

Dragon Boating Water Bottle Holder



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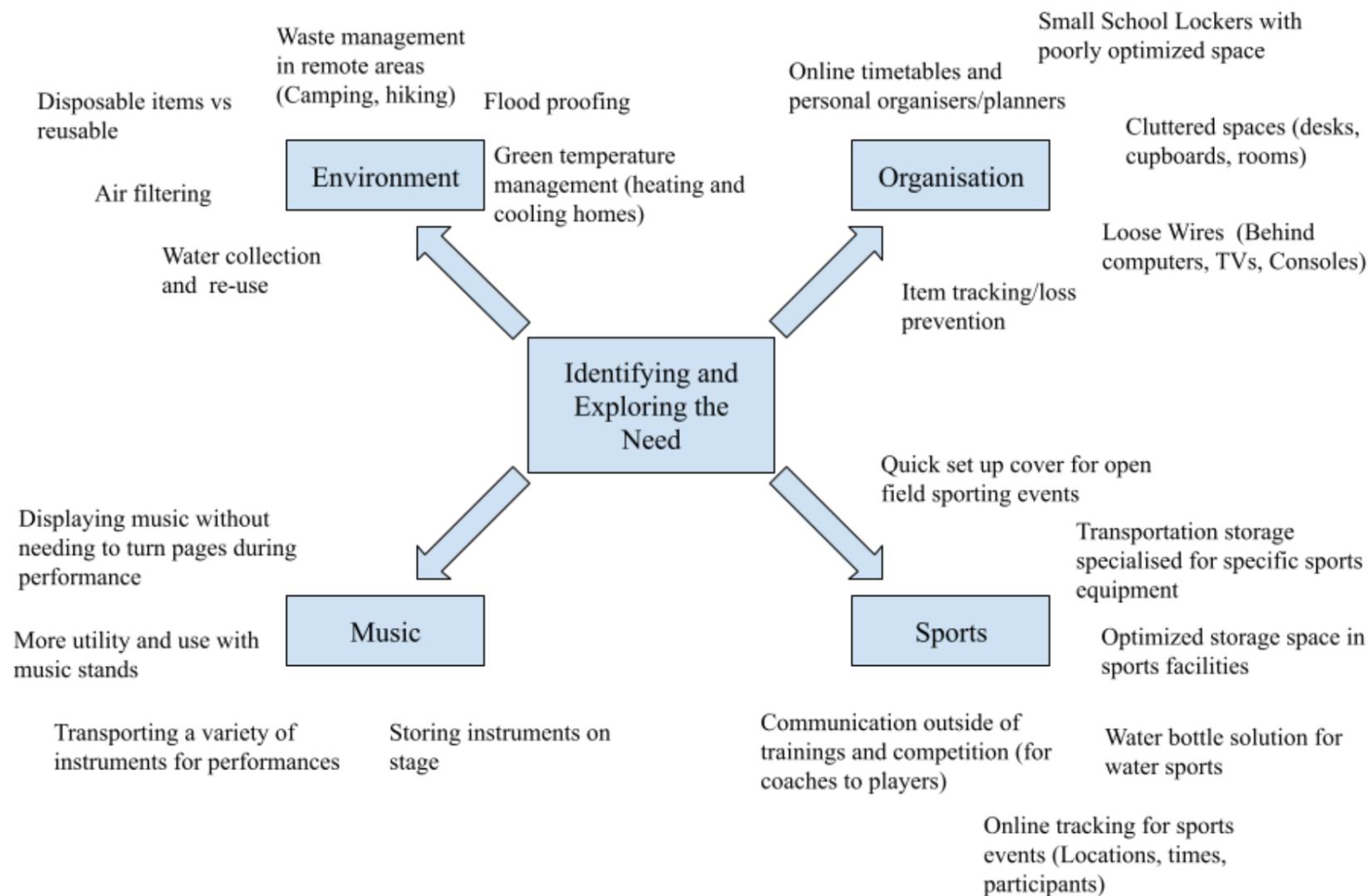
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1.0 Project proposal and management

1.1 Identification and Exploration of the Need

Possibilities of the project

The first steps of my major project is investigating the possibilities of the project, using a simple mind map to develop early ideas of different problems that can become the need for my MDP. To guide my brainstorm I divided it into 4 sub-categories. Environmental, as a way to find solutions to improve the environment or reduce human impact. Organisation, as a way to improve everyday organisation or improve an aspect of everyday life to make it more efficient. These first 2 areas of investigation are very broad, general but important problems, so the next 2 sub-categories in my brainstorm were focused on interests in my life. This allowed me to better find problems and opportunities as these are spaces I interact with on a daily basis, being music as I have been a musician for the last 10 years of my life, and sports as I've been involved in many of them, specifically water sports at a high level for the past 4 years. To further explore these areas I created a SWOT analysis for both to further the final selection.



Music

Sports

Strength

- Plenty of experience in the area
- Am very passionate in the area

Weakness

- Aren't many problems to create a solution for
- Only experienced in one area of music
- Lack technical knowledge of music

Strength

- Plenty of experience in water sports
- Have a wide variety of problems that need solving
- Have access to lots of equipment from this area that can be used in experimentation

Weakness

- Lots of parameters that need to be followed due to the nature of the sport
- I lack experience in using materials necessary for the environment they would be needed for

Opportunity

- Have access to many other musicians and experts in the field to receive feedback and suggestions from

Threat

- Music is very technical and is hard to create something without it having a impact on instruments or music

Opportunity

- Have access to experts in the field through coaches and athletes where I can get feedback and advice
- Very few others who are trying to design solutions in the same problem areas

Threat

- The sport is very niche and has a small following
- Due to the specifics of the sport it can't easily be crossovered with other sports

Final Selection and Justification of MDP

After the initial identification process and SWOT analysis I found many needs I could develop an impactful solution for, but lacked investment or interest in the area. Hence, I decided to focus on sports as my main area of investigation due to it being such a major area in my life. To further specify my research further exploration will be focused on one sport I certainly participate in, Dragon Boating. Dragon Boating is a water sport that involves paddling and large groups that work together in one boat.

Throughout my time in Dragon Boating I have found one persistent problem that almost every paddler faces, access to water, due to there being no location to place your water bottle, it sits on the floor of the boat (gunnel) and rolls, creating noise, scratching, and making bottles hard to access, especially when the gunnel fills with water. This being the main focus of my major project.

Identification of the MDP Need (Design Brief and situation)

Design Brief

For my major project I plan to design and create a water bottle holder that is designed to hold a variety of water bottles with different sizes and shapes, through my research I have found that despite many people finding or creating their own makeshift solution to this problem, there is no mainstream, universal solution to this problem, as well as a solution that does not hinder the paddling ability of the user or others. Hence I have identified a need for this solution. Through my experience in prototyping, sketching and 3D modelling, as well as experience in Dragon Boating and knowledge of how a boat functions, I plan to create a bottle holder that adequately holds a bottle without getting in the way of the user or other athletes paddling.

Design Situation

As mentioned previously, due to there being no dedicated area for your bottle to be held in a Dragon boat, they must sit in the gunnel of the boat. In my 4 years of paddling myself and many others have found this to be a major inconvenience, as well as the previously mentioned inconveniences, it also results in the bottle sitting in dirty water as the boat fills with water, this can be a major health concern as your water can easily become contaminated, this is especially a concern in locations such as Canberra where there are often cases of hazardous blue-green algae being present in the lake. Another major inconvenience is access to water during short breaks. Dragon Boating is a high intensity sport, and therefore there are very short breaks in between sets that allow you to get a drink of water, typically 30 seconds. During a set the movement of the boat results in your bottle rolling around and moving locations, this on top of your bottle sitting at the lowest point of the boat makes it difficult to get hydrated during such a short break. Overall, this situation, as well as a distinct lack of current solutions shows a need for a bottle holder designed to keep your bottle off the gunnel of the boat, in an easy to access location.

