsten
Another important feature of the design process is continuous evaluation. Week 7 was allocated for primary research and investigating needs that exist in childhood education. My discussion with Kirsten was an invaluable source of information as not only did it provide me with detailed insight, but it drew attention to two significant needs: difficulting focusing and engaging children in discussions, and difficulty effectively communicating with additional needs children.

2. Possibilities of the Project: Primary Research

The second source of primary research I used was again from a childhood educator. Mandy Rattray was initially educated as a nutritionist, but is now at university studying to be a specialised childhood educator. Outside of this Mandy works at a childcare centre in Sydney that specialises in working with bilingual and autistic children.

Mandy was invited to a webinar about visual communication with children which I will be attending with her as another source of information from field specialists. A summary for this webinar is seen in Figure 1.1

This webinar focused on visual communication, the benefits of using augmentative communication and how it can be implemented in childhood education settings. There was a particular focus on children with different sensory needs which has significant influence on design of products.

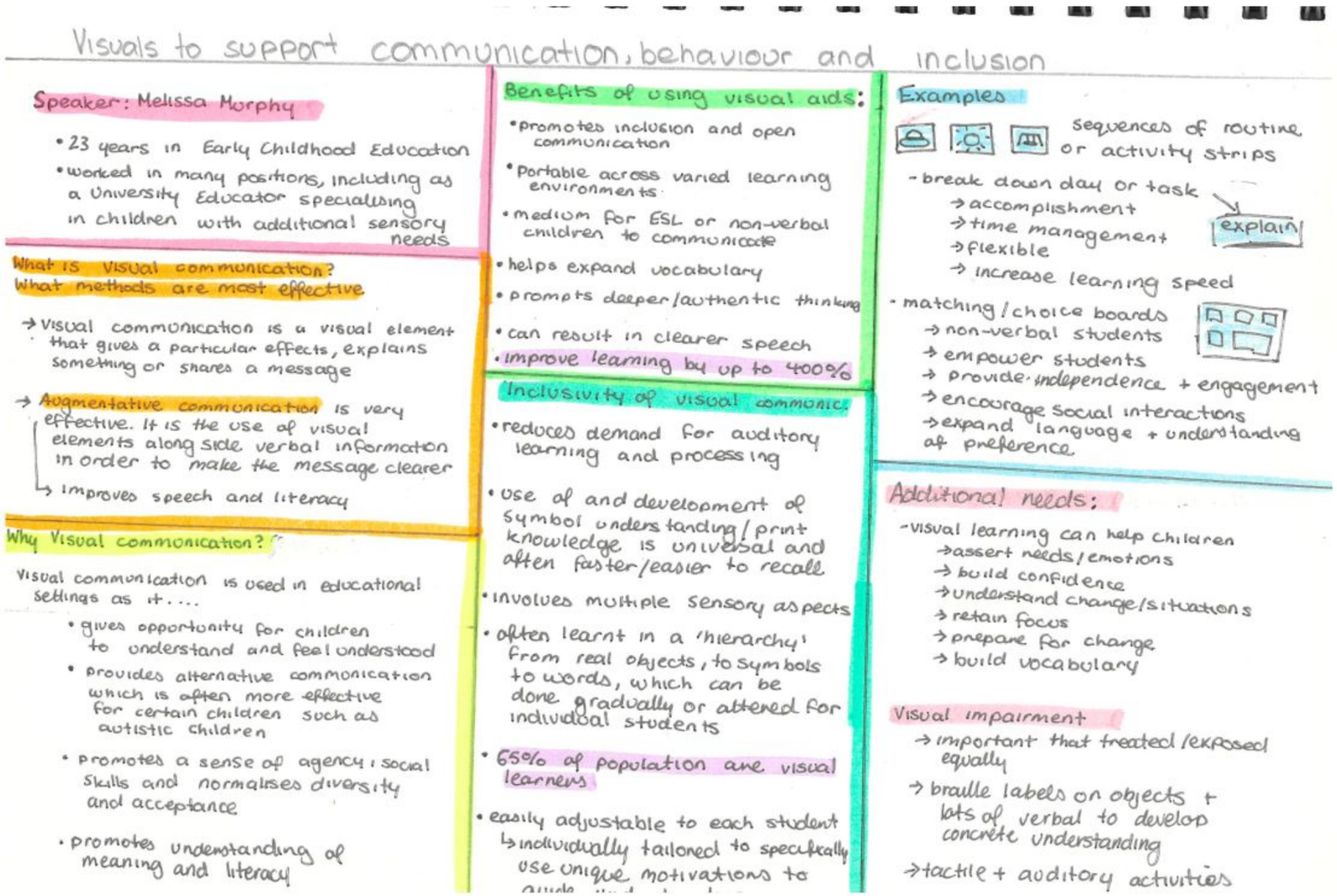


Figure 1.1: Discussion notes from Mandy and webinar

Evaluation (Week 7): My discussion with Mandy and Webinar
Unfortunately this webinar happened at a postponed date in July, by which point I had already selected my target area of literacy for visually impaired students, and hence a webinar on visual communication was not so applicable. However, this webinar provided detailed information about examples of early education tools at strategies, as well as research into the benefits of certain education styles. In addition to this, the speaker, Melissa Murphy, had personal experience working with blind children and was able to comment on literacy and communication with visually impaired students, which is invaluable to the remainder of my project. This webinar highlighted the importance of flexibility in tools to adjust to individual students, and of tactile, visual and auditory elements involved in learning, especially where a sensory disability is present.

2. Possibilities of the Project: Primary Research

My third source of primary research was gathered at Questacon, a scientific educational facility aimed at children across the age range, providing facilities to those as young as 2, or teenagers and parents. As a small class group we planned an excursion to Questacon where would be able to not only observe children interacting with the learning activities, but make use of them ourselves to identify what features were common, popular, effective and engaging. We were also able to speak to members of staff who provided insight as educators.

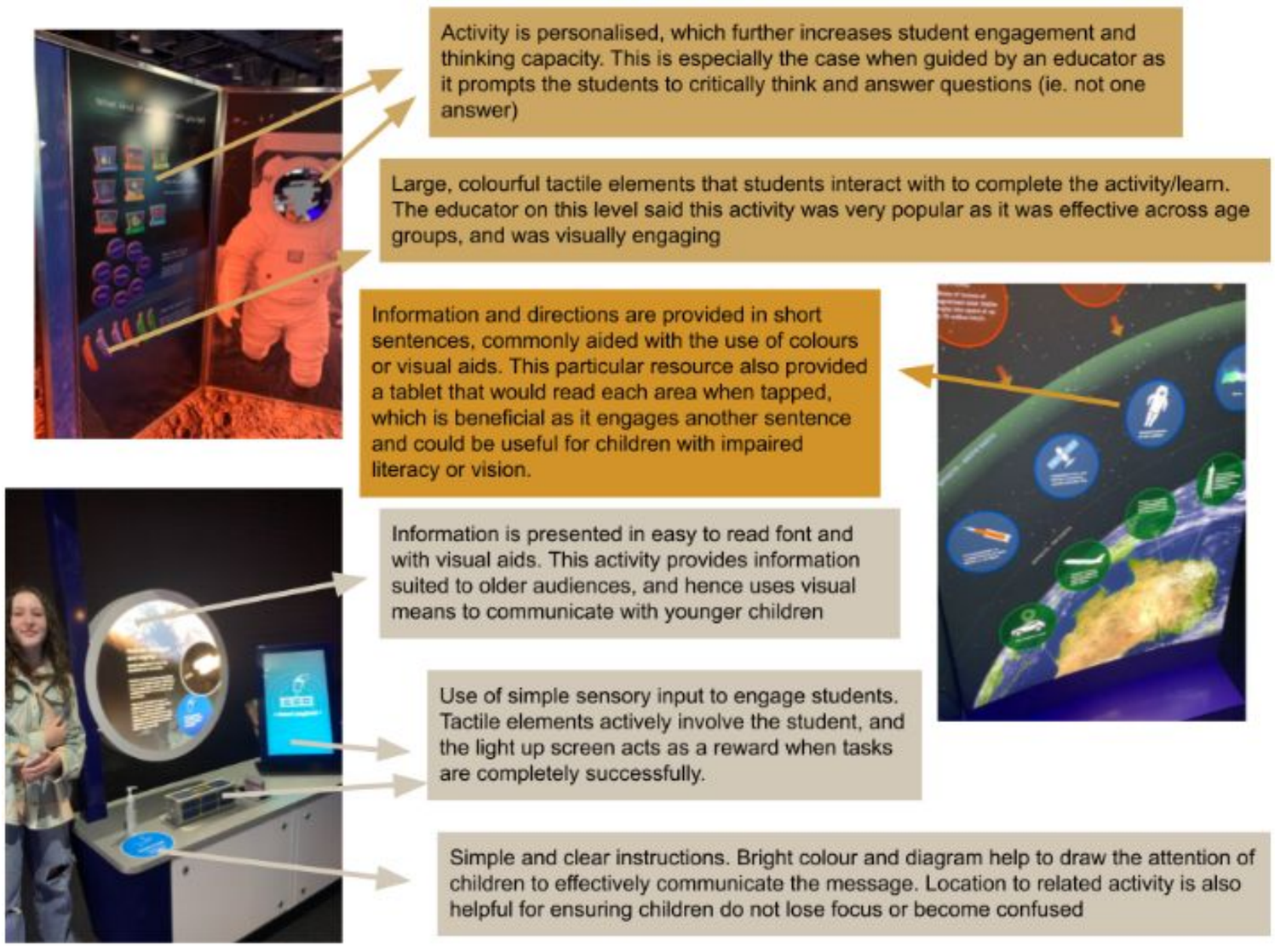


Figure 1.2: Analysis and notes from Questacon Excursion

Evaluation (Week 7): Questacon Trip + Evaluation Question

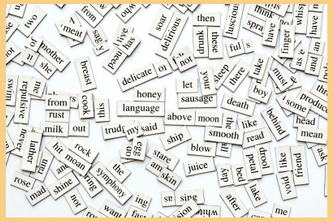
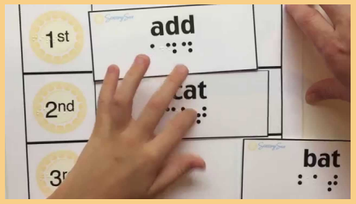
While the information obtained from Questacon was not as focused on identifying issues that could be researched and solved, it was still an invaluable experience. Primarily, this gave us time to discuss our ideas as a group of students while interacting in an appropriate research setting. Furthermore, figure 1.2 above demonstrates, while it did not identify areas to overcome, the information gathered allowed us to pinpoint strategies that are already used in education and how information is communicated and taught.

