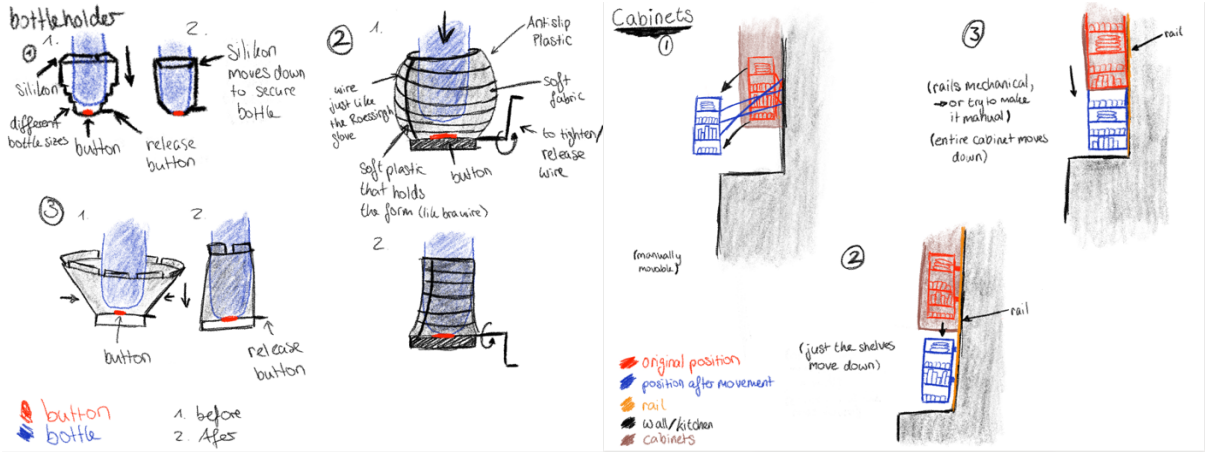
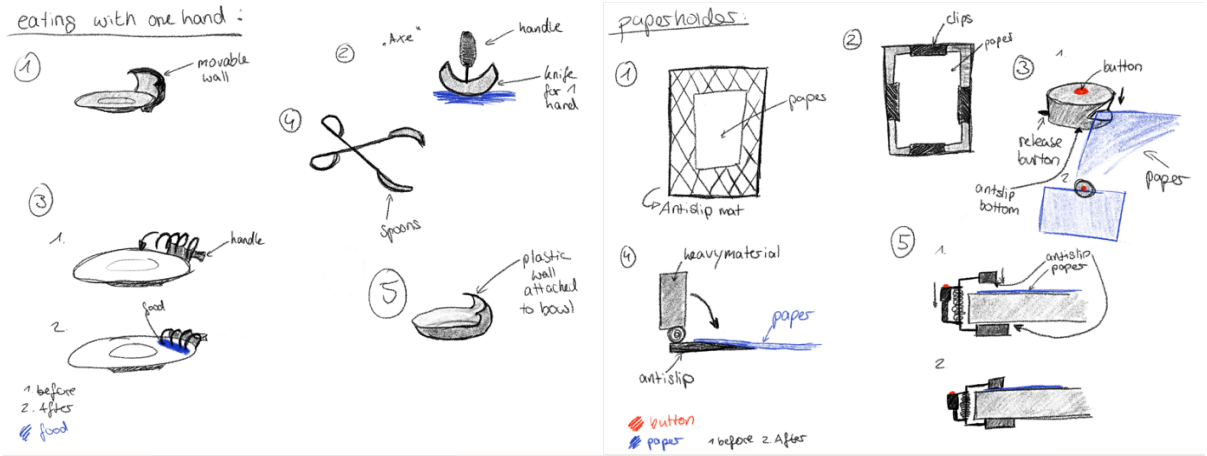
Project Group 3

Reflection on results

This project began a few months ago, when we were presented with a client and tasked with creating a product that would improve his daily life. Our client is a stroke victim who is paralyzed on the left side of his body, this has left him primarily wheelchair bound and unable to perform several daily tasks. After a couple visits to his living space, we determined a few ideas for products that may be helpful to him, including a holder to help him open bottles, an adjustable cabinet, modified cutlery, a paper holder to help him write, and a sink tub that could make the dished more comfortable for him. We created sketches of each of these ideas to gauge their viability. Our main selection criteria were that the product should be helpful in everyday life, it should be challenging but feasible, our client should be enthusiastic about it, it should be broadly applicable beyond only our client, and it should not require modifications to the client's home.





