



Assistive Communication Abacus (ACA)

Bianca (Bee) Handel

Product Purpose

This portfolio and the final product were created as my Major Design Project for the HSC. The structure of the portfolio was dictated by HSC marking criteria, but the visual elements and content are my own work.

The portfolio component was created on Adobe InDesign, as well as some inclusions created with Canva, Google Sheets, Google Forms, hand drawings and Adobe Illustrator.

Design Brief / Explanation

The ACA was designed in response to the lack of educational products that focus on alternative means of communication that aren't technologically reliant, as well as increased rates of a condition known as Alexithymia in neurodivergent children. The ACA features a storage box with coloured boxes that are used to store the various bead designs. To communicate, the child or adult moves the beads along the brass rod to correspond with a level of pain, noise, or emotion. These tiles are interchangeable, as are the beads, which is important for maintaining personalisation and engaging children

Research

Research was a huge component in developing and designing the ACA. I made use of primary and secondary research methods, developing PMI tables, interviewing and surveying children and teachers, as well as reading relevant articles. This research was used to influence my design decisions. A few images of this research is included to the right. My research is located from pages 4-9, 12, 24-26

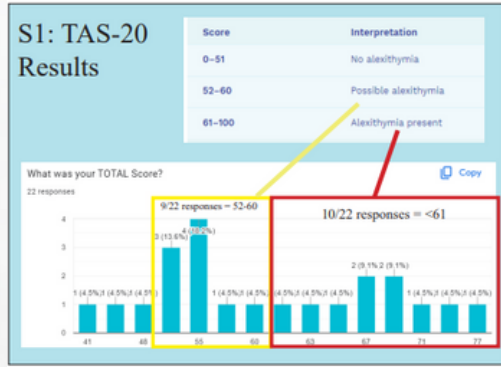
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Exploration of the Need: Research Into Existing Solutions

An important part of the design process is preliminary investigation into products or solutions already available within the target area. In the case of this project, that meant investigating what alternative methods of communicating emotions or pain were already on the market. Pictured below are some common alternative or assistive communication products that have been investigated, with key features identified.

EXISTING PRODUCT	POSITIVES	NEGATIVES	INTERESTING
(Felix & Fay, Emotions Broomster)	<ul style="list-style-type: none"> Simple design is aesthetically suited to many settings/contexts Visual display of emotional progression helps to communicate meaning and develop connections in the child's mind Mature aesthetics and colour scheme mean that this design is suitable to adolescent/older children who may also benefit from using the product 	<ul style="list-style-type: none"> Difficult to adjust to other scales such as pain, or to use in multifunctional settings Difficult to display or store when not in use Could lack ergonomics/functionality in terms of young children having enough coordination to remove/add the balls 	<ul style="list-style-type: none"> This design is made from interesting materials as it could easily be constructed from recycled materials This product is also interesting in that it does not use bright colours, as is common with products made for children.
(Motivation Without Borders 2019)	<ul style="list-style-type: none"> This poster provides examples of much more complex emotions which can be valuable if working with older children who are learning about having multiple or specific feelings. Visual representation of how these emotions may look on a person is useful for increasing a child's understanding of how emotions may feel or exhibit 	<ul style="list-style-type: none"> Posters lack interactivity which can substantially reduce engagement 	<ul style="list-style-type: none"> An interesting point about the use of posters for communication is that they are very easy to incorporate into a classroom as they can be easily stored or displayed
(Emotional Scales)	<ul style="list-style-type: none"> The key positive of this design is that it presents multiple ways to communicate emotions to teachers or carers (ie. through association or emotional scales) 	<ul style="list-style-type: none"> This product is limited primarily in its size and busy design. This not only impairs functionality in terms of storing/displaying the items, but could 	<ul style="list-style-type: none"> The most interesting point of this design is the inclusion of the face. This is a very unique feature and is not common across many products. This face has been included as it allows children

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S2: EAQ Results

Question	True (%)	Somewhat True (%)	Not True (%)
I am often confused or puzzled about what I am feeling	0	56.3	43.8
I find it difficult to explain to a friend how I feel	50	37.5	12.5
I find it hard to talk to anyone about how I feel	25	50	25
I never know exactly what kind of feeling I am having	18.8	68.8	12.5
It is difficult to know whether I feel sad or angry or if I am feeling something else	18.8	31.3	50

Experimentation + Design Development

As well as being research heavy, my MDP involved a lot of intensive practical work and evaluation. Evaluation is colour coded in yellow through my portfolio.

To build the ACA, I made use of numerous skills include CNC routing, metal work, laser cutting, 3D printing, painting, clay work, sewing and general woodworking skills. In creating each component I experimented with various materials, production techniques, and designs. This is included in section 2 of the portfolio from page 17-35.