What have you discovered through identifying a need?

Through the primary research I have conducted, it has become clear that education is highly complex, and hence a single need is difficult to pin down. Despite this, I have discovered that balancing sensory input is imperative as while it is necessary to engage students, too much can become distracting or overwhelming for many students. In addition to this I have discovered that while there are many products for very young children with additional needs, there are not so many strategies or products tailored to these children when they are older, which can making teaching difficult in turn.

In speaking to Mandy and Kirsten specifically it was also apparent that while they are both wonderful and experienced educators, there is a significant lack of circulating information that could help teachers to understand new research and developments.

2. Possibilities of the Project: Secondary Research

	POSITIVES	NEGATIVES / IMPROVEMENTS
	- Numerous words and uniform design make this a very effective tool for teaching students literacy skills and sentence building - Small size and lack of colours promote understanding, reduce distractions and encourage fine motor skills - Magnetic nature means that the words can be secured while still remaining useable by a group as multiple children can contribute and actively move the pieces	- Words pieces are very small and visually similar which may be confusing or frustrating when children are first learning - A major drawback to these magnetic words is that they limit engaging sensory input, especially tactile features, which has been identified as a key component of early education design - Magnets are quite small and hence could be easily lost as well as being a choking hazard
	- Erasable/reusable nature is a strong sustainability point, but is also beneficial for students engaging in quick paced activities or who are first learning - Discussions with primary school teachers identified whiteboards as a useful tool for keeping students engaged in the lesson and activities - Lined whiteboards provide extra structure and guides, which is useful for young children or those with motor difficulties.	- Mini whiteboards are often quite flimsy which may impact functionality in that it could easily be broken, or serve as a distraction for children to fiddle with - As these particular whiteboards often require two hands to use (one support, one to write) it may also pose focus issues to children who require a free hand to fidget such as those with ADHD - Flimsy nature also limits whiteboard functionality and use in a seated position as it will bend in the child's lap
	- Inclusion of both braille and alphabetical letters encourages development of literacy skills between students regardless of individual abilities. This can also provide an alternative form of communication if there is nonverbality etc - Flashcards can be easily moved to help students understand structure	- Specialist 3D cards may be expensive, and potentially inaccessible to all teachers - Primary research indicated that identifying parts of a sentence is often difficult (eg. nouns) and so these flashcards could potentially be improved by the inclusion of symbols/colour that identifying these language features - Simple colour scheme lacks engagement (however not detrimental if only used with vision impaired students)
	- Monopoly is not strictly educational however it promotes engagement with other children and respectful communication - This specific board provides both alphabetical and visual cues, but also has a braille overlay which makes the game more accessible to vision impaired students. It could also be used to teach braille as another language	- Game board is specialised and would likely be quite expensive, and therefore not accessible to all teachers/parents - The plastic covering appears to be fairly flimsy, which can be a major disadvantage as the board could be damaged by the children - The plastic covering may also impair functionality in terms of placing game pieces and storage. Would benefit from being removable
	- Large size reduce risk of choking and make the blocks easy to use - Clear numbers/letters in large font make it easier for children to read, including those with minor vision impairments. This in turn enhances understanding - Bright colours visually draw attention but also promote recall as each number could be assigned a value - These particular blocks include braille along the bottom, which is a major positive for early braille education	- Wooden blocks present the risk of sharp edges or splinters which could injure the children - Blocks are difficult to use with multiple children unless carefully structured by the teacher - Number is not engraved/raised, which limits the amount of understanding that can be gained through the tactile sense. This is especially a disadvantage for blind students who could trace the shape of the number to gain further understanding.

3. Exploring the Problem

The mind map below in figure 1.3 was constructed to explore some of the issues in Australian education. This mindmap makes reference to several reports and statistics which help to contextualise the extent and impact of these issues, and provide much needed secondary research to ground the project. This mindmap essentially explore communication along two lines which were brought up in primary research: issues with literacy rates and engagement. Specifically thai mindmap delves into the issues facing vision impaired students as well as difficulties for teachers.

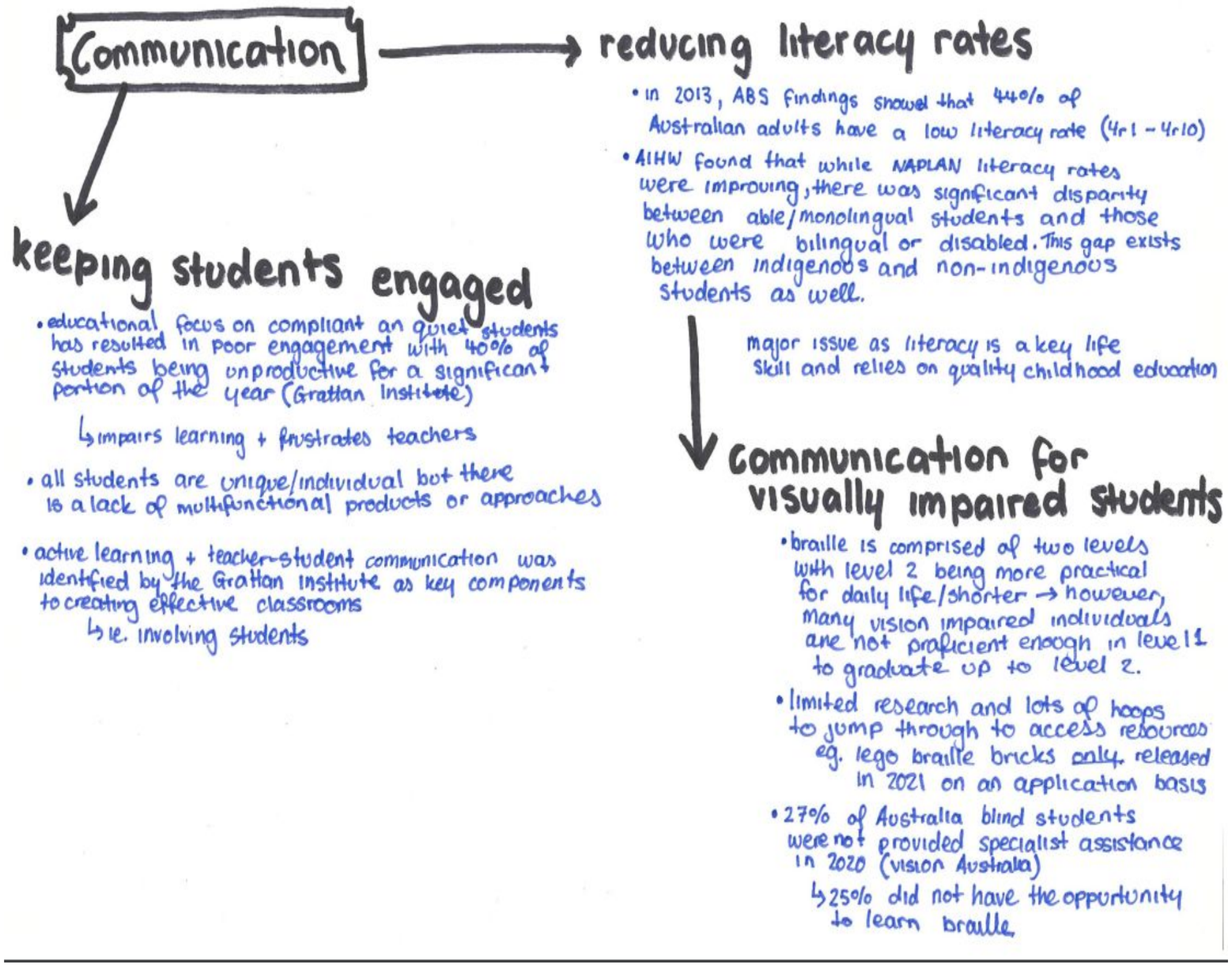


Figure 1.3: Mind Map exploring need (with statistics)

Evaluation (Week 8): Secondary Research and Exploration

How has your research influenced the identification of your need?

Research has significantly impacted my understanding of problems and needs within communication in educational settings. As an individual I have limited experience outside of personal knowledge about neurodivergent children, so both the primary and secondary research was invaluable. At its core the primary research provided a structure and guide for my research, and my secondary research allowed me to narrow my goals and understanding so that I could critically see what areas needed improving.

From my research I have decided that the key paths I would like to pursue surrounds childhood literacy development, specifically for vision impaired students. Furthermore, I would like to keep social development and understanding central as well as classrooms by nature involve many students, and creating ways for disabled and non-disabled students to learn and communicate together should be paramount.