After another visit to Livio, where we presented our ideas to the client and contact person, we assessed that the best problem to tackle was the issues our client was having with his kitchen sink. The issue here was that our client could not easily reach for his dishes because, due to his dependence on the wheelchair, the bottom of the sink was too deep for his lack of reach. The basic idea was an insert for the sink that would effectively raise the bottom surface of the sink.

Solution requirements

Requirements	Wishes
Sustainable/durable (as long as possible, min 5 years)	Collects dishwashing dirt in a place that is easy to clean out
Resistant to temperatures at which you wash dishes (at least 120 Degrees)	Our client will use the product daily
Resistant to water, soap and dishwashing dirt	Our client will find the product helpful
Dishwashing dirt and soap don't stick to the material	The production cost is low
Easy to clean (elements should be detachable within the product)	Easy to store
Operatable with one hand	Dirt doesn't slow down the mechanism (runs smoothly)
Applicable to sinks of most sizes	
Applicable for a broad range of clients	
As light as possible (max: 1.5 kg)	
User-friendly (Instruction how to use it)	
Fits dishes (3 days of not doing the dishes for 1 person, approximately 3 kg)	

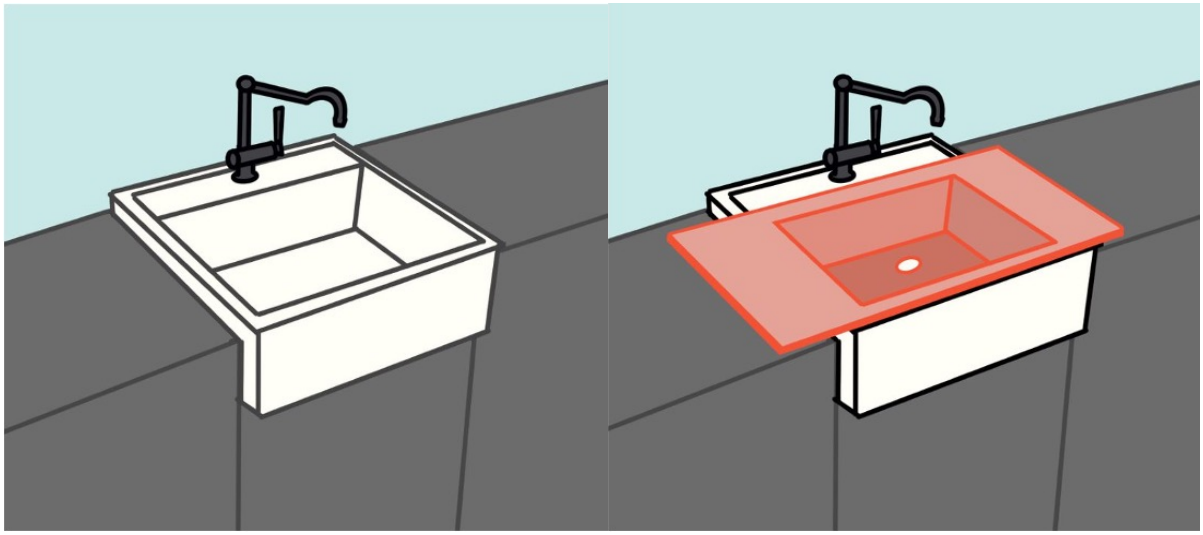
Supports the weight of dishes and water (hold at least 3 kg of dishes, at least 5 kg in total)	
Client can reach the bottom of the product (platform should be adjustable)	
Minimize the dirt and soap that gets stuck between elements (design the product so that as little unnecessary dirt and soap accumulated between compartments)	
When the level of water is high, it doesn't spill all over the counter	
Sink (in which the product is placed) should have a drain, which doesn't clog	