Possibilities of the Function and Aesthetic Factor

The key design factor for this project is the functionality as the success of the product is determined based on how well it performs at the task it has been designed for. The functional element of this project is to give paddlers a place to store their water bottles when paddling to prevent the water bottle from rolling around, getting in the way of others foot placement, and prevent bottles from being placed with contaminated water that sits in the bottom of the boat. While achieving this the bottle holder cannot hinder the ability of the user or others by getting in the way of foot placement, or taking up too much space. Another important consideration is the functional materials used in the project, it needs to be made of a durable material that can handle getting wet and being exposed to large amounts of sunlight. On top of this it needs to be lightweight and ergonomic to allow for easy transportation. As well as primary function, it needs to be accounted for throughout the design process of how the holder will maintain if the boat capsizes, to make sure that it isn't easily lost or made of a material that sinks as capsizes are a common occurrence. Overall, this product has many functional components that need to be considered for the design to succeed. Aside from the function, the Aesthetic factor plays a secondary role, this is due to the role that the design of the product plays in its success. For a product to be successful, it needs to have an aesthetically pleasing and visually appealing design to drive people to want the item, as well as this, the design needs to be ergonomic, look comfortable, and easy to understand. These are all factors that can be achieved through focus on aesthetic factors. The success of these factors are also related to and directly contributed to by other factors, such as material, environmental and ergonomic factors, and can also be achieved through the success of the two major factors. Overall, the success of the function and aesthetic factors prove to be the most essential for the success of this project, ensuring a product that is effective as well as having a visually appealing design.

Target Market

The target audience that this need would appeal to are mainly individual paddlers who are interested in the product for their own use, this need is also intended for larger parties such as clubs or state organisers (Dragon Boating Federation) who would desire this need for large scales uses. This would serve as the target market due to the need being specific to dragon boating, the focus of the need not to have implications in other similar sports, so it makes sense that this would be designed and marketed to dragon boaters. Due to this need being designed based off my interactions and research being based in canberra, my primary target audience are paddlers and clubs in the canberra area, this includes clubs such as the Canberra Komodos, Ice Dragons, and the CGS Dragon Boating Club, as well as the larger DBACT organisation (Dragon Boating ACT).

Exploration of the Need: Initial Research

Water Bottles In Dragon Boating

Hello and thank you for taking a look at my survey, I am a year 12 design and technology student who is currently working on my Major Design Project, but more importantly I am a dedicated dragon boater who plans on continuing the amazing sport for many years to come. As a dragon boater one of the major problems I face when paddling is my water bottle, more specifically better ways I can store my water bottle in the boat with minimal inconvenience to myself and those around me, which will be the focus of the product I will be developing for this project. By filling out this survey you will be helping me greatly in collecting research and insight from fellow paddlers who may face a similar issue and ways I can solve this problem. As a side note, all questions are optional, and a few of the questions are quite specific, so if you feel that a question doesn't relate to your own experiences, free to leave them blank. As well as this most question will have a space where you can provide detail, as more information gives me a better idea of ways I can improve quality of life in the boat, any ideas and pieces of insight are really helpful! Any and all answers are really appreciated, thanks!

jacob.sidaros@cgs.act.edu.au [Switch accounts](#)

Not shared

How many years (season) have you been doing dragon boating?

Your answer

Do you often carry a water bottle with you on the boat?

Yes

No

Other: _____

If you answered 'no' is there a particular reason why?

Your answer

If you answered 'yes' do you ever find that your water bottle is an inconvenience in the boat? if so why?

Your answer

Do you find that your water bottle offers little to no inconvenience to you in the boat? if so why?

Your answer

Do you use any equipment or items that make it easier to carry water with you on the boat? if so what are they? Did you make it yourself?

Your answer

Are there any major problems or issues you face with carrying a water bottle with you on the boat? Maybe to the point to where you don't typically carry one with you? If so please provide detail.

Your answer

Did you have any suggestions, ideas or tips on ways you could carry and store water with you on the boat that could help others who find it a problem?

Your answer

Was there anything else you would like to add?

Your answer

Submit

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Summarised Results

Responses from 63 paddlers, experience ranging from 1 to 10+ years of experience

90% of responses said they bring a water bottle with them on the boat, of those, only 2 said they don't find their water bottle as an inconvenience

Common ways people have made water bottles less of an inconvenience include the use of camel pack, bands to attach their bottle to the seat, and attaching their bottle to the side of the boat using a hanger

Issues people find when using a bottle in the boat include contamination from the lake, noise from the bottle rolling around, and bottles getting in the way of foot placement

In a solution people want to see incorporations of a pouch to carry small items such as a phone, as well as a solution that has minimal impact on the user paddling via being out of the way

Vast majority of those who completed the survey included that they would be very interested to see a refined, universal solution made and manufactured, as well as how popular and beneficial said solution would be

Overall, through my research I found that in the current situation, there are no mainstream or manufactured solutions. Through interviewing I found examples of home made solutions, but none that could work as a manufactured design that would work with any water bottle, or work with multiple people using said item in the boat. Overall I found that the market is underdeveloped, with high demand for the item but close to no other products available or in production.

1.2 Areas of Investigation

Areas to be considered & Research Plan

<u>Areas of Investigation</u>		<u>Reason Investigation is Required</u>	<u>Method of Investigation</u>
Function	Ergonomic	This needs to be investigated to ensure the product can actually be used by the target audience.	Personal testing and research of existing products and their execution.
	Durability	This needs to be investigated to ensure the product can hold up against the elements, this is crucial as the product would be used in a very harsh environment, in which it will need to hold up against heat and moisture.	Online research of different materials used in similar conditions and testing.
	Safety	This needs to be investigated to ensure the product does not harm the user, as well as safety by completing its function and preventing dehydration.	Investigating the environment the item will be used in and interviewing the target market on their thoughts and concerns.
Aesthetic	Material	This needs to be investigated to ensure and fine the best materials are being used for the environment.	Online research and experimentation.
	Colour	This needs to be investigated to look into the psychological factors behind the colour, and the best colours to be associated with the product, as well as the best colour for the environment.	Online research and interviewing/surveying.
	Logo	This needs to be investigated as I am interested in creating a logo for this product, as well as this, and it is crucial to investigate the psychological factors associated with logos.	Online research and interviewing/surveying.
Target Market	Existing solutions	This needs to be investigated to discover new and unique solutions to the problem, as well as investigating ways people have already found solutions to this problem, and drawing inspiration from these features used by others.	Interviewing those who have created their own solutions and surveying.
	Possible markets	This needs to be investigated to find possible new markets for this solution aside from my chosen target (Canberra dragon boating), as there may be a need for this solution in other markets (dragon boating in other states).	Online research and investigating Dragon Boating in other states to see the conditions they paddle in, contacting paddlers/coaches from other states.
Manufacturing	Cost	This needs to be investigated to ensure there is an efficient output for this product, to ensure it is not too expensive to produce, the cost needs to be balanced to use quality materials but not too expensive that it is unrealistic.	Finance plan and online research.
	Tools	This needs to be investigated to find the best manufacturing methods and tools to effectively make this product, as well as discovering new tools i may not be experienced with that may be more effective then the tools i am used to	Online research and investigating new tools in the school workshop through the help of teachers and staff

Limitations and parameters

One major parameter i face is the actual construction method, most of my testing would be through 3D printing models, but realistically i wouldn't be able to mass produce my final solution via 3D printing, so I will need to keep in mind that the actual production method and materials used will be different from the final product and prototypes. A limitation is my lack of knowledge with using neoprene and sewing, as this will be needed for a large part of my project, but despite this I have no prior experience with sewing, especially with a material such as neoprene.