3. Exploring the Problem -Research Summary

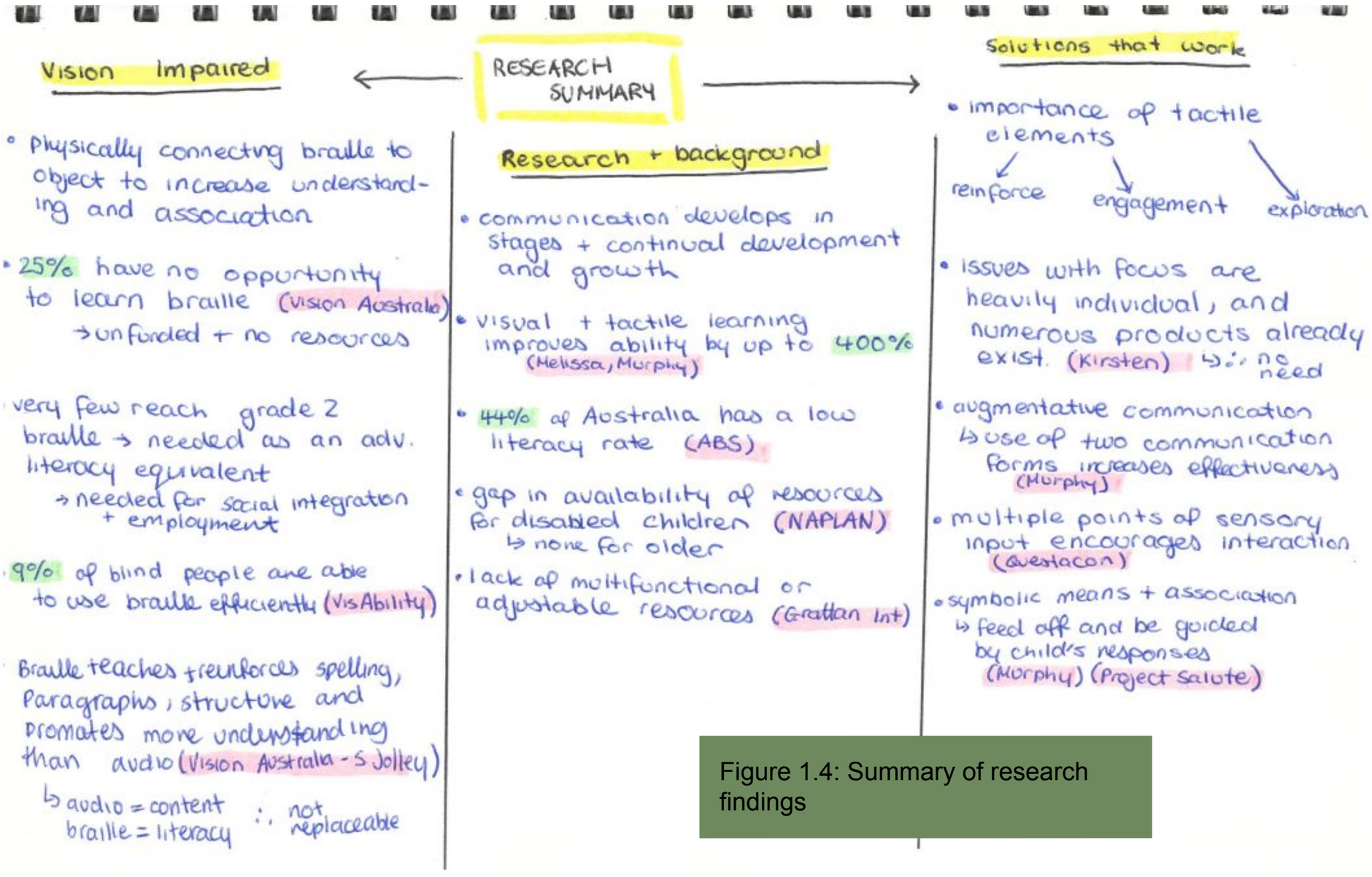


Figure 1.4: Summary of research findings

To the left in figure 1.4, is a summary of my research findings. This research has been compiled from various sources including research by institutes and organisations, information from disability advocates, childhood educators, and through analysis and observation of existing educational products and places. This research has heavily influenced my plans for the remainder of the project as it has shifted my focus from engagement, towards communication and literacy development for vision impiared students. It also provides essential background information that will inform specific design choices such as colour and feel.

Evaluation: Research
Completing figure 1.4 was a hugely important step in guiding the rest of my project. It allowed me to collate the significant research I had conducted, and hence choose the area with the most interest and need to then focus my design brief towards. Additionally, this research was incredibly enjoyable to complete and compile as it demonstrated the depth of my knowledge and got lost in the vast amount of information.

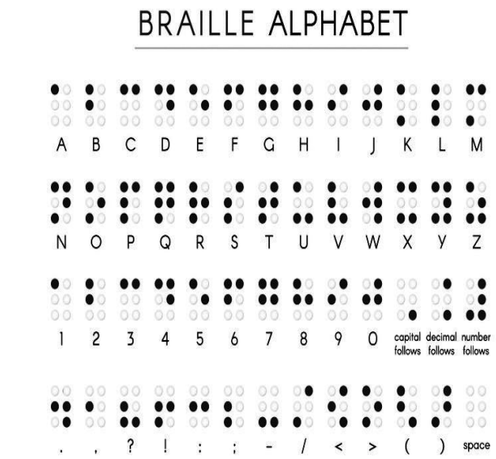
4. Design Brief

Design Problem / The Need:
Through my research into existing products, as well as detailed information provided from teachers and educators, it has been identified that two key issues are faced in youth education and the development of communication skills. The main issue is a lack of resources that are both fun and engaging, while accessible to students with varying abilities. Commonly each tool is individualised to one specific need and as a result limits functionality in a group setting, which ultimately can be linked to impaired social and communication skills. Furthermore, it has been identified that while products exist that target children with vision impairments of additional focus and communication needs, these are often aimed at a younger age group, and are not functional in terms of growing skills as the child grows up.. This a major gap in the market as it is very uncommon that children are learning exclusively by themselves (Img 1.3), or that their literacy and communication skills are not continuing to be developed. Hence, the identified need is to create a multifunctional, literacy based product, that is accessible to students with varying capacities and disabilities.

Design Brief:
Throughout the remainder of this project I will be exploring solutions to the need identified above, with a particular focus on products that would **assist vision impaired students to collaborate, communicate and play with non-vision impaired students**. Alongside this, a key focus will be on **building intermediate literacy skills** such as sentence construction in the hopes of addressing the low braille literacy rate in Australia that was identified in Figure 1.3.

There are a few constraints that must be adhered to throughout the undertaking of this project. Namely, these apply to **time, cost, materials and the target audience** of the project. As this is a school assessment task the final prototype must not cost very much, and must be built from readily accessible materials at the school such a wood, acrylic, cardboard, spray paint etc. In much the same way there are **limited production processes** available such as handwork, laser cutting and 3D printing. In addition to this, the **project must be completed by week 5**, and hence the portfolio and construction work must reflect this short timeframe in terms of depth. Most importantly though, the assignment criteria set that this project must focus on **communication for young children** around the primary school age of about **6 - 9 years old**.

Constraints aside, my final design must address the communication needs of vision impaired students, but it must also take into account additional criterion such as **safety, durability, aesthetics and educational functionality**. For example, the product must be of a **size** that does not pose **choking hazards**, while still being **small enough** for young hands. A key criteria is making sure that the product makes use of **sensory input** in a way that is engaging and practical **without overwhelming** the child, such as using **unobtrusive** and **safe materials**, while adding **visual and tactile elements** to engage the child.



Img 1.2: Braille Alphabet (excluding common words)

Img 1.3: Children playing with lego together

5. Criteria for Success and Evaluation Procedure

Needs:
The communication product must address the needs identified: ie. it must act as a means for vision impaired and non-vision impaired children to communicate and build intermediate literacy skills. Assessing whether this has been met will be difficult, however, the easiest methodology would be sending the prototypes to teachers such as Kirsten who could provide feedback.

Ergonomics:
Children present very different physical characteristics to the average adult market. For example, children often have very small hands and hence any product must be designed in such a way that it is easy for the child to handle. In order to assess this at the project completion, I will give the scale prototype to a child of the target age, and observe how well they are able to physically interact with the product

Materials:
For this project, material is constrained by the products available at CGS, however, given the young target audience, it is important that a durable material is selected that does not detract from functionality Materials is again difficult to assess, with the easiest means simply being giving the product to multiple children and asking them questions around how the product feels in their hands and observing their response to the tactile sensation.

Quality:
As with most products, it is important that the educational resource produced is of high quality. If the product is not of high quality than it will likely not be durable, strong and safe, which are highly important in an educational setting as products are used over many years. There is not any easy way to assess quality other than having others review the prototype and critically evaluate the quality of its construction in terms of cleanliness and completeness.

Safety:
Safety is one of the most important criterion surrounding products designed for children. Children, especially this young, are very vulnerable and susceptible to injuries simply through misuse and misunderstanding. As a result, it is essential that the final design/product adhere to safety standards set out by the QIMA. These standards include ensuring the size of the product is not small enough to be consumed/choked on, that all batteries/buttons/choking hazards are well secured, that the product will not shatter into dangerous parts if dropped, hit or squashed. These standards will in turn inform the materials and design of any product developed. The safety of the product is relatively easy to assess as QIMA has specific questions to compare the product to, but it will also be possible to reach out to teachers or QIMA for further evaluation. Safety must remain a central element of this design, otherwise it will be useless as an educational resource and pose dangers to vulnerable persons.