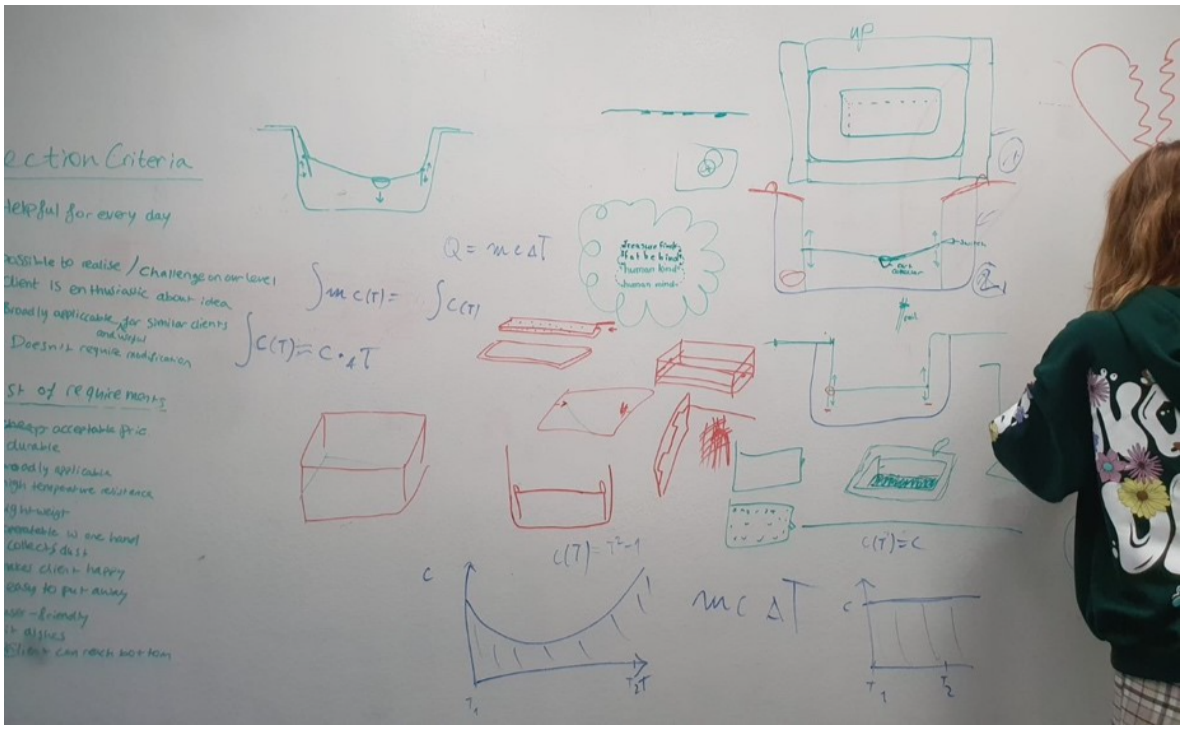
Throughout the design process we considered these requirements at every step to ensure that our product brought the most convenience to our client's daily routine.

Reflection on the design work

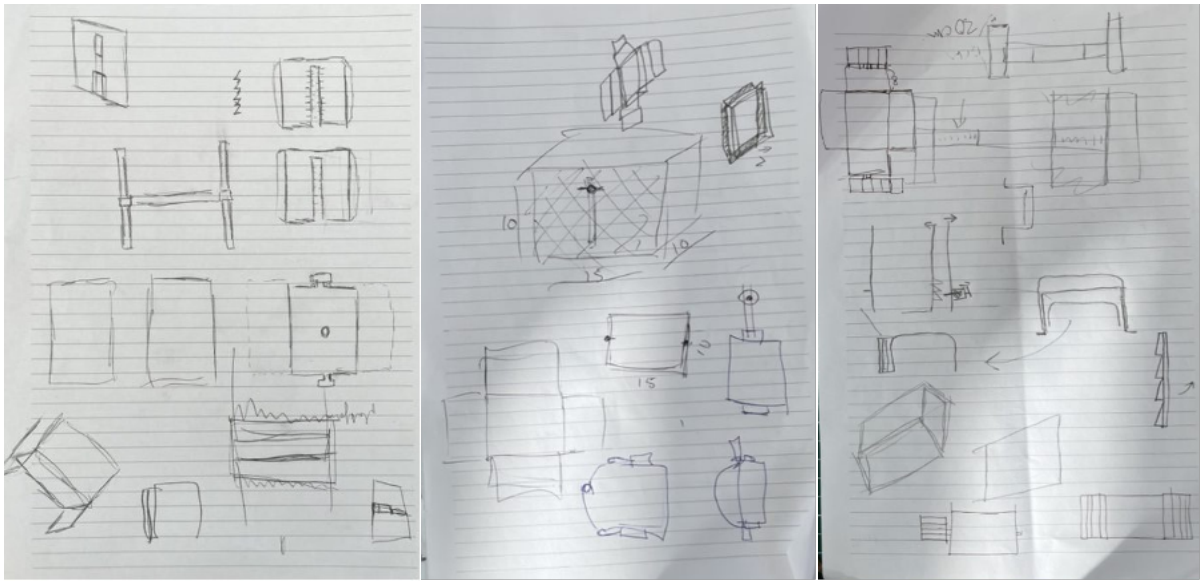
The design process was very detailed, and the design of our final product went through many evolutions and redesigns. We began with some research into existing products that served a similar purpose to the one we were aiming to create such as sink colanders, dish tubs, and drying racks. This research helped us create a foundational understanding of our goal product, as well as establish a general size and function. We then proceeded with a series of brainstorming in which we collaborated on a series of design ideas. We considered all possible risks of the product, which was essential to kick off the design process, and was essential to get through the different design phases.