1.3 Criteria for Evaluating Success

Criteria (Most-to-least important)	Explanation	Method of Evaluation	Evidence of success
1. Time	The project must be completed by the due date on the 24th of August at 3pm, this is the most important criteria as this is when all components of the project must be complete.	This can be evaluated by how well I am able to adhere to my time plan and have sections completed by appointed progress checks.	If the project is submitted in completion by the due date.
2. Function	Aside from formalities, this is the most important criteria for success, as my project is measured almost solely on how well it can complete its function.	This can be evaluated by testing prototypes and experimentation, making sure the first focus of a prototype is its ability to complete the function.	If by the end of the project, the final product is able to complete its given need to a high degree.
3. Ergonomic	This is important to the success of the product as this solution is focused on human interaction and use, and needs to have an easy to understand design that clearly represents its purpose and is easy to understand/use.	This can be evaluated by testing my prototypes and models by getting others to evaluate how effective they are, this will give me a good idea of how well the design works with the target audience.	If the end results have positive audience feedback and are easy to identify and use by its target market.
4. Durability	This is important to the success of the product as it will need to be durable to handle the elements as this product will be used exclusively outdoors, this is also to support the image of the product as being a long lasting, quality product.	This can be evaluated through testing the materials being used, and doing quality tests on prototypes and materials being considered to be used for the final product.	If the product is able to function in its environment, as well as being durable enough to last for 2-3 seasons of use (2-3 years).
5. Aesthetic	Although being the lowest criteria, aesthetics are still important for marketing and selling the product, although it does not directly contribute to the functional success of the product, it improves and is of value for the target audience.	This can be evaluated throughout the process by having received feedback from the target audience on how aesthetically pleasing the product is.	If the product has positive feedback from testers and members of the target audience to do with the aesthetics of the product, how eye-catching and aesthetically pleasing the product is.

1.4 Project Management: Action, time and finance plans and their application

Proposed action plan for terms 4,1,2 and 3

Term 4 2022

1. Begin Research on different topic that interest me that could be the problem for my MDP
2. Pick one topic that will be main focus
3. Select 3 best problems to choose from chosen topic
4. Select 1 from the 3 that will serve as your main problem for MDP
5. Begin initial research into topic
6. Create and release a survey that can be filled over the holidays

Holidays 2022/23

1. Create some sketches in leisure time to stimulate ideas while you're away

Term 1 2023

1. Experiment with different solutions, create more refined sketches
2. Start prototyping to introduce more ideas
3. Find your final solution that you will work towards over the next term

Term 1 holidays

1. Prepare for manufacturing, purchase any materials you may need

Term 2 2023

1. Start manufacturing of your final model
2. Experiment with different materials and techniques
3. Finish final model by the end of term

Term 2 Holidays

1. Ensure final model is complete, finish off anything that isn't already complete with the model
2. Start testing / experimenting if finished

Term 3 2023

1. Focus on portfolio and evaluating, test product and get reviews from external sources
2. Evaluate product and complete portfolio
3. Submit completed task with finished product

Proposed finance plan and budget/ Actual finance expenditure and evaluation

Product	Proposed Price	Actual Price
Waterproof zips	Provided	\$5
Neoprene	\$40	\$35
Clips	Provided	\$12.50
Logo	\$5	\$11.31
TPU filament	\$34.90	Provided
Epoxy glue	provided	\$21
Total	\$79.9	\$84.81

Despite being quite close to the proposed price, i went slightly over what I expected, this was largely due to a lot of materials being offered by the school, but when the manufacturing process went underway i discovered that a lot of the materials I needed I would need to purchase as the schools supply was very limited, regardless I still went under budget, largely due to most of the materials i needed was 3D printing filament, which the school provided in both PLA and TPU.

Application of time and finance plans - ongoing evaluation

Term 4 Week 2

I've found it quite difficult to narrow down my choices for the main problem area. I'm lost for an idea of what I should do as I don't want to do something I'll lose investment in.

Term 4 Week 4

I've narrowed it down to two areas I am invested in, sport and music, but I'm still struggling to find something I'll be invested in for the whole year this project takes place.

Term 4 Week 6

I was able to decide on a topic, being dragon boating, but i was still struggling to find a specific problem

Term 4 Week 8

I left it pretty late but I decided on my focus problem area, it shouldn't be hard to catch up as I have a lot of experience in this area and access to a lot of very knowledgeable people in the area. Overall not much happened in term 4, more time should had been spent during this beginning phase

Holidays 2022/23

I was able to create a survey and get results with the help of my coach. I received a lot of really good feedback and suggestions that will be helpful when making prototypes.

Term 1 Week 2

Returning to school things were very slow but i'm back on track with my time plan, I've created a few sketches based on the feedback i received from the survey, as well as this im doing general research into other sports that try to solve a similar issue

Term 1 Week 4

My design for the bottle holder was finished but there were delays for 3D printing

Term 1 Week 6

Not much was done this period as there were still complications with the 3D printing

Term 1 Week 8

At this point I decided to add the accessory of a neoprene pouch designed to hold your phone or any other small item due to how fast I am progressing with the project

Term 1 Week 10

I spent this time learning how to sew and constructing the neoprene pouch for my project, as well as getting the neoprene for the project,

Term 1 Holidays

Not much progress was made this holidays as I was away, I should of done something during this period as this could have really put me ahead

Term 2 Week 2

It was at this point when i returned to school that I was able to start printing to model