Aesthetics:
Despite the fact that visual aesthetics are not of the highest importance to a visually impaired student, aesthetics must still be taken into consideration. This is largely as the focus of this project is to develop a product that is useable by students without a disability, and hence the product must also visually appeal to these students. This will be achieved through careful colour selection to ensure that there is variety without being overwhelming or incohesive. In order to assess this, multiple prototypes should be constructed so that the products could be viewed together and evaluated in terms of visual appeal as a set, ideally from multiple people.

Functionality:
Functionality, alongside safety and ergonomics, are three of the most important factors to consider when designing an educational product suited for the visually imapired. Whatever the product may be, it must meet the needs of the project around literacy and communication, with a key component being that the product must be multipurpose. In terms of functionality in and education setting, the product must be easy to store, easy to use/explain, useable by children without significant guidance as well operating as intended (eg. whiteboard must erase).

Functionality will be assessed through use of the prototype, ideally by multiple people, including teachers in order to ascertain whether the product is a feasible solution to the identified problem.

6. Ongoing Evaluation

Evaluation is a key component of determining project success, but also for developing and improving upon design skills. On this page are evaluations completed across the first section of this project, which discuss each section, its challenges, impact and success. Reflecting on progress before undertaking the next section of this project will be invaluable for ensuring that the best quality product is produced.

Evaluation (Week 9): Design Brief and Criteria for Success

How will you use your Design Parameters and what have you had to reconsider through your research?
Design parameters while fairly straightforward to compose, are not quite so easy to think about and test, especially for such a short project. The way I play to use my design parameters is to use each subheading and goal as a point to annotate as I develop my design ideas. Through doing this it is hoped that I will be able to critically analyse each design, make the necessary changes and ultimately, will result in a quality, successful product being produced. In addition to this, I will use my design parameters as points of evaluation as I reach end points in the design and construction processes respectively. These parameters can also be used by external individuals such as peers, Kirsten, or other teachers. to comment on the success of my design.

Through my research, I have had to reconsider the focus of this project. Initially I was very set on focusing on nonverbal communication and issues facing young autistic children; however, after discussing with Kirsten it was noted that many solutions do exist. However, as I researched these existing solutions, I began to focus in on literacy more as this was a connected topic. After a little investigation into Australian literarcy, I began delving into the niche of vision impaired children and the poor education that currently exists. This then informed a lot of the notes and observations I made at the Webinar and Questacon, as well as the products I have evaluated.

Through this change in direction, I have had to entirely reconsider my focus, but also the age group, as I have chosen to address the market gap for intermediate literacy skills of vision impaired children of about year 1 - 4 age who are just beginning to learn the proper conventions of sentences.

While this change and reconsideration happened quite early into my research, and subsequently is not too evident in my portfolio work (aside from a few pieces around focus and engagement), I do ultimately feel it was a positive change as I am now heavily invested and interested in the area. As well as this, it genuinely addresses an issue that exists, which is ultimately the goal of any designer.

Evaluation (Part One):

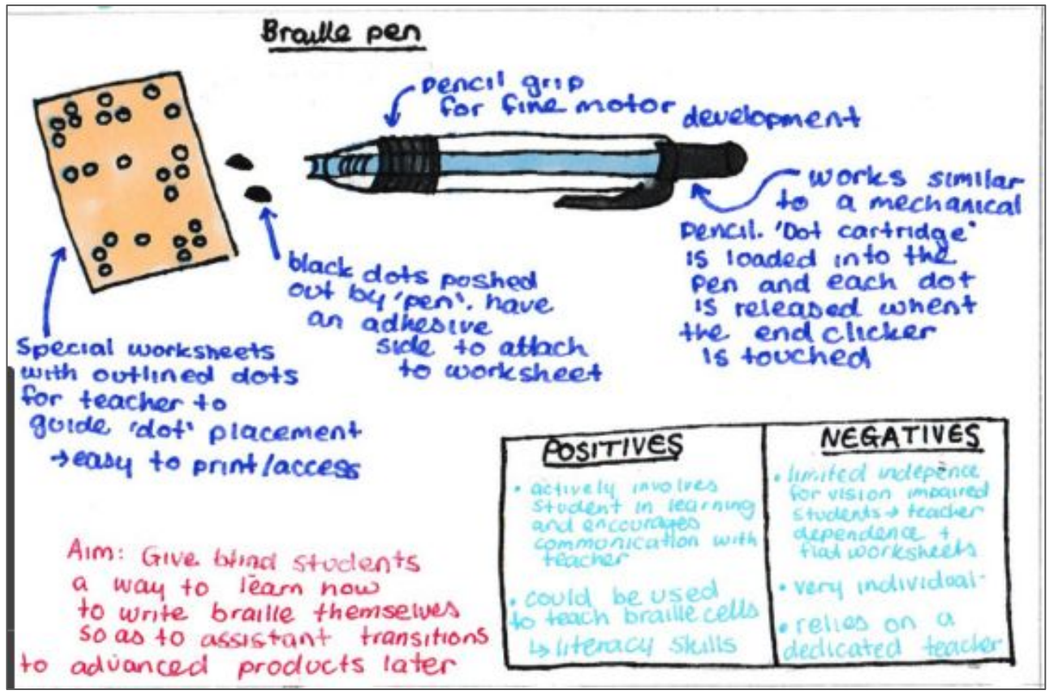
Per the project timeline in Image 1.0, Part 1 of this project was allocated three full weeks to be completed within. This, while possible, did not end up being enough, largely due to the extent of research and several lesson disruptions around the end of term. As a result, much of part one has carried into the holidays and the start of term 2. Subsequently, sections of this project have been completed in slight disorder. For instance, many of my ideas have already been discussed with Kirsten, while not yet formally documented.

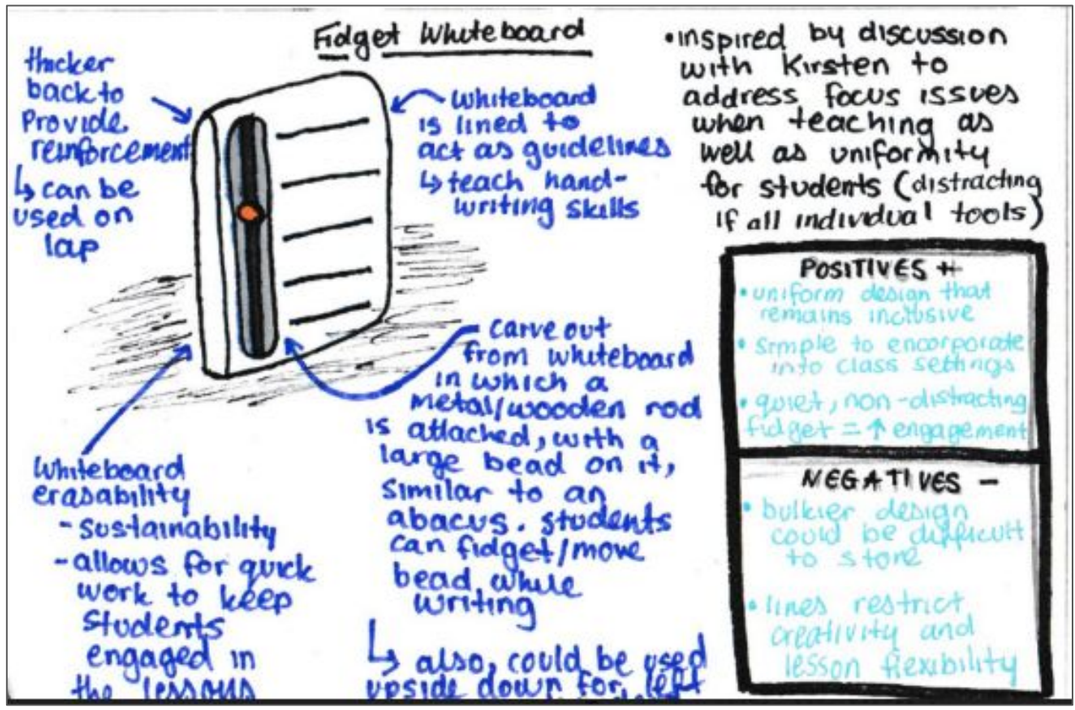
Despite all this, I am very satisfied with the work I have completed in part one. My research, while not all documented, has been extensive and thorough, which has allowed me to develop a sound understanding of the issue, and hone in my focus in response. In addition to this, one of the goals I personally set when going into this project was to better manage, space, time and layout. This has resulted in substantial changes in the way I have approached this task, however, I am very happy with how it is progressing as of now, and am hopeful I will achieve these goals and am excited to begin working on my designs.