The first iteration of our design was a suspended sink with flaps that lean on the surrounding counter of the sink.

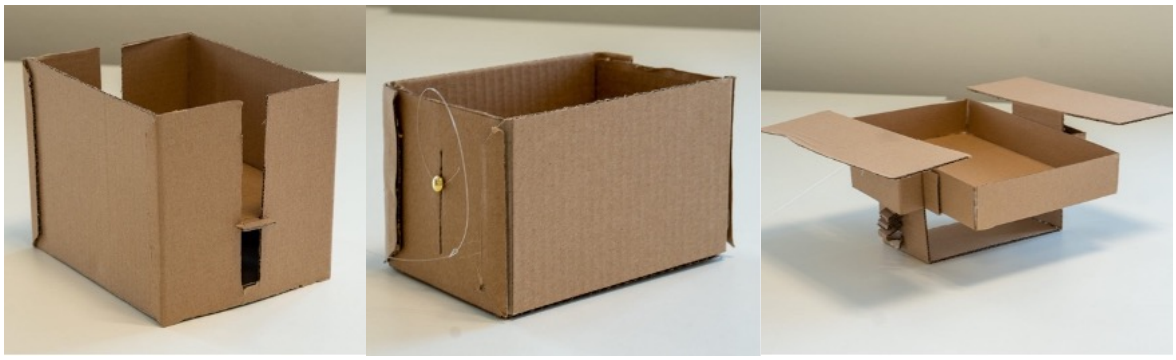




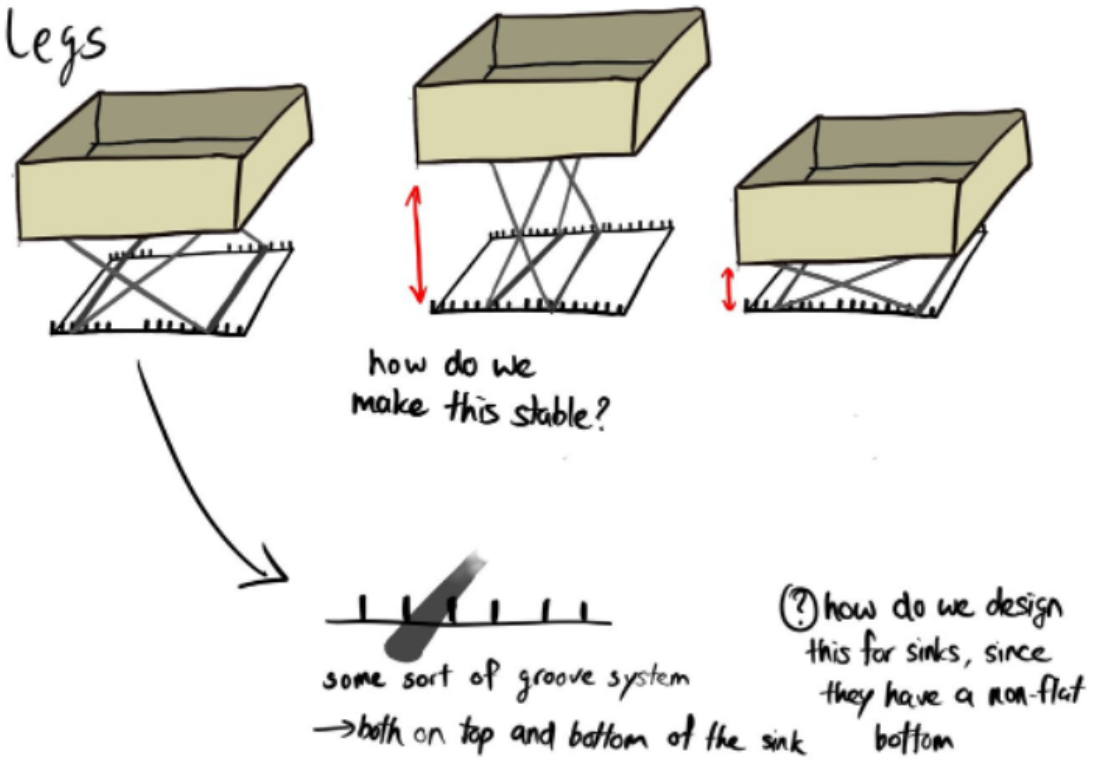
We then aimed to implement an element of adjustability that would allow the consumer to change the height of the platform based on their preference and personal needs.