Term 2 Week 4& Week 6 & Week 8

This whole period was spent creating the final product

Term 2 Holidays

By the end of the holidays, I had completed the physical element of the project

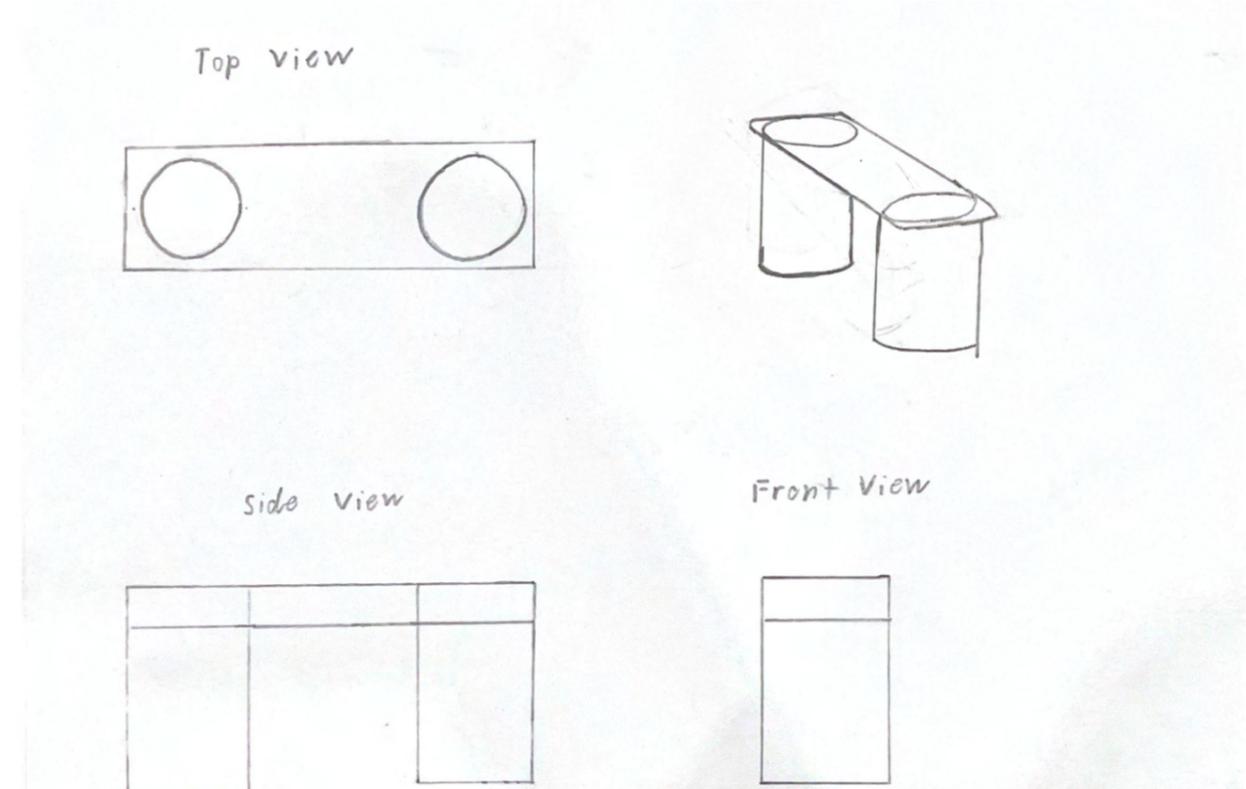
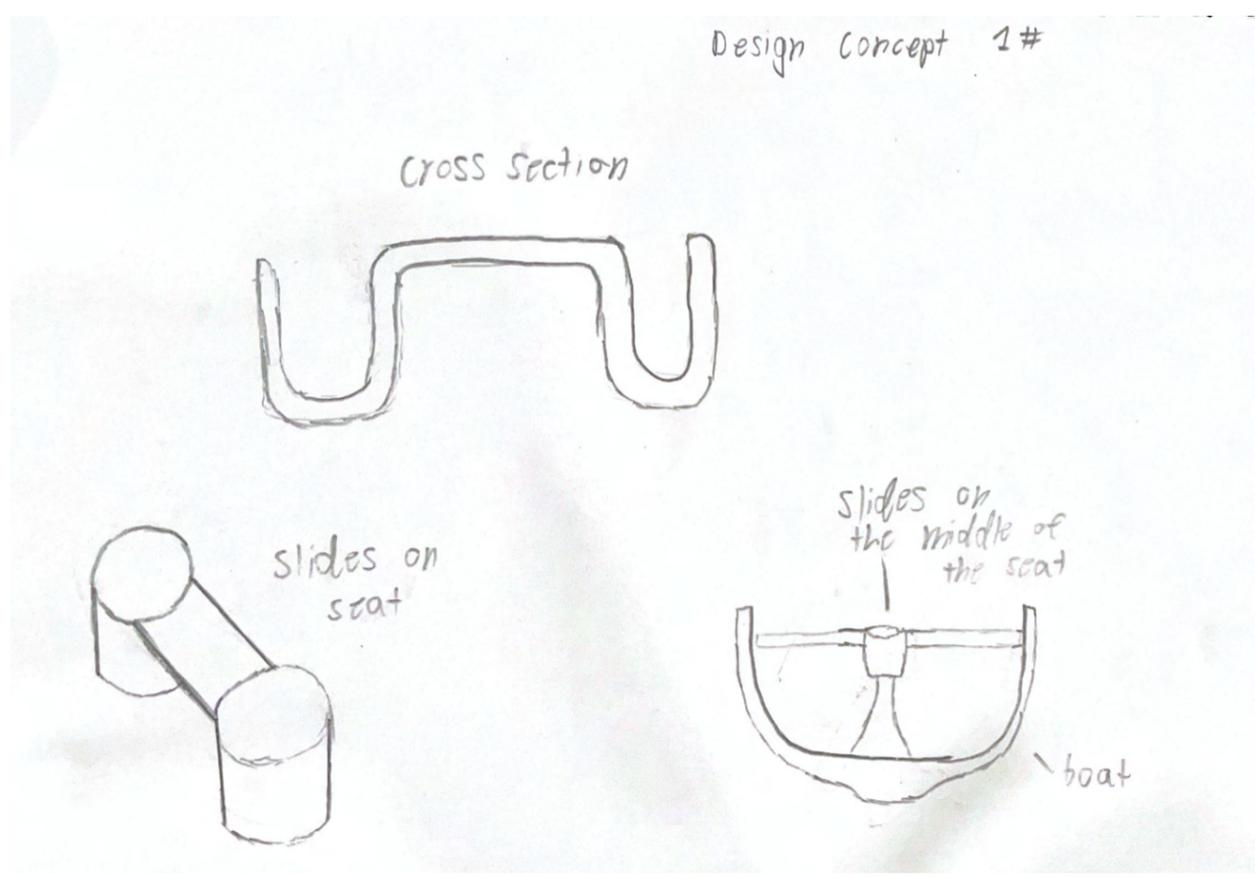
Term 3 Week 2 & Week 4

Unfortunately I was away during this period for exams and a dragon boating competition and was not able to do any work, this set me back quite a bit. This period I really should have been more focused on DT and this was were the project started to crumble for me

Term 3 Week 6 (Due date)

Due to my absence most of this term I really had to cram these last 2 weeks, I did not complete the portfolio to as high a degree as I wanted but I had it completed. This was largely due to having spent too much time on the physical model and not on the portfolio

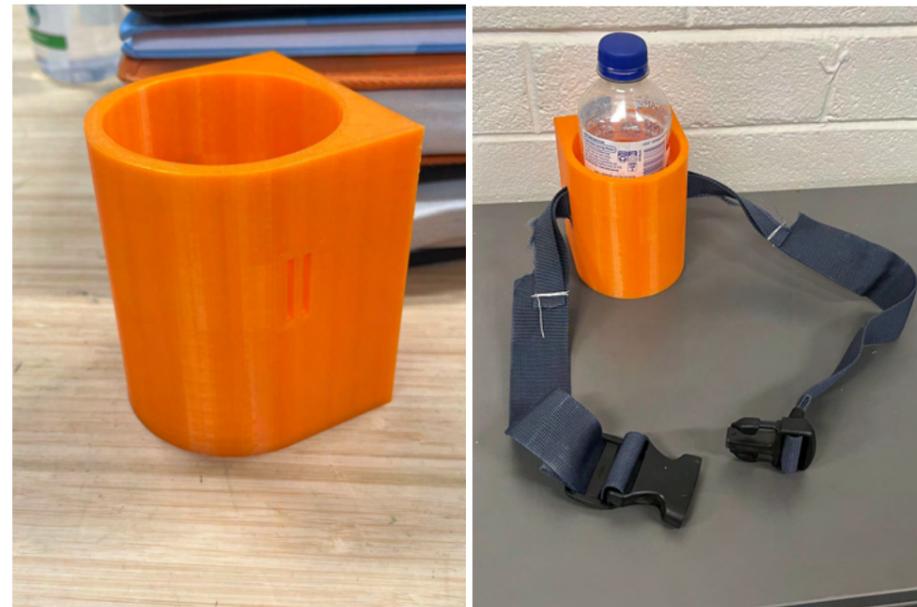
2.0 Product development and realisation



2.1 Evidence of Creativity

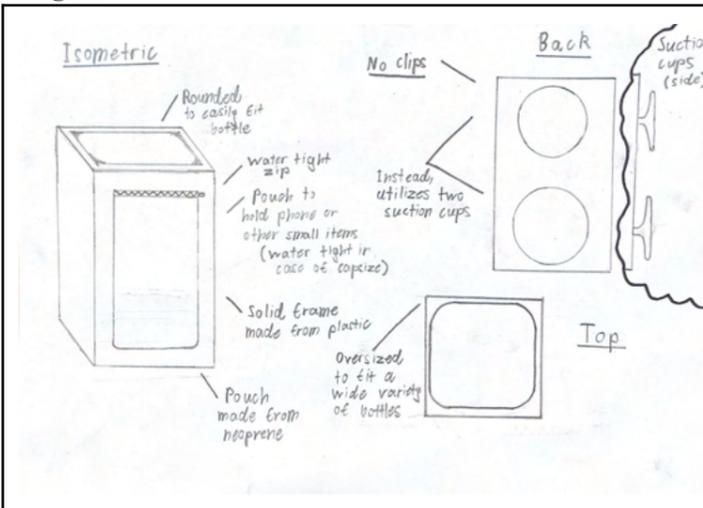
Idea generation

Design 1:



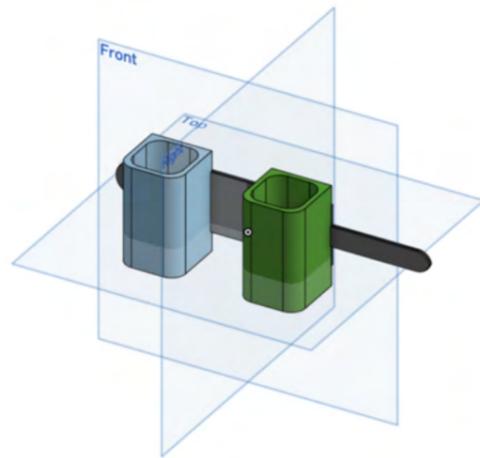
Design 1 was my first design and prototype that I was able to field test and apply in the real world to see how my solution would work. This variation of design was produced using two production processes, first, I created a 3D model on onshape. After adjusting small details and scale I was ready to send the file to be 3D printed. After this was done I was able to utilise recycled clips and attached siad clips to the prototype via sewing, being the first time I've used sewing in a prototype. Overall this design, on top of developing existing, and creating new skills. This design was also my first opportunity in which I was able to test my design for its indeed process, and through the success of this model has given me a solid, functional base model to build on. It's this base model that my next to design varieties are based on due to the success I found in this design through my testing, overall making it my most reliable model so far.