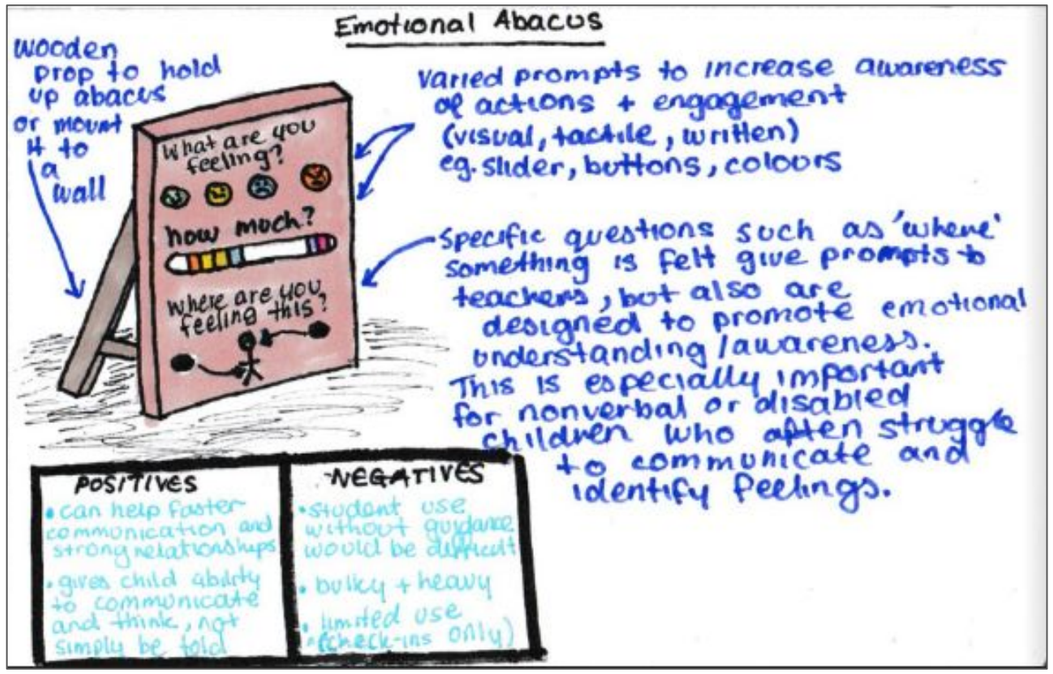
Task Two: Developing Ideas

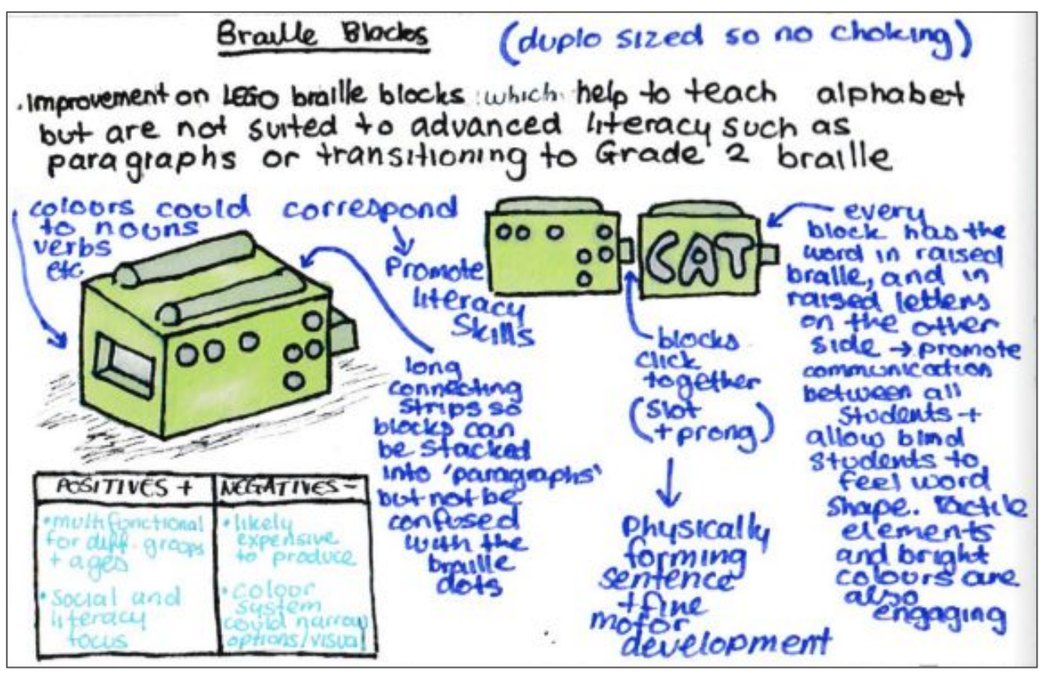
7. Idea Generation

Pictured to the right are four thumbnail sketches of designs intended to overcome specific issues surrounding communication within childhood education. Two of the designs focus heavily on providing means for vision impaired children to develop literacy and fine motor skills, one is focused on provided an additional means of communication for students, and the final design focuses on class engagement and literacy/communication in a class setting. These are all hand drawn, and annotated in regards to the purpose of design features, and then briefly evaluated.









8. Preferred Option

Figure 1.5 and 1.6 below document two preliminary models of the preferred design. This design was selected from my original sketches explored in the thumbnail design images. I elected to go with the concept of a 'braille literacy brick' as it balances the criteria very well and was considered to be a good idea by both Mandy and Kirsten who are experienced educators themselves. In each figure below the model is evaluated, including any improvements and reasoning for each feature

Figure 1.5: Cardboard prototype evaluation

Unfortunately as the cardboard was quite flimsy to work with, it was not possible to add the long raised sections under or on top of the brick as shown in the initial thumbnail sketch. These would have allowed bricks to be stacked together.

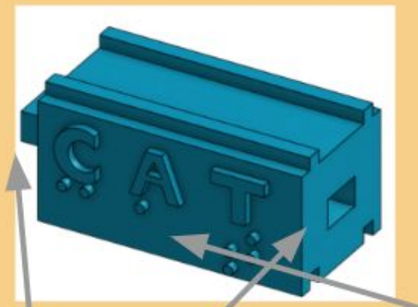
This prototype was constructed in a 1:1 scale with a typical 4x2 duplo brick. After completing this prototype it was identified while the size is perfect for small hands, if the word and braille are to be on the same side in figure 1.6, then more space would be needed, and hence the size would have to be increased slightly.

Braille cell included on other side to promote word association and braille literacy skills.

However, it was pointed out during peer discussion that while including both the letters and the braille word are beneficial for promoting association, this particular layout is not suited to use by multiple students. As the bricks are connected, a student on one side would be reading the sentence backwards, limiting communication and learning accuracy.

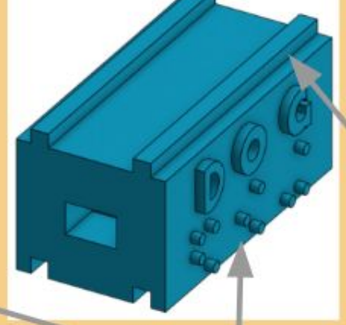
Raised lettering allows non-visually impaired students to read to block, but also gives vision impaired students the opportunity to trace the letters to gain knowledge of the alphabet in a tactile manner.

Figure 1.6: 3D model annotations + improvements

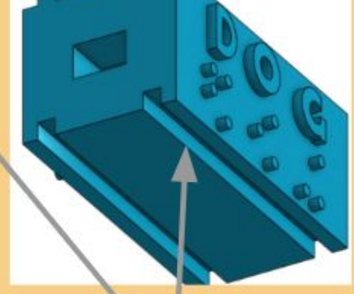


Much the same as the original design, this 3D model includes the same hollowed out nook and protruding section to join bricks at the edge. This was again allow bricks to be connected at the sides in order to form sentences. As the connection is quite precise, but also easily noticeable through only touch, the act of joining bricks will likely help promote fine motor skills of all children.

Note: these bricks would be roughly the same size as duplo to reduce risk of injury, choking or loss of pieces.



In this version of my prefered solution, I have altered the design to include two separate words, with the braille equivalent written under rather than on the opposite side. This was in response to an issue raised through peer evaluation around concerns that if children were to sit on either side of the block and read a sentence, one child would be reading it backwards due to letter placement. By having one side only construct the sentence, this issue is avoided. In addition to this, by having two words on each brick, the product multifunctionality is increased.



Long raised sections would act as 'joins' between stacked bricks, similar to a regular lego. The long design was selected as it reduces chance of confusion with the braille cells. These would slot into identical hat the base of another brick.

This iteration of my design has been changed slightly since my first sketch. Instead of having long sections which were not the length of the block, and hence would have presented difficulties for stacking blocks of different lengths, this block has sections that span the whole width so that all blocks can be connected together regardless of size

8. Preferred Option

Pictured below in figure 1.7 and 1.8 are some of the key steps taken in exploring my selected option. These are further developments on the two initial explorations in figure 1.5 and 1.6, and were used to further specify and refine features of the design. The evaluation in 1.8 goes into many of the specific components of the braille brick and discusses why these changes or features are ideal for meeting the needs and criteria investigated at the start of this project.

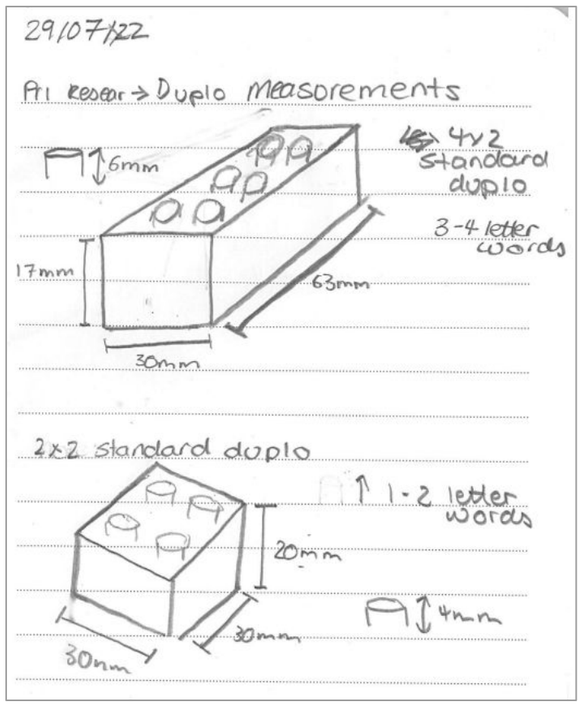
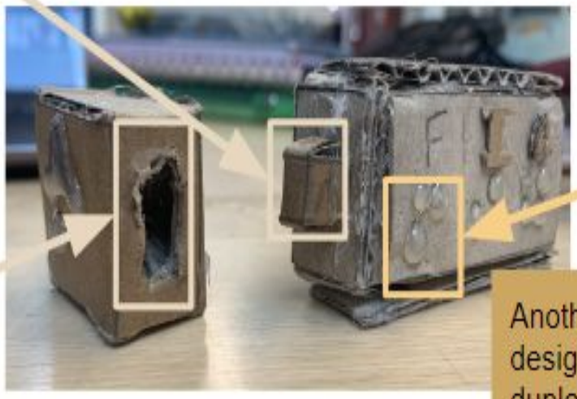


Figure 1.7: Measuring Standard Duplo Blocks

Large joining sections allow the blocks to be connected and form sentences. Having these joins large is an important feature in terms of functionality as it ensures vision impaired children will be able to notice each half of the connection, and physically guide them together. This is important for physical development and fine motor skills, but also helps to promote confidence and independence. Furthermore, these joins are beneficial as they help to orientate the brick, and hence the direction of the word. This is an essential feature to ensure correct sentence structure is learnt.