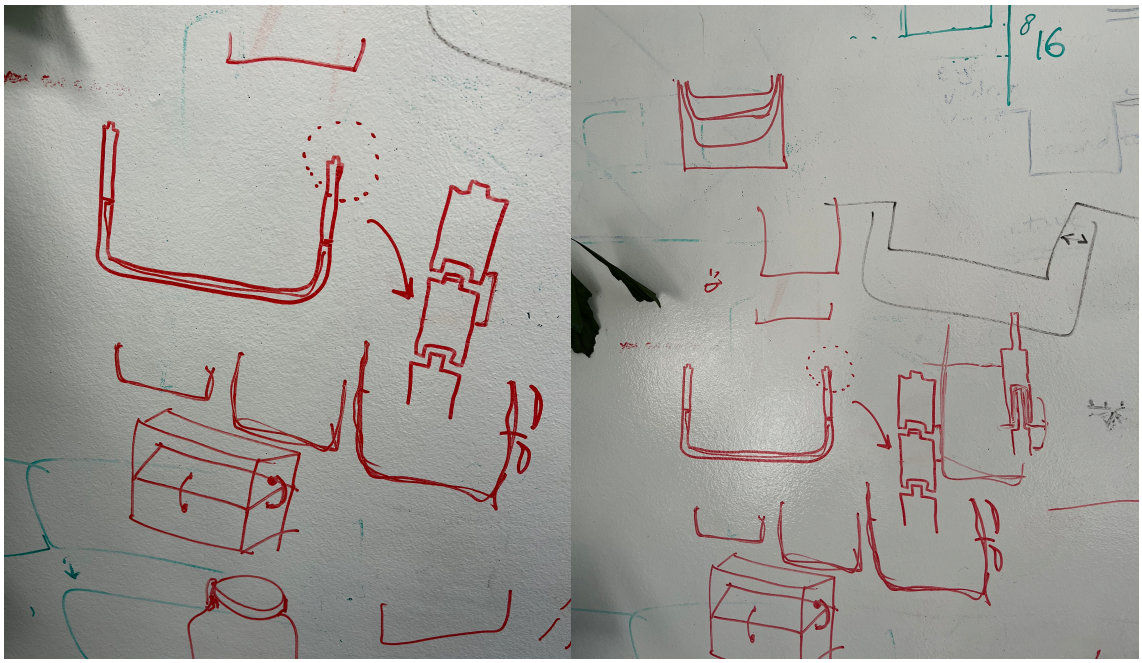
With this model in mind, our group was able to go to the design lab and construct various rough ideas for the adjustable aspect of the product:



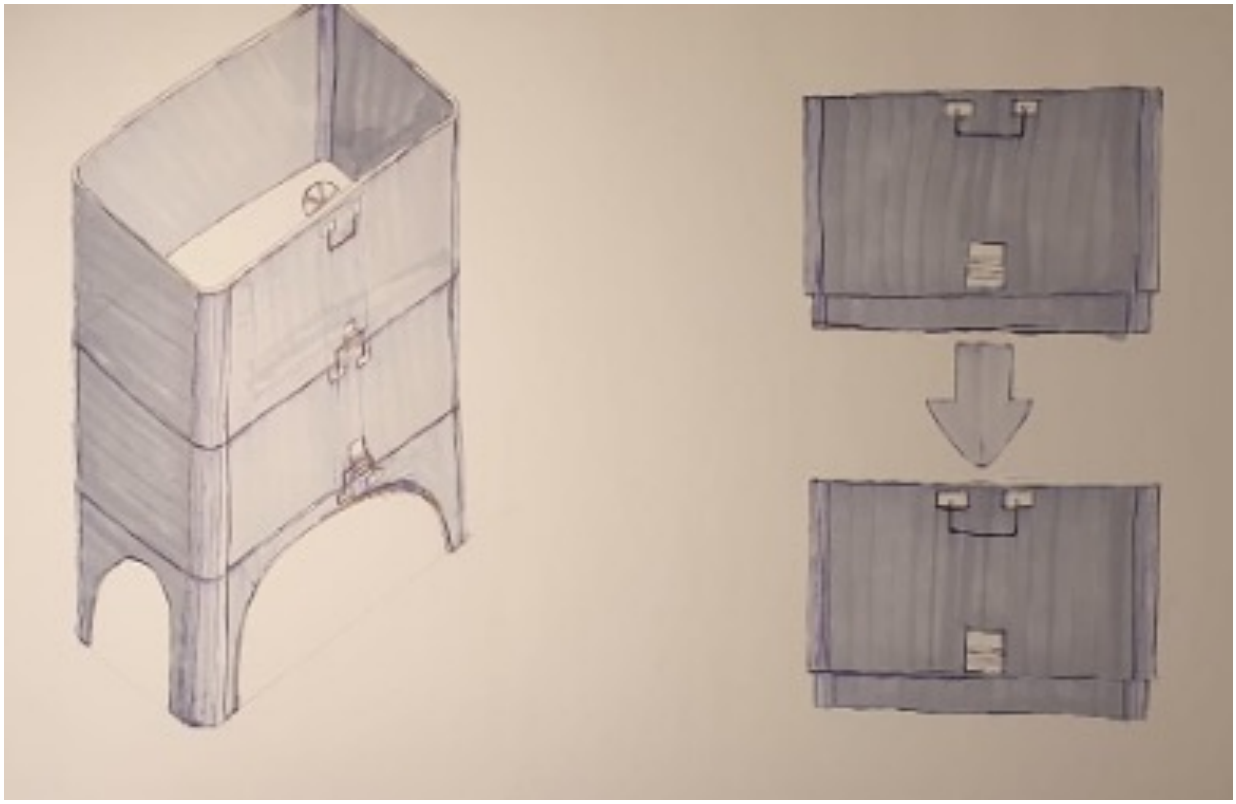
We soon realized that the constructed methods of making the product adjustable were incompatible with the general design of the flaps and additionally not very feasible for us to construct. Furthermore, cleanability and simplicity were not well considered in these designs. After another series of brainstorming, we decided to add legs to the product to increase simplicity and cleanability, as well as change the method of adjustability. The first idea for this was an X-shaped adjustable stand that the product could sit on and be brought easily up and down.



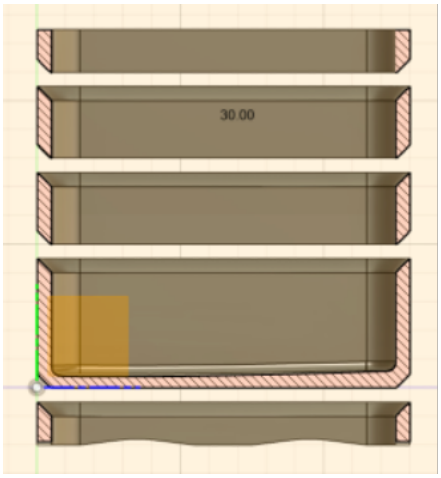
These x-shaped legs were, however, instable and too complicated and breakable. In the next iteration, the product consists of multiple layers, one of which has a bottom with a drain. This layer can be moved to different heights by rearranging the layers. There would also be a layer that remained on top which was fitted with flaps to prevent dishes from falling between our product and the sink.

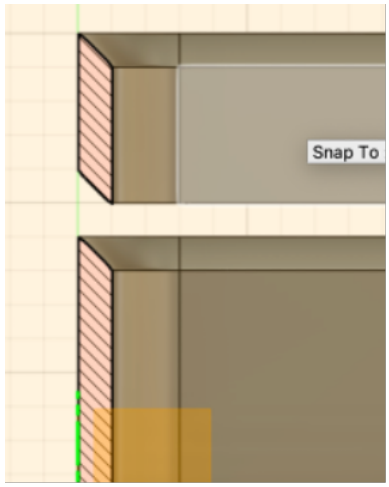


After finally settling on this, still vague, design choice we then had to move on to figuring out the best materials, connection mechanisms, and measurements for the final product. We began with the materials research keeping in mind some requirements such as durability, cleanability, heat, resistance, chemical resistance, structural strength, and affordability. Eventually we settled on acrylonitrile butadiene styrene (ABS) for the body of the product and stainless steel for the drain, both met almost all requirements. It is important to mention that we were not able to acquire these materials for the final prototype due to budget and time but the ideal product would include these materials.