Design 2:



After the success of design 1, I wanted to look at a different approach to introduce completely new ideas to my design problem. The most significant variation design 2 being the removal of clips, replacing them with more compact suction cups that would make conceptually, attaching and removing the bottle holder from the boat a lot faster and easier. Although this introduces less reliability and the strength of the bottle holder and its ability to stay attached with the added weight of the bottle. Another point of variation introduced in design 2 is the incorporation of a neoprene, watertight pouch (opened and closed via a zip) that could be used to hold small items such as a phone, snacks, or small essentials while on the boat. Due to this pouch being mainly intended to hold a phone, it is designed to keep items inside completely dry in case the boat fills with water or capsizes, hence why it would be made from neoprene. Overall, design 2 introduces new concepts and variation to incorporate in future prototypes, specifically the incorporation of a neoprene pouch.

Design 3:



Design 3 goes back to the fundamental design of design 1, but introduces a second bottle holder as its point of variation, as well as a slightly different style of attachment, a velcro strap rather than a traditional clip. This feature would allow for both you and your bench partner to utilise the bottle holder rather than just yourself, although more efficient, this variation creates a few inefficiencies in the model, such as increasing the size of the design and making it bigger, heavier and clunkier, it would also require to attachment to the boat, the velcro strap, to be a lot stronger as it would need to carry two bottles instead of just one. As well as this the incorporation of a velcro strap also introduces a few problems as the velcro may become water damaged over time, as well as not having as much structural integrity compared to the attachments featured in the previous tow designs.

Cognitive Organiser: PMI

Design 1	Design 2	Design 3
<ul style="list-style-type: none"> ● Simple but effective ● Completes its given function ● Lacks variation apart from the main need it fulfils; lacks additional features/variation 	<ul style="list-style-type: none"> ● Similar to design 1 but utilises suction cups and a neoprene pouch ● Fulfils multiple needs, neoprene pouch can be used to carry any small items without the worry of it getting wet ● Design is very under developed in how it would work realistically due to a lack of experimentation of how the suction cups would work in holding weight, especially with the additional weight the phone pouch would add 	<ul style="list-style-type: none"> ● Features a second bottle holder so your bench partner can also use it ● Is more convenient having 2 holders in one, especially if multiple people in the boat are using them, as it saves space and materials ● Is a lot larger, heavier, and materials would need to be stronger to hold the weight; is also less compact and inconvenient to carry around

Comparative evaluation of the designs: SWOT Analysis

	Strength	Weakness	Opportunity	Threat
Design 1	<ul style="list-style-type: none"> - Is very effective in offering a solid solution for its given need that can be built upon in creating future designs and prototypes 	<ul style="list-style-type: none"> - Is very fundamental, does not offer any unique function/variation apart from fulfilling its basic function/need 	<ul style="list-style-type: none"> - Could benefit from offering more in the solution, such as utilising additional features to offer to more needs (an example of this would be the pouch in design 2) 	<ul style="list-style-type: none"> - The current materials used could be susceptible to weather and water damage and will likely need to be adjusted in future prototypes to be more durable
Design 2	<ul style="list-style-type: none"> - offers new variation and more features compared to previous 	<ul style="list-style-type: none"> - Due to the lack of prototyping for the design, there is little evidence 	<ul style="list-style-type: none"> - Could benefit from more development of the design, rather 	<ul style="list-style-type: none"> - Due to the effect water has on the strength of a suction cup, it could

	designs, fulfilling more needs	behind the effectiveness of the suction cups, neoprene pouch and overall design	than just an orthographic, making a prototype of the design may help in making its features more effective/refined through experimentation	make it more difficult to remove the bottle holder from its placement, and could easily cause the suction cups to become damaged over time through the need of excessive force.
Design 3	<ul style="list-style-type: none"> - Allows for both you and your partner to utilise a bottle holder, as well as making mass use on a boat more conventional due to having the holder attached to your bench rather than the bench in front 	<ul style="list-style-type: none"> - Would be a lot more heavier, bulkier, and require a lot more strength in the attachment as it will need to hold two bottles instead of one 	<ul style="list-style-type: none"> - Would work very effectively as a bottle holder built into the boat, or as a holder owned and used by a club for its members rather than individual use 	<ul style="list-style-type: none"> - The use of a velcro strap would heavily reduce the lifespan of the product due to the damaging effects that water has on velcro after prolonged exposure and water damage.

Chosen Idea and Justification

I have decided on Design 1 for the chosen design. This is primarily due to how effective it was during my testing and how it was able to properly fulfil my design needs with little to no problems. Once scaled up for a full sized water bottle and improving the quality and design of some select features, the design will be effective in completing its design needs. This compared to design 2 & 3, which featured many interesting variations and additional features, they conceptually were not nearly as effective at completing the original given function of the project. Through the strong fundamental bases set by design 1, I can build upon it by including additional features and functions as shown in design 2 & 3, while also having a solid base that will fulfil the primary need. An example of a further feature I want to incorporate to further elevate the projects major design is the neoprene pouch featured in design 2, I really like the additional features this added to the design, and see ways were it can be added to design 1 to further elevate its functionality without affecting its already solid basis. Overall, design 1 sets a very solid model in which I can build upon to further improve the design across the process of the MDP, while still having the original design that effectively completes my ongoing design need.

Degree of difference & Exploration of existing ideas

Existing Ideas	Similarities	Differences
	<ul style="list-style-type: none"> - This product was made via 3D printing - This design functions in a similar way, in which it is designed to be attached to the centre support under your bench, aside from the different shape and one less strap, it is designed to function in the exact same way 	<ul style="list-style-type: none"> - It uses a uniquely printed attachment as a strap, this allows for full adjustment of the tightness of strap, and is also more water resistant but is also less secure compared to the buckle straps i have used in my designs and prototypes - This product is designed to exclusively hold the users bottle it was designed after, this means it is effective in tightly holding the users bottle, but can't be used for others bottles
	<ul style="list-style-type: none"> - Solves the same issues, although being very different in design and a lot more simple - Allows the user to easily access water with little to no inconvenience, and allows the use of multiple of the same design to be used throughout the boat 	<ul style="list-style-type: none"> - This product is designed to to built as part of the bottle, rather than an item that you place your bottle into, because of this it means it is bottle specific - This bottle holder is attached to the side of the boat rather than the centre support, because of this it is more likely to get in the way of paddling, as well as being a lot less secure as it is merely being held on the side and is not properly attached to the boat - Is a lot more minimalistic and ergonomic, simple to use

Both these designs were solutions made by other paddlers I've interviewed as part of my research for this project, both offer very different solutions to the need. I don't find much in the second design due to how differently it solves the need, i can't gather much from it, as well as this, i don't find it nearly as effective because of how it can get in the way of paddling, as well as offering very little versatility and compatibility with other bottles, despite how ergonomic it is. The first design on the other hand is very similar in function to my own design, and offers a lot of beneficial features that could be incorporated into my own design in future, the main of these being the unique strapping mechanism due to its suitability for the environment as well the more ergonomic design/functionality.