Image 4: Avocado Seed Buttons

My decision to experiment with avocado seeds as a bead material was inspired from a video I saw on Instagram where a lady was using the avocado pit to create buttons, similar to those pictured in Image 4. The idea of using an avocado pit to create products was really intriguing to me as they are such a unique material, and one that is not often repurposed, and so, using them in my MDP would add both an element of creativity and sustainability. (Image 4: Armstrong, 2022)

Creating my avocado beads took a lot of experimentation. I did lots of trials to find the best way to create the beads as it was a very difficult material to work with. If not handled perfectly, I found that many of the beads would crack/split, or I would simply be unable to cut each slice out of the pit. The method I found that worked best was to wash the pit, leave it to dry for a few days, and then roll it across a hard surface. This rolling allowed the skin to come off in flakes. While the skinned pit could be cut with a sharp kitchen knife, I found that using a mandolin was the most ideal. Once each slice was cut, I left the beads to thoroughly dry before painting them with paint pens. If the beads were not completely dried out, they would splinter when a hole was drilled through, or were stained with orange 'cut marks'

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EVALUATION	IMAGE/S
Sanding the lid was a very satisfying part of the production process as it finally felt as though my design was coming together. I am happy with how smooth the lid ended up being, though I wish I had moved up in grits more gradually as some tears occurred which required wood putty to mend.	Repairing tears with wood putty
Ultimately, I was happy with how the lid stain colour looks with the storage box, in terms of how well it creates aesthetic cohesion. However, I'm not too pleased with the overall quality because of how difficult the pressed bamboo was as a material.	Smoothing edges with orbital sander
I'm really happy with how this step turned out, especially as the holes drilled were able to be adjusted when I switched from flexible steel rope to brass rods	Electric drill
Overall, I am happy with how this step ended up. I was quite worried about how the brass rods would clean up, as they were quite dirty initially, however, Autosol worked well, and was inexpensive as my Dad had a bottle at home already.	Close up of marked out hole
	Freshly cut rods with length marked with masking tape before filing
	Brass rods in progress polishing

This space would be used to label the ends of each abacus spectrum so that intensity of feelings can be communicated

Abacus rod can be removed from the lid component. This allows for bead designs to be switched out based on individual preference/needs

Abacus component serves as the lid for the storage box. This helps to improve storage and portability, which are key functional criteria

Storage box features compartments of various sizes that can be rearranged multiple ways and removed individually. This is to assist with organisation

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Exemplar Pages

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Design Situation

The design situation I have chosen to focus on is quite complex, and multi-faceted. This however, felt the most appropriate for several reasons. The first being that I have a particular interest in environmental conservation, and **strongly believe that products should be designed with longevity in mind**; in this case, that means I wanted to design a product that could be used across settings or grow with children. Importantly though, the direction of this project was further refined after discussion with teachers, primarily two teaching friends who work in childcare and primary school, specifically working with autistic or ADHD children, as well as those who have English as a second language. After discussion with these two teachers it was clearly identified that the **barriers around developing strong emotional and communicative skills were varied for these children**. Some struggled to understand the verbal cues or were becoming too attached to devices, many had difficulties with maintaining focus or being unable to regulate their emotions enough to communicate, on top of struggling to identify the type and severity of the feeling they were experiencing. This is a huge concern to educators, but also to parents and children's healthcare workers as **without the child's emotion, need or pain being identified, providing the appropriate care is difficult**. Hence, the design situation encompasses many facets; the solution is primarily concerned with providing an alternative, physical means for a child to express their feelings in response to written or verbal cues, but this must be done in a way that can be adapted to domestic, education and healthcare settings, while also holding the balance and inclusion of sensory elements central. More details of needs specific to each environment can be seen in Figure 3 below



Figure 3: Target Market Mindmap

Target Market

Ultimately, my goal with this project is to create a product that could be used by many children; for example, a product that while designed particularly for children with additional needs, is able to be used by children who do not, whether for similar purposes or adapted to a new use. For instance, lego braille bricks provide building blocks for non-vision impaired students, but serve to teach literacy to children with vision impairments.

For the sake of this project though, it is important to narrow onto a specific target market. The main market I will be catering towards is children with additional needs, specifically young children ranging from toddlers to grade 2, depending on their individual capacity. While the product will be designed for young children ranging from 3 to 8 years of age, it is also in part designed for teachers, parents and healthcare workers who often work with young children, particularly children who are in distress or require additional support. I will not be specifying in regards to certain genders, or developmental disabilities such as ADHD or visual impairments, but rather attempting to keep all of these needs in mind as so often these are comorbid, and hence encapsulate the same target audience.

Possibilities of the Project

Functionality is the most important design consideration for this project; the product will not be successful if it cannot perform or be used by children for the intended purpose. However, there are many competing factors and possibilities, particularly safety and ergonomics.