Rounded braille dots/cells also promote safety as it reduces sharp edges and potential for a child to bite/pull them off and accidentally choke on them.

Another key feature of this particular design is that it is sized similarly to duplo. A duplo brick was used as my reference during the construction of this model. This is an important feature as it means that the bricks are ergonomically suited to younger children, as they are not too large to hold, but are not so small that they are difficult to manipulate. Furthermore, it helps to reduce the risk of joking, and hence, overall product safety.

This design has both the letter word and braille word on the same side. This allows both vision impaired and non-vision impaired students to be able to read the same sentence. Additionally, it means that children can communicate with each other with limited confusion regardless of ability. This increases the functionality of the product as it is accessible to all students, is multifunctional and actively encourages communication

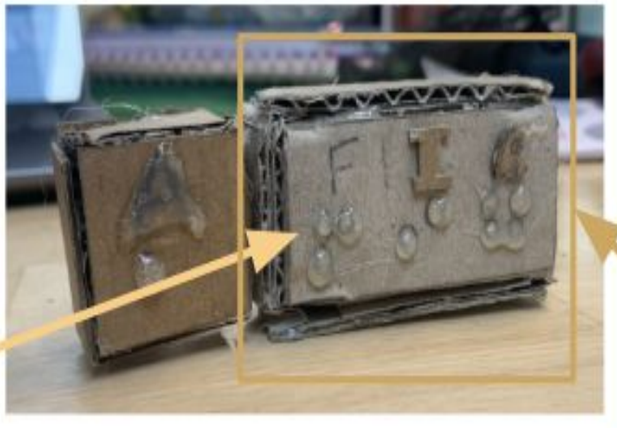


Figure 1.8: Evaluation and Justification of Second Cardboard Model

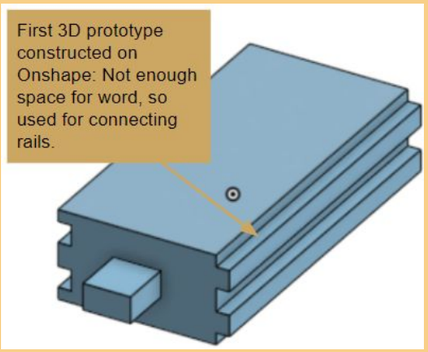
Evaluation: Unfortunately due to limited access to resources at home, this is a very rough model. For instance, the hot glue gun available was not very accurate and as a result the pieces do not fit perfectly, the 'A' is misshapen and the F was not able to be securely attached. This aside, constructing this model was incredibly valuable. It allowed me to explore the new design with both braille and the letters on one side, as well as physically being able to have the blocks join and interact. Again, this model does not have the connecting joints at the base and top.

Task Three: Creating the Solution

9. Construction Process

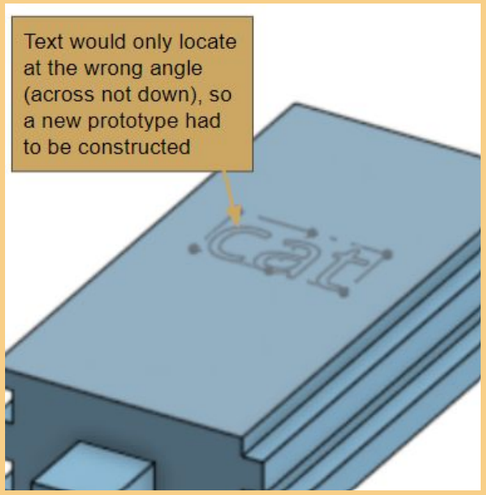
Detailed in the sequence below, are the key steps taken in the construction of the final prototype. After noting that working with cardboard was difficult, it was decided that the remainder of the project should be explored through 3D models, and the solution subsequently 3D printed.

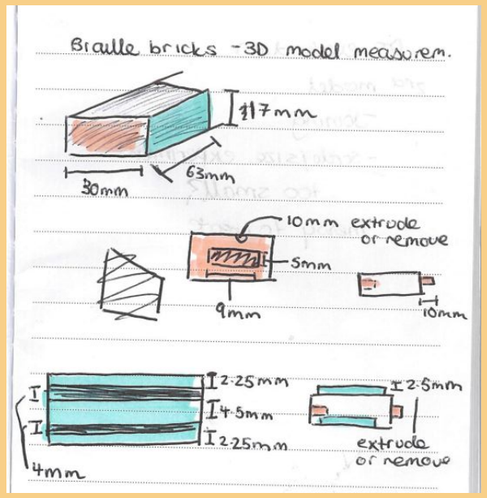
1. Measurements and final research



One of the first steps I took to begin completing my final prototype was finalising the measurements of my design. The initial plan was my lego brick to have the exact dimensions of a standard duplo brick, however, this was not so easy. First and foremost, due to copyright restrictions the measurements of duplo are not readily available, and so I had to set aside time to find some duplo and measure the bricks as is seen in Figure 1.7. Once I had these measurements, I was still not able to progress far with construction. This is because when I went to construct the 3D CAD model of my design, it was quickly identified that there was simply not enough space on the 1.7mm tall side of the brick to fit both the word and corresponding braille. In order to overcome this, I made the decision to flip the brick, using this narrow edge for the joining rails, and the wider side for the word, essentially creating an inverse of the traditional duplo brick.

2. Final OnShape Model Construction





After making the decision to invert my measurements, Time was taken to explore how these adjusted dimensions would interact. This is pictured in the small sketchbook page scan to the left. This step was fairly straightforward as I was able to play around with how the changes would physically look through use of OnShape. Highlighting of the parts was also incredibly useful for keeping track of thoughts and making the diagrams easier to understand.

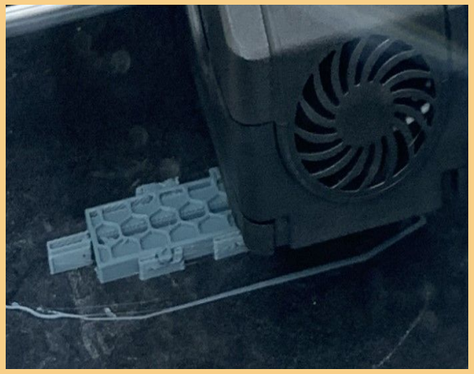
Once these measurements were decided, I began working in OnShape again. Initially this step was progressing very efficiently, however, I was unable to add text to the top of the brick, due to the orientation of the planes. Unfortunately I was unable to to adjust the planes due to the document set up, however, I was able to note the measurements and begin working in a new document to create the final 3D model.

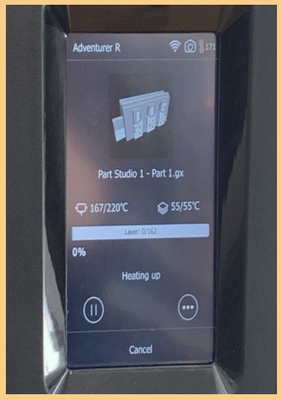
Evaluation Term 3, Week 2 and 3: First Stages of Construction

As I had put a lot of work into my project over the term 2 holidays, I was able to get started on my final prototype quite early into term 3 after short discussion with Ms Sutherland. As a result, I had quite a lot of time to work with, and hence, I elected to develop my solution through CAD models and 3D printing, and area which I was not experienced with. This was an interesting area to explore, and a great opportunity to begin expanding my skills before entering into design careers of my major project next year. Furthermore, I enjoyed the flexibility of technology based design and the ease of experimentation and modification is permitted me. This was in turn a huge advantage for evaluating, discussing and improving my design as I developed, as I could easily experiment with ideas, seek peer feedback and make the corresponding decisions.

8. Construction Process

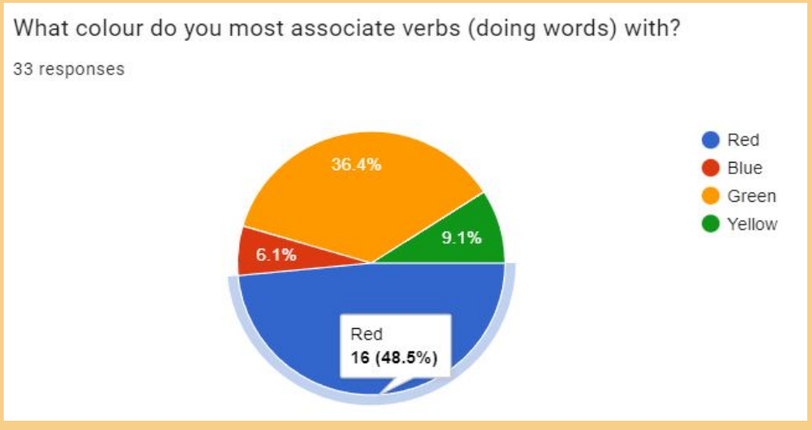
Detailed in the sequence below, are more of the key steps and modifications that were undertaken in the process of developing my final solution to childhood communication with visually impaired children.