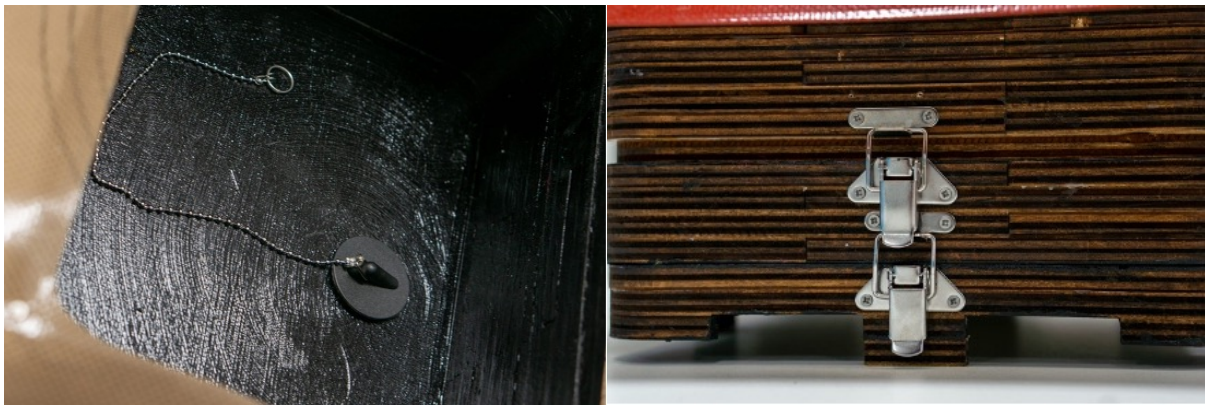
We also had to consider the best connection mechanism between layers that would fulfill its own set of requirements: watertightness, easiness to connect and disconnect, simpleness, and sturdiness. We settled on creating an indent in the brim of each layer with an inverse indent on the bottom. This way, the layers fit together and are easy to rearrange, as they will fall into place easily. A model of this idea was created in the application Fusion360 to demonstrate this idea. The connection mechanism is shown in the section analysis below:





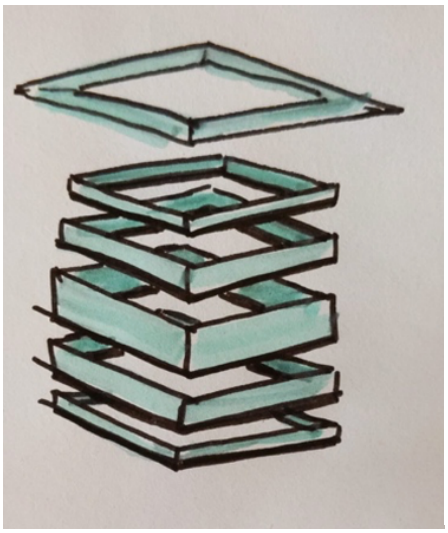
Between these layers, a rubber layer would be placed to maximize the watertightness between the layers. To make the attachment between the layers more sturdy, and the watertightness maximal, clips are attached on the sides of all layers, connecting the layers and increasing the force applied between the layers. We considered many kinds of latches and clips to connect the layers. After some deliberation we found that the ideal material for these clips would be stainless steel.

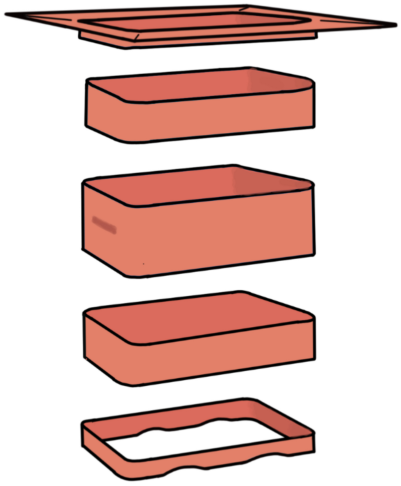
Additionally, we wanted a way for the water to drain from our project to the client's sink drain. While our ideal model includes a stainless steel drain, our final prototype includes only the round rubber plug, that can easily be inserted and removed. This provides the client with the option to fill the whole product with water or have the water draining constantly.