Factor	Possible Design Elements/Considerations
Function	<ul style="list-style-type: none"> Providing structured organisation or storage space Interactive elements to engage children with attention difficulties or help regulate through sensory input Developing a product that can be adapted to different learning activities, individual needs or the capabilities of the child as they age.
Aesthetics	<ul style="list-style-type: none"> Having ways for the colours or materials to be adjusted to maximise sensory engagement/appeal to children Balance colour with neutral tones Simple, smooth or natural inspired elements to suit all classrooms etc
Ergonomics	<ul style="list-style-type: none"> Using materials that are safe, durable and generally accessible or easy to interact with Sizing the product appropriately for a young child, or allowing for sizing to be adjusted accordingly for each child/age
Sustainability	<ul style="list-style-type: none"> Using materials that are easy to recycle/repurpose or are biodegradable Ways for the product to be repurposed as the child grows to reduce need for further consumerism Incorporating natural elements to reduce dependence on chemically manufactured materials

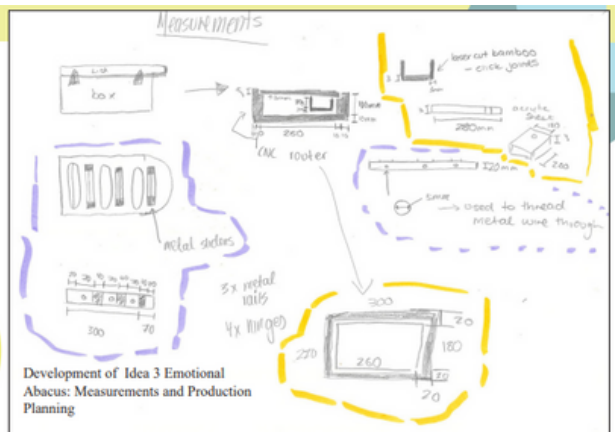
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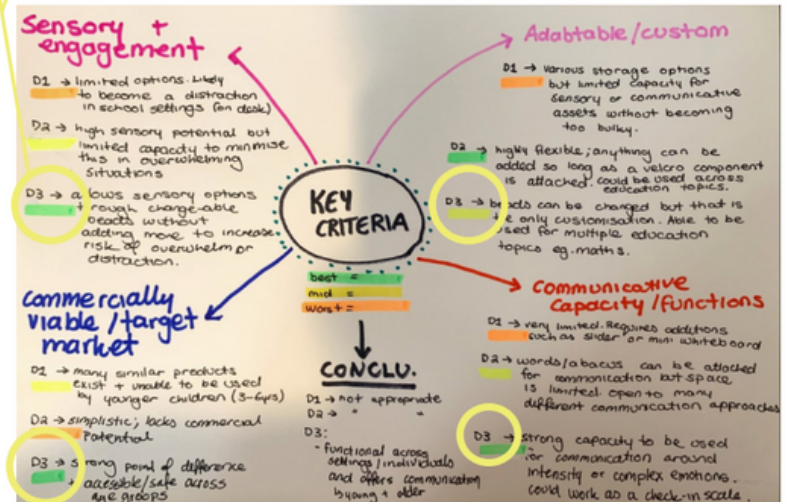
EVALUATION OF FURTHER EXPLORATIONS + DESIGN SELECTION AND JUSTIFICATION:

Ultimately, I decided that Idea 3, the Emotional Abacus, showed the most promise. While both the desk organisers were interesting as a way to combine the organisational and communicative needs of neurodivergent kids, I felt that they did not achieve the design brief as completely. The Emotional Abacus however, holds functional criteria central, especially in regards to having multiple abacus rods that can be used as scales for communication. Additionally, the abacus offers a lot of potential for experimenting and more opportunities to develop the design. As the abacus is based on an existing product that has been modified for a new purpose, there are plenty of opportunities to research existing products, and incorporate the best parts in my MDP. This is especially true for the removable beads, which really excites me as an opportunity to incorporate varied manufacturing styles and techniques, as well as exploring the possibilities to commercialise aspects as a children's craft activity.

CRITERIA	MODULAR DESK ORGANISER	ABACUS + STORAGE BOX	DESK COMMUNICATION BOX
FUNCTION	<ul style="list-style-type: none"> Adaptable to needs of individuals (attach different storage or fidgets) Assists with organisation Minimal communicative potential 	<ul style="list-style-type: none"> Versatile to need of individuals (beads, tiles) Communication involves tactile input (important for engagement) Storage improves practicality for teachers 	<ul style="list-style-type: none"> Assists with organisation Used by individuals = personalisable Various sensory elements included Communication is restricted to one or two scales
SAFETY	<ul style="list-style-type: none"> Not suitable for young children as desk organisers would encourage small objects to be present that could become choking hazards 	<ul style="list-style-type: none"> Beads pose possible choking hazard Sharp edges of box/rods could result in injury Latches could be incorporated to make the storage box childproof 	<ul style="list-style-type: none"> Not suitable for young children as desk organisers would encourage small objects to be present that could become choking hazards Fingers could become trapped in the drawer or under the beads
AESTHETICS	<ul style="list-style-type: none"> Highly customisable Minimalistic design ensures aesthetic appeal grows with the user Limited colour incorporation 	<ul style="list-style-type: none"> Beads offer opportunities for colour and texture Rounded lid creates a finished and quality appearance More luxurious than a traditional abacus 	<ul style="list-style-type: none"> Customisable (Sticker tray, name tag) Beads could not be switched based on personal preference Colourful draw compliments dark wood = timeless, but playful design



"D3" = Emotional Abacus
 "D2" = Velcro Sensory Board
 "D1" = Modular Stationary Organiser



Mindmap evaluating 3 designs and justifying the selection of the abacus (D3)