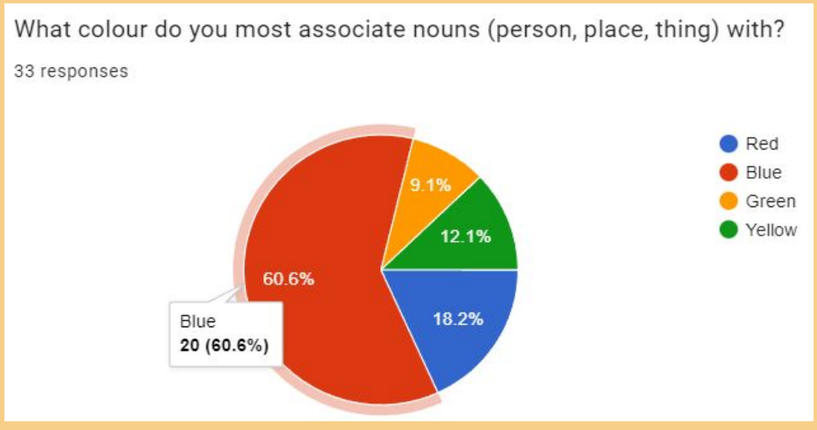




3. Final Prototype (Stage One)

As I had substantial time available to complete this project, I allowed myself to complete an initial 3D prototype before constructing ones in full colour. This prototype was constructed in grey plastic filament, and essentially served as a test as to whether my brick was in the right scale, met criteria and was structurally sound. In order to 3D print this prototype I constructed the model on Onshape and then converted it to a mm based STL which I was able to export and send to the 3D printer. During this process, Mr McAllister also helped me to add additional supports to reinforce the letters so that they did not print separately. Photos from this process can be seen to the left





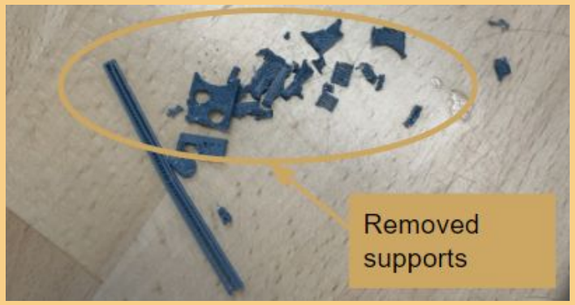
4. Research and Peer Research

One of the key focuses of this assessment task is evaluation and research, as these are integral pillars to quality design. One of the points that came up during discussion was the role of sensory input and engagement in increasing the participation and learning capacity for children. While visual elements are not as important for visually impaired students, the intent of these bricks was for them to be multifunctional. An issues raised by Kirsten identified that many children have difficulties distinguishing the parts of a sentence (nouns from verbs etc). From this I thought that it would be beneficial to have a coloured system to the bricks so that they could be used to teach and visually identify/segregate these sentence components. However, often people have varying opinions about which colour they associate with a noun, and so I made the decision to conduct a simple survey where I would collect the associations from other students. The group of 33 students I picked are diverse in that they are not from the same cultural background, face the same disabilities, live in the same place, are of the same gender or age. The hope with selecting such a wide group was that it would provide a more comprehensive result, which in turn allows for an informed decision around colour to be made, rather than something that is selected only by me.

From this survey it was decided that verbs would be red bricks, nouns would be blue, adjectives would be green, and any connecting or possessive words will be yellow. Adjectives were closer in results with 30.3% voting for yellow and 27.3% voting for green, which is essentially a one vote difference. As a result it was decided that descriptive adjectives would be yellow and possessive/connecting ones would be green.

8. Construction Process

Detailed in the sequence below, are more of the key steps and modifications that were undertaken in the process of developing my final solution to childhood communication with visually impaired children.



5. Final Prototype (Stage 2)

Once the initial grey model had been printed, I had to carefully pull off the added supports with a stanley knife. This was quite a finicky job, however it was not too difficult, but great care had to be taken to ensure no injuries occurred.

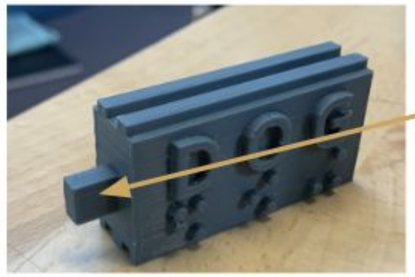
The next step at this point in the construction process was to discuss the model with others, and test its functionality. In order to this I first cut a piece of cardboard to the join dimensions, and inserted it in the join cavity. This was done to roughly estimate as to whether the bricks would successfully join. I was also able to discuss with other DT students in regards to any improvements they would make. Some of this feedback is noted below.

6. Initial Model Evaluation

Before continuing on with the remainder of the construction process, I wanted to evaluate this initial grey prototype, and discuss any possible improvements with other peers. This evaluation is pictured to the right.

Ultimately, taking the time to evaluate this initial model was incredibly valuable, as several issues were identified. These issues are not significant, however, they will need to be fixed in the next CAD models before printing. By making these improvements the design will be more successful and better meet the criteria required. It also became essential to conduct brief, but further research into braille conventions to further increase design suitability.

Space between each braille dot/cell is very small, making them difficult to distinguish. This is a major flaw and will significantly impair functionality if not improved in the next model. One possible solution is to not only space out the dots more, but also to round them out more. This will be beneficial as it will mean it is not a flat surface against the finger, thereby increasing distinguishability. Rounded dots is also more characteristic of a standard braille cell, which is important for truly improving literacy.



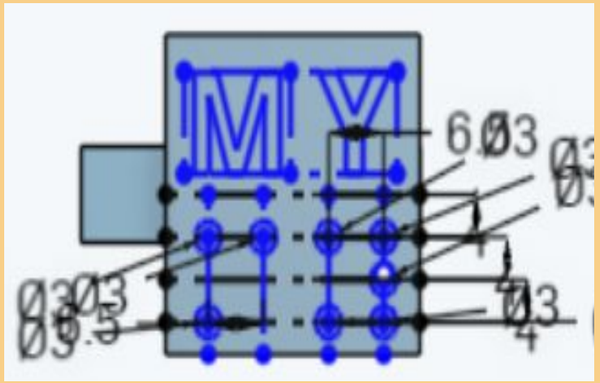
Another issue was that the side joins were not central, which presents a minor visual disturbance, but may also hinder the ability of a visually impaired student to accurately line up and connect the bricks, as they are not able to line up the side of each brick to assist.

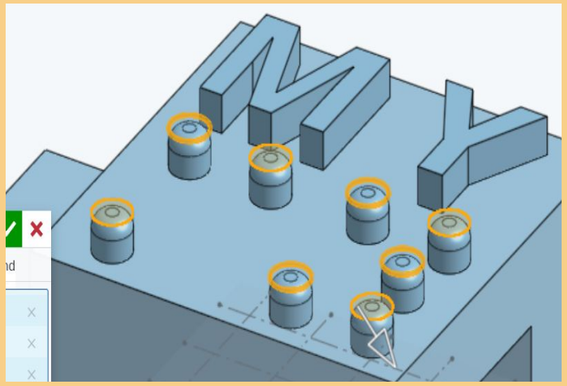
When text on one side is oriented the correct way (as pictured) the text on the other side is upside down, with the letts back to front and the braille at the top. This potentially reduces the functionality of the bricks as another child is not able to read a word on the other side, reducing communication.

While a flaw, this does mean that the issue of incorrect sentences being accidentally constructed on one side due to mismatched word sets is avoided. Additionally, an important point raised in discussion with another classmate was that having the inverse orientations meant that the start of a word was always closest to the protruding side. This is a massive asset when teaching visually impaired children as it allows them to independent navigate the bricks. Hence, it was decided that these positives outweigh the need for change

8. Construction Process

Detailed in the sequence below, are more of the key steps and modifications that were undertaken in the process of developing my final solution to childhood communication with visually impaired children.





6. Final Prototype (Stage 3)

After evaluating my initial 3D printed model, I began constructing new CAD designs which would include the suggested improvements from the last model. A few images of the process can be seen to the left. This stage was all done electronically on Onshape. I started with a basic rectangle shape, and from here I was able to sketch each element and then extrude them to the required dimensions. In order to improve the accuracy of centring and the issue with dot spacing, for this prototype I made substantial use of construction lines and the measurement tool. I also used the fillet tool to play around with rounded corners.

7. Final Prototype (Stage 4)

Once each of my bricks were constructed I simply had to send the to the 3D printer with the colour specifications attached. Unfortunately, due to time restraints, it would have taken too long for each of the three bricks to be printed in the set colour. As a result I have decided to print them all in one colour, and then spray paint them appropriately after to help overcome this issue while still meeting the functionality criteria. In order to ensure that this method was suitable and did not detract from or ruin the details of each brick, I completed a trial paint on my first printed brick.

The main issue encountered at this step was that the pieces did not easily fit together as a result of tight measurements and overhangs from supports. This was annoying, however, it was easy to resolve. I used a small file to file back the joining components of each brick, continually testing them until they were able to connect.