2.2 Consideration of Design Factors relevant to the major design Project

• Function/ Ergonomics (ease of use/portability)

This solution has been made with functionality and ergonomics in mind, the solution would be made to optimise function and ergonomics over everything else, the bottle holder would use a very simplistic, optimised design for ease of use, in which it can simply be attached, this minimal design also ensures that the product is easy to carry, being both ergonomic and completing its function to a high degree, as well as this, the inclusion of a neoprene pouch adds extra functionality while still being simple and human in its design, in which the pouch is easily and securely connected to the front and offers the user a small, watertight pouch that can carry essentials such as a phone while removing the risk of damage in case of a capsizing.

• Life Cycle Analysis

The bottle holder has been designed to have its life cycle in mind, it would be made of lightweight but durable materials that even against the harsh environment will ensure the product lasts multiple seasons, a few years at the minimum. As well as this, although the prototype would use PLA filament plastic, the design if made on a larger scale would be made of a similar plastic, likely injection moulded. This means that at the end of the product's life cycle, it can be recycled and reused for further products.

• Sustainability

Due to this product being intended to be used outdoors in the elements, it is designed to have as minimal impact as possible, despite being made on processed materials, the product has a long enough life span and utilised materials so it is 100% recyclable. This reduces waste and ensures that, if enough of this product is in circulation, it can be fully renewable. As for the neoprene pouch, despite not being as renewable, due to the durability of the material, especially for its environment, it ensures that it can be used for a very long period of time before needing to be replaced.

• Impact on individual, society and environment

Individually, this product would improve the quality of life of paddlers, it will solve a problem that many find relevant in the sport. In a practical term, it will allow paddlers to more easily hydrate when paddling without having to worry about factors of my water bottle moving in the boat, and having to drink from a bottle that is covered in contaminated water. As for the community, it is a general consensus that the current method of carrying a water bottle in the boat is too much of an inconvenience and safety hazard, especially with the quality of lake water. This product will positively affect the community in removing those inconveniences when paddling, especially since it will allow paddlers to better keep hydrated. Generally this product will be used in an unclean environment, as the lake used in paddling is very contaminated. Generally this product should not have any negative effects through waste as it will be a reusable product with a long lifespan. Although the products will use processed materials, it will still positively affect the environment through its long lifespan.

• Finance

The solution requires a very small input and can easily be mass produced, because of this the solution would have a very small price tag, this would complement the product as most paddlers make their own solutions to these inconveniences, so by having a very affordable product it encourages paddlers to purchase the product, this is further complemented by its long lifespan and high durability.

• Physical Characteristics/Quality (Shape, size, weight, strength)

Due to the simplicity of the solution, a lot of close attention has been paid to the characteristics of the solution. The shape of the design is square, this is to ensure that the product does not roll as it will be attached against a flat surface, as well as a flat surface on all sides, this makes attaching the neoprene pouch easy and once again to prevent rolling as the pouch is intended for phones. The square design also increases the size of the inside of the holder, this increases the range of water bottle sizes that the bottle holder can carry. The solution is intended to be as light as possible to further encourage the use of the product, as it is intended to be carried a lot in and out of boats, as well as other items paddlers may need to carry with them, having as light as product as possible is only beneficial, this is to be balanced with the strength to ensure the structural integrity of the solution is maintained.

• Materials / Tools / Techniques

This solution is being made via 3D printing for the sake of this project, but if produced would be made via injection moulding plastic, this would result in a easy to make, strong and effective product that is long lasting and resistant to the elements.

• Safety

This solution is made with safety in mind, apart from being made of safe materials, one small but impactful design choice is making sure the corners and edges of this solution are rounded, this ensures that the users don't cut or scratch themselves, which can easily happen, especially since this item would be move a lot in and out of boats.

2.3 Appropriate Research and experimentation

Research – use the headings from your research plan. - Internet/Books/Products - Materials/Tools/Techniques - Production Processes

Primary research was based on the results from my survey and is referenced in part 1.

neoprene pouch

Through online research i found that neoprene was a good material to use for the phone pouch, it was through my research that i found that neoprene is a rubber like, water resilient material and is often found in wetsuits, due to the long lasting nature of neoprene, and water resistance, is why i went further to experiment with the material.

Neoprene - Chemical Safety Facts (2023). Available at:

<https://www.chemicalsafetyfacts.org/chemicals/neoprene/#:~:text=Neoprene%20is%20a%20synthetic%20rubber,solvents%20and%20water%20through%20vulcanization>. (Accessed: 23 August 2023).

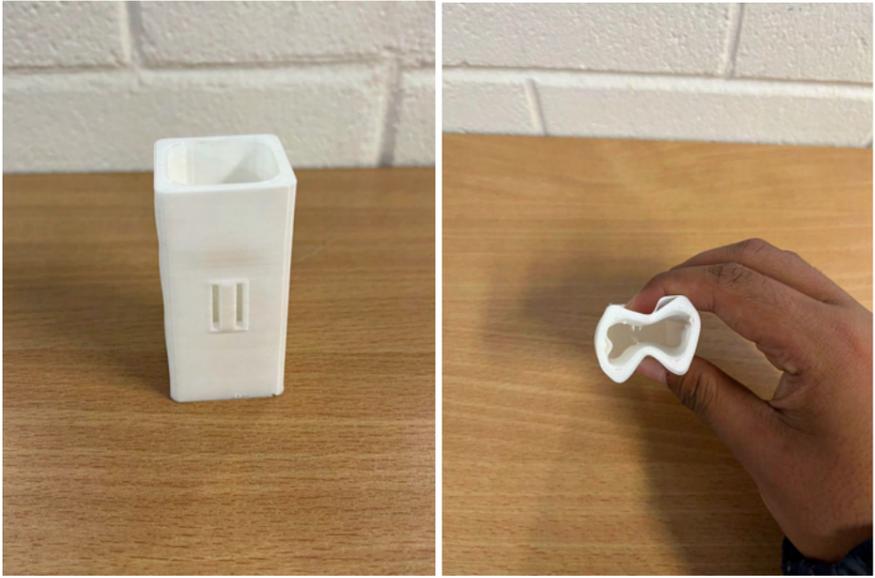
Best way to Sew thicker materials

After my research through consulting the textiles teacher at my school, I discovered the best way to sew, despite the difficulty, would be to use a sewing machine, as hand sewing will not result in a watertight pouch.

Average water bottle sizes

Through research by taking the sizes of water bottles I found through my school and dragon boating club, I found that the vast majority of water bottles vary between 60mm and 80mm in diameter. I need these statistics so I can figure out the best size to make the inside of the bottle holder so it can account for most water bottles.

Experimentation - Tools - Materials - Techniques - Testing and trialling of design solutions/ideas

<p><u>TPU Filament</u></p>	<p>One major area of my MDP was experimenting with new materials, for a large part of my research, I experimented with TPU filament when 3D printing prototypes, TPU, unlike regular PLA filament, is flexible. The use of flexible materials in the solution would better add to the ergonomic factor of the design, as it would be lighter and foldable. Due to the unknowns of TPU and limited supply, I started with a miniature model, this allowed me to see how the print would come up, it was through this that I found the main issue to do with TPU filament, durability. Because of the way the design would be layered when printing, it caused the layers to not properly connect, resulting in the outer layers of the print to come off. Through lots of test prints I could not find a solution to this issue, which forced me to make a decision to maintain the structural integrity of the solution. I decided that the best option was to return to PLA filament. Despite the loss, it was still valuable experimenting with TPU as I learnt more about 3D printing and how layering works during a print.</p>	
<p><u>Sewing Neoprene</u></p>	<p>A major skill I had to learn for the production process of this project was learning how to sew and use a sewing machine for the production of the neoprene pouch, this also resulting in the experimentation with neoprene as a sewing material. This came with a lot of skills, such as learning how to set up and use a sewing machine, how to sew with thicker materials, how to hand sew and sew buttons, and how to sew buttons. All together I gained the most in this project through sewing. Through experimenting with neoprene i found that, despite its thickness and difficulty to sew, it was the best material for the pouch, once it was completed I tested the material by completely soaking it in water, which is unlikely to happen when paddling, while there was a piece of paper, inside. After the experiment the paper came out completely dry, showing that the neoprene was perfect in completing its function, while also being a lightweight and durable material, it is the best option for this project.</p>	

<p>3D Printing Clips</p>	<p>Another chance I took to improve my own skills was attempting to design my own clips for the solution, despite deciding to buy them in the end, it was still a valuable learning experience in which I was able to extend my knowledge on how 3D printing connecting parts works.</p>	
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2.4 Application of Conclusions Materials, Tools, Techniques, Testing

Through my research and experimentation I came to the following conclusions. Neoprene was the best material to use for the pouch and interlining of the bottle holder, but would require the use of a stronger sew due to the thickness of the material, this will be done via a sewing machine. I also decided it was best to return to PLA for the construction of the main base, despite its solid structure compared to the TPU filament, it's a lot more structurally sound, and is very similar in weight so won't be too much of a drawback. I also found that to best account for most water bottles, the inside of the bottle holder would need to be 90mm.