Finally, we had to decide on the material and design of the flaps. While this seemed like a simple aspect of the product, it proved to be a very complex feature to design. The first design of this feature was simply rubber or silicone flaps that bridged from each side of the product to the edges of the sink. The issue with this design was that the flaps would not be very adjustable and the average consumer would have to have specific sink dimensions to use them. We also considered a net with suction cups that would attach to the sides of the sink, and making the flaps out of wood with a laser cut design that would allow the flaps to be bendable. After a long period of brainstorming, we finalized an idea in which the flaps are made out of a similar material to silicone baking sheets which are malleable but sturdy, and very cleanable. The flexibility of the flaps would allow them to bend against the faucet obstacle on

one side of the sink. The only remaining issue was that this product was non-collapsible and therefore difficult to store, but with the other requirements being of more importance to us, this remaining issue was not possible to overcome in our process. The final design was the optimal choice to minimize issues and maximize efficiency. We chose it call our product the "Sink Insert."





Reflection prototyping process

The prototyping process was often very experimental, which taught us a lot of things about the shortcomings of our product ideas. Throughout the prototyping, we realized that some of the ideas we came up with were not feasible. We then again started brainstorming and came up with even more diverse ideas to solve the problems we encountered while prototyping. Because of this process, we eventually came closer to a design for our final prototype. Especially prototyping the connection mechanisms between the layers proved to be very useful for selecting a final mechanism. We did plenty of experimental prototypes to find designs and mechanisms. However, we did not prototype our total final design, except for the final prototype that would be used for the presentation. Although this was partially due to the limitations of material use at Design Lab, it was also due to a lack of organization, and this is a part that we could have improved upon. However, brainstorming and sketching the product with the team was sufficient for coming to a final idea and design. Not making more prototypes did, however, result in some issues when attaching the drain to the product, as measurement inaccuracies and overlooked factors such as availability of add-ons made these add-ons less compatible with the prototype.

Feedback from client and Livio healthcare professional

After completing the final prototype, we were able to present it to our client at his home and observe how the product fit into his daily life. The feedback from the client himself was overall positive. In the initial impression, he found that the depth of the sink was perfect and the height was satisfactory, however it was a little too high. Another small issue was that the sides of the sink in our client's kitchen curved slightly so the cubic design of the Sink Insert did not fit as expected, it was a bit instable. While testing the product, our client expressed that he would need help connecting the layers and taking it out of the sink but overall found it easy to use. He also mentioned that because he only uses his sink to do dishes, the Sink Insert would rarely leave the sink so these issues would not be too inconvenient. Additionally, we received feedback from our client's contact person, who suggested that it would have been helpful to visit the client more often during the design and prototype process to check the parameters. It is important to note that our client was somewhat hesitant to remain a part of our project and dropped out of the project twice in the last four months. Because of this hesitation, we decided to make our design more of a general product that could be brought to the market and be compatible to many people in similar situations as our client. This is why the height of the product was not perfectly compatible with the sink of our client. We do, however, acknowledge that visiting the client more often could have been more beneficial for our final design solution, as certain overlooked factors, such as the curvature of the sink, could have been better incorporated.

Future work

For future work on this product, better prototypes could be made, using the ideal materials mentioned earlier. When using these materials, factors that remain untested such as weight, watertightness and cleanability could be better assessed. Additionally, the curvature of the average sink should be considered. In addition, an easier connection mechanism could be devised that requires less effort and is more accessible. It would also be ideal to have different sizes of the Sink Insert and the flaps available for wider or deeper sinks. We also discussed the concept of making the Sink Insert collapsible and easier to store extensively during the design process, but couldn't find a way to implement this feature within our limited expertise and time. Future work could explore this element of collapsibility and storability. Another factor that could be improved upon would be the top layer, which consists of a flexible silicone flap attached to the sturdy top layer of the layer of the product. The gaps in between this connection will be especially difficult to clean. Making all the pieces separate and removable would make the product more convenient. Finally, making the flaps adjustable, considering the faucet as well as different sink widths could be implemented.

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