Evaluation Term 3, Week 4 and 5: Completion of construction

Week 4 and Week 5 were very busy. My blocks were cut over the weekend which was a huge benefit as it allowed me to get straight into the project. At this point in the project, I am running slightly behind my initial schedule in that I had planned to have the project completed and submitted by this stage, however, the project is not due until the conclusion of week 6 and so running overtime in this case is okay. This plan was enacted for this purpose exactly, to ensure there was time remaining if any delays were experienced. This aside, this week has gone very well; despite the bricks not fitting perfectly, I was able to quickly identify a solution and begin filing the bricks. Furthermore, the design of these bricks is wonderful, especially the rounded cells, and cleverly meets criteria. There are some areas of improvement that will be discussed in the final evaluation.

Task Four: Evaluation

9. Product Evaluation – Criteria and Target Audience

At the conclusion of this project, I am quite satisfied with the product I have created. As with most design projects, especially those conducted over a short period of time, there are certainly areas that could do with improvements or adjustments in hindsight. Despite this though, the 'braille bricks' I have created meet criteria fabulously, and have a strong foundation on which could very easily be pursued and expanded upon. The criteria identified at the beginning of this project were the needs of vision-impaired students, functionality, ergonomics, safety, quality (of production and material) and aesthetics. The final product has been evaluated against this criteria to the right in figure 1.9, noting which features have achieved what criteria.

The most important component of this project is it's target market. Overarchingly, this product was designed for children around the age of 6 - 9 years old, but also for educators and parents who work with these children. However, the specific target audience, was young children with vision impairments. Ultimately, my 'braille bricks' have excellently catered to the needs of these groups as they hold function, ergonomics and safety at their core; which are the components of a successful educational resources. A more important measure of success however is the impact this product will have on the target audience. These 'braille bricks' are not revolutionary, but rather are an iteration on products that already exist. However, their impact is still extensive, as they address three key gaps in the educational market: a lack of resources accessible to both vision impaired and non-vision impaired students, resources that cater towards improved braille literacy and a way for students to physically engage with and identify the components of a sentence. Subsequently, these 'braille bricks' would have a huge impact as an educational product as they provide a resource that previously did not exist, and will help to foster communication and literacy skills, which are essential for promoting inclusion and development of children, with or without disabilities.

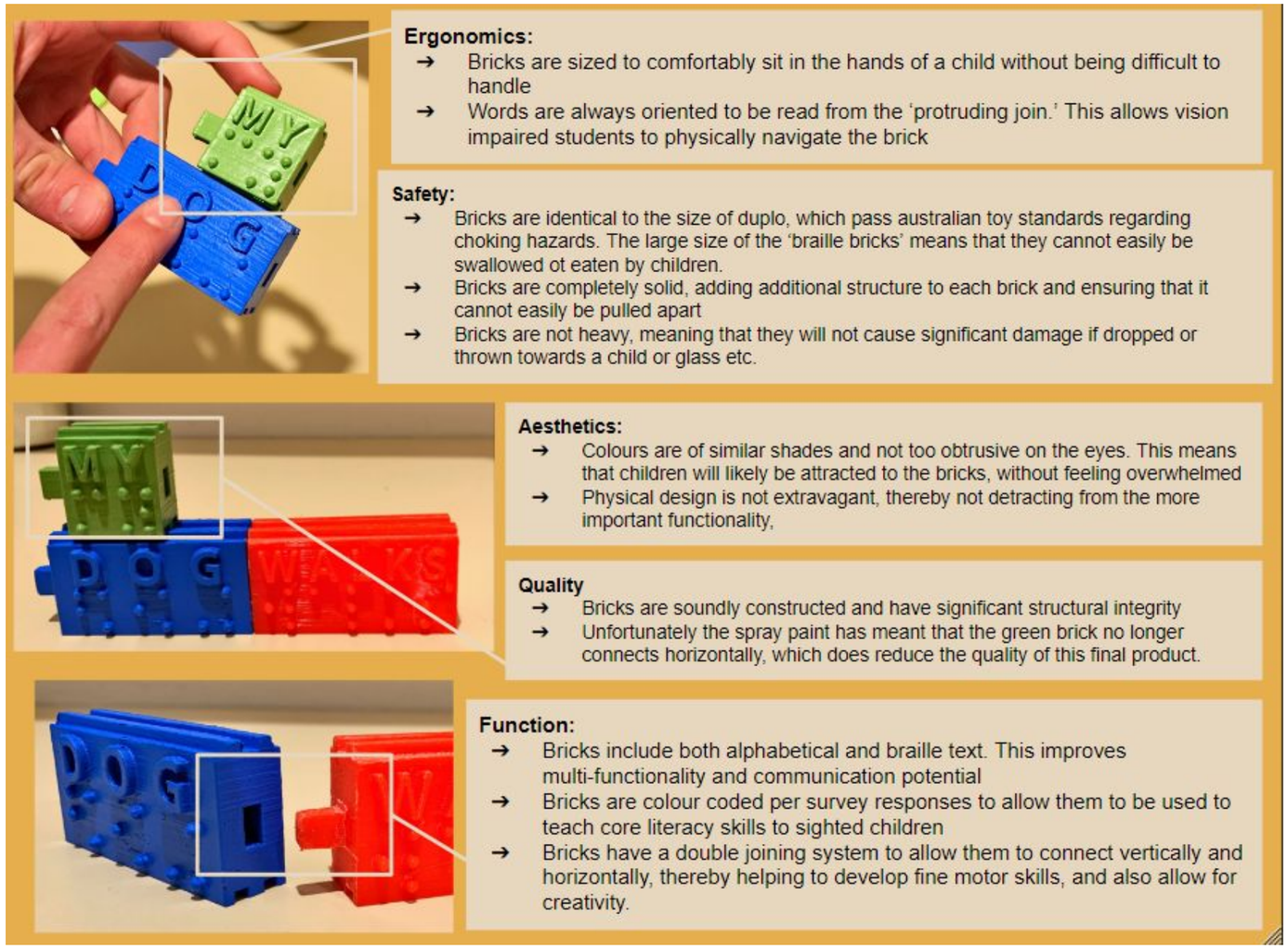


Figure 1.9: Criteria for Success Brief Evaluation

9. Product Evaluation – Improvements

While my ‘braille bricks’ are largely a success, there are a few things I would improve upon, or approach differently if I were to complete this project again.

One of the points that Kirsten suggested when I was able to show her the completed prototype was that while the colour differentiation adds tremendous multi-functionality to the product, it falls short in terms of catering to those with vision impairments. She suggested that in addition to the differentiated colours, the blocks should also have raised symbol that correlates with the particle, ie. whether it is a noun or a verb. This would mean that students who are vision impaired can also participate in identification of the parts of a sentence.

Another point of improvement that was suggested by Ms Sutherland and classmates was that the top join intended to create paragraphs was quite tricky to navigate. This could potentially hinder the success of the product when used with younger children, especially those with visual impairments. While this inclusion is useful for encouraging literacy development, it may not be appropriate for the target age, where simple sentences are of much more focus. If this feature was adjusted or removed it would also address issues around not all bricks fitting together as the joins were opposing. One possible method of adjustment would be to use magnets. This would mean that the bricks could be connected regardless of orientation, and would also provide a sensory experience to students when magnets either pulled together or pushed apart, which is another important part of education engagement.

Another improvement that I would make if I were to do this project again, is to focus more on the nature of braille, how it operates and how this can be best transferred into multi-functional educational tools. The key way that could be used to achieve this is through slightly redesigning the bricks. This would essentially mean that bricks would be designed to fit the length of their word, as well as including features such as the braille indication of capital letters. Another point would be to separate word components such as ‘s’ and ‘ed’ so that they could be added onto the end of any word to construct the sentence, but also to promote understanding of tense.

One point raised by Mandy, who works with children with additional needs, is that often it is important to have multiple levels of development and learning. For example, the ‘braille bricks’ could be adjusted so that some have much larger cells for early learners, and then get progressively smaller until they are in line with standard braille dimensions. This would encourage active progression of skills, which is essential for improving literacy.

10. Research/Process Evaluation and Reflection

In terms of the project, I am very pleased with how I managed and undertook the task. It was initially very daunting as the scope was so broad, however, I quickly found myself invested, which was hugely beneficial to my overall engagement with the task.

While I did originally fall fairly behind with this project, I found that once I had decided on my target market, it was much easier to focus in on more detailed research and funnell my ideas together. Having Kirsten and Mandy only a phone call away was also hugely beneficial, as it allowed me to continually receive feedback and information regarding the direction I was heading. This meant that I was able to continually evaluate and consider new approaches, which has resulted in my design being so successful. Furthermore, the extent of research I undertook was vast and time consuming from talking to Ms Wright to visiting questacon to webinars, however, it allowed me to have a well rounded view into the task, which is a major assess in terms of informing designs.

Coming out of this project, I do wish that I had spent longer sketching designs, rather than jumping straight into 3D models. Not only would this have given me the opportunity to explore more options, but it may also have helped me identify issues that emerged during production, and prevent these from happening. For example, the dimensions of the horizontal joins on my bricks were not able to be slotted together initially, nor after they were spray painted. This impacts the quality of my final prototype substantially, and possibly could have been avoided if more time had been taken to sketch and explore dimensions or joining options.

All this aside, I was able to manage this project well; catching up to speed where required and maintaining continued communication with teachers, peers and research sources alike to ensure that my project was well informed. As a result, I feel that this project has suitability hit not only assessment criteria, but explored a solution that could have a major impact on the lives of vision impaired Australian students, providing them a tool to encourage literacy, and subsequent social integration.

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