2.5 Identification and justification of ideas and resources - Ideas - Resources

Resources	Identification and Justification
People	<p>Teachers - Ms sutherland who was my teacher throughout the process and crucial to my success as being a guiding force throughout the process</p> <p>Coach - Tomas Wicks, who helped me buy sharing his experience in the sport, helping in getting people to respond to my survey, and reviewing my solution when it was finally complete</p> <p>Survey respondents - for contributing to my research by responding to my survey and sharing their experience as paddlers</p>

Materials	<p>Neoprene - water resistance and strength, as well as being an effective inside lining for noise suppression.</p> <p>PLA filament - strong representation of plastic, as well as being comparable with 3D printing</p> <p>epoxy Glue - strong binding capability</p> <p>Straps / clips - supplementary way of attaching the bottle holder to its desired location</p>
Tools	<p>3D printer - catalyst to make the main component of my design solution</p> <p>Computer (Macbook) - main tool in creating portfolio, 3D modelling, collecting survey responses, and online research</p> <p>Sewing machine / kit / thread - catalyst to create neoprene pouch and attach straps to the main bottle holder</p> <p>Soldering Iron - used to burin strap ends so they don't flake</p>
Techniques	<p>Sketching - initial production step to express ideas</p> <p>3D Modelling - allows user to get a 3D perspective of a prototype, as well as being the precursor to 3D printing a prototype</p> <p>Sewing - technique to bind neoprene pouch together</p>
Software	<p>Onshape - software used to 3D model and export models to be 3D printed</p> <p>Google Docs - software used to create portfolio and receive feedback from teachers</p>

2.6 Use of Communication and Presentation Techniques Suggested sections: idea generation, journal, folio, practical, presentation for examiners

Font

For this folio I have decided to use size 12 times new roman, not only because i like the look of this font but also because it is what was listed on the nesa requirements, additionally i think this font suits the theme of the document, A3 landscape.

Headings

To make headings clearer I used size 20 for main headings as presented on the table of content and size 15 for subheadings.

Theme

I've decided to not use a theme for this portfolio as I believe it makes the screen more cluttered and difficult to read compared to the simple black and white.

Format

I've decided to use A3 landscape as it allows for more space to make images larger and makes everything more spread out and easier to read.

Markers Consideration

I've made my document so that it is easier for the marker, it uses the correct headings and follows the same order as presented by the marking rubric so that it is easier to follow.

Prototype

My prototype is presented at full scale as it is a small project to begin with, this demonstrates to full practicality and functionality of the prototype as presented and tested by myself and others.

Component / Model Display

As well as my final product I will also be displaying my previous prototypes and other pieces that were part of the experimentation process to give the marker the full caliber of my progress throughout this project.

Evaluation

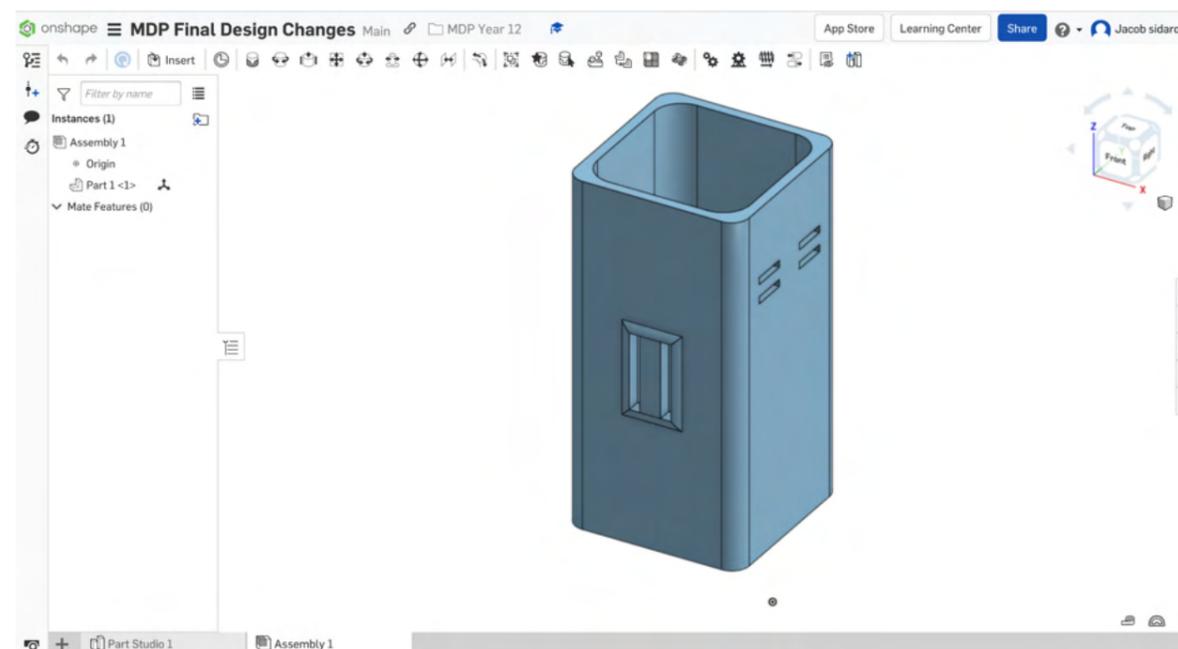
Overally, I believe I have set out this portfolio and physical components / model to best suit the needs of the marker to make the process as easy and efficient as possible.

2.7 Evidence and application of practical skills to produce a quality product

Detailed record of MDP manufacturing/production process showing each step or stage

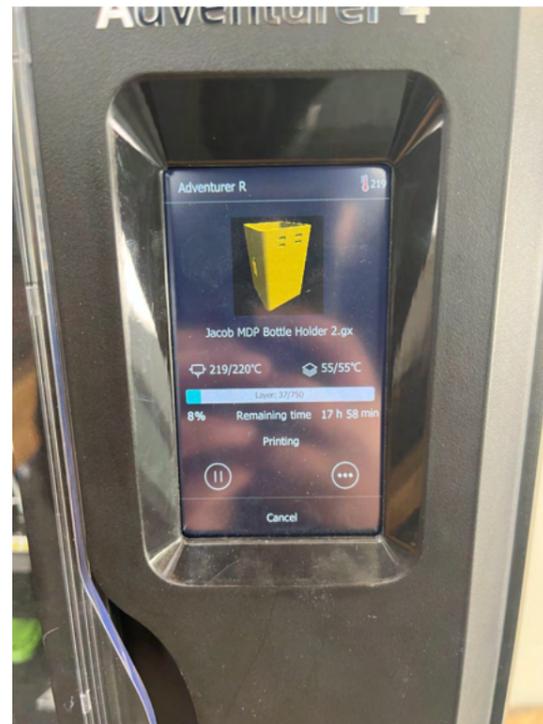
Step 1: 1 hour

Process: The first step of the manufacturing process of the final design was creating the final 3D model that i would be send to be printed, at first this was a problem, as i struggled to get the dimensions right, at first the file was way too big and needed to be split into 3 section, but after experimentation with bottle sizes i decided to instead shrink the model slightly, this reduced the print time from 50 hours to 14.



Step 2: 17 hours

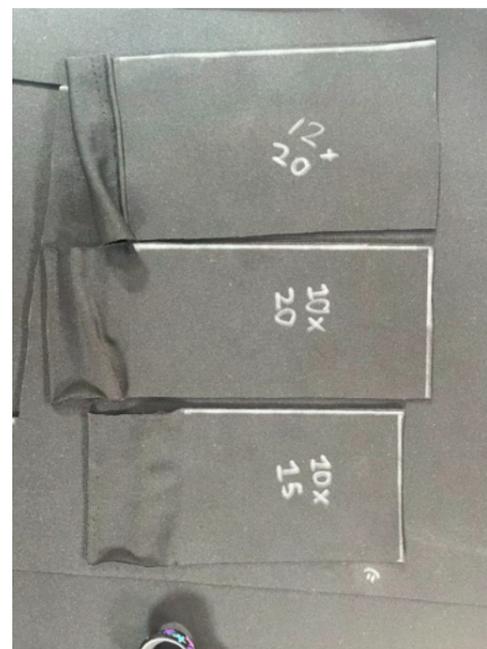
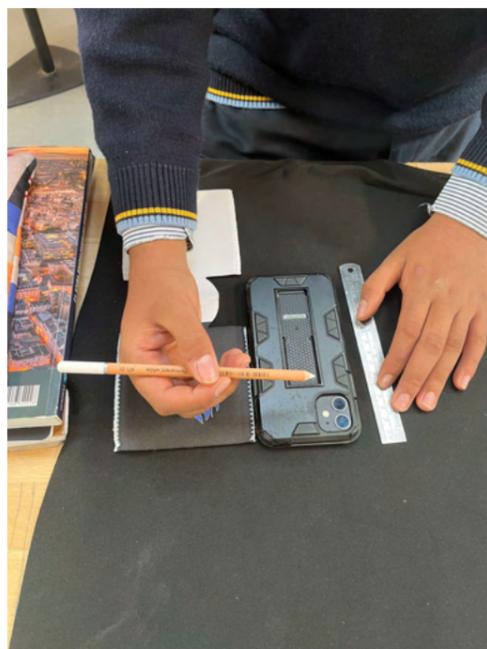
Process: Now it was time for the actual 3D print, this took roughly 17 hours and took place over night, while I was waiting for the print to complete it gave me time to start construction the neoprene pouch



Step 3: 30 minutes

Process: While the print was taking place I cut out the neoprene for the pouch, having used my phone as the basis of measurement as it is designed to carry a phone. To begin with there were 3 different measurements cut out, I went with the smallest so it could sit comfortably on the front of the bottle holder without much overhang.

Evaluation: It was definitely beneficial using the smallest cut, although it's a bit smaller and can't carry more than a few items, it sits much more comparable on the holder



Step 4: 20 minutes

Process: This step involved sewing on the base of the neoprene pouch together, this was the steepest learning curve during the production, and required a lot of test runs before I could do the final one.

Evaluation: Going back, I should have attached the logo before sewing the pouch together, as sewing the pouch prevented me from being able to attach the logo, meaning it had to be glued on instead.



Step 5: 1 hour

Process: This step involved attaching the zip, unfortunately due to the thickness of both the neoprene and zip it was too difficult to put through a sewing machine, so instead the zip was sewn by hand. This was a lot more painstaking and time consuming but came out fine in the end

Evaluation: After testing, this had no negative impact on the structural integrity of the pouch, even when drenched, no water seeped in.



Step 6: 30 minutes

Process: Here I attached the buttons by hand, once again it came out fine but was a lot more time consuming than just using a machine.

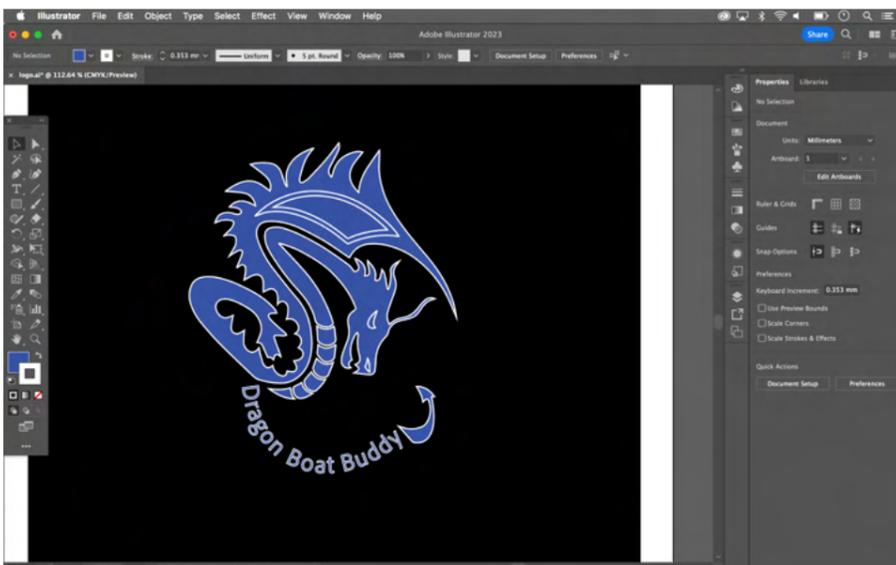
Evaluation: going back i would have used a machine instead, as the buttons were being used more they started to get loose and required further maintenance.



Step 7: 2 hours

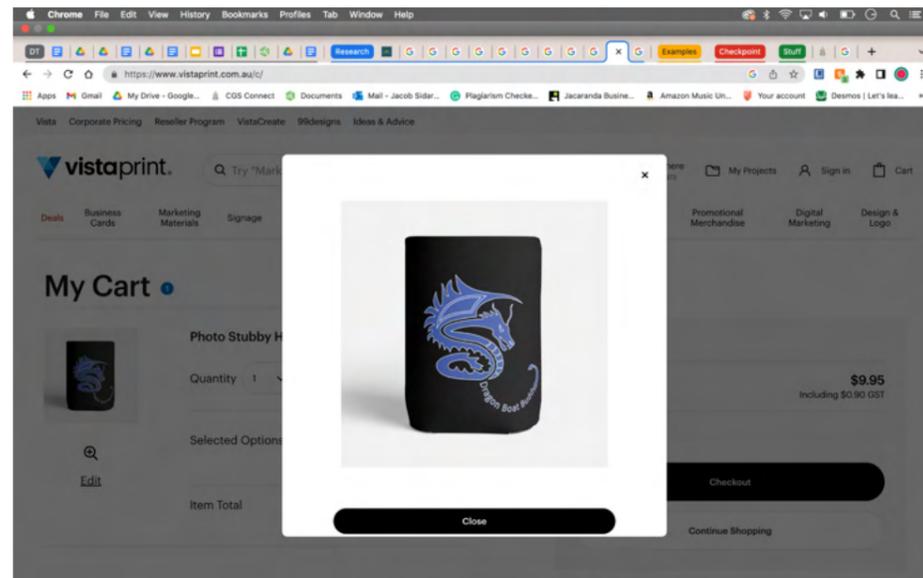
Process: Now that the pouch was done, it was time to design and order the logo for the product, i used the standard dragon boating template, but modified the tail to resemble the name of the product. After going through multiple designs I found one that I believe suited the solution the best.

Evaluation: The logo was somewhat popular among testers, but they found the text was too small on the tail and was too contorted to be readable. It went through many prototypes before landing on the final design.



Step 8: 14 days (delivery)

Process: Now that the logo was completed it was time to print it, I did this by ordering from a store I found locally that can print your custom designs, so I got mine printed on a stubby cooler as they are made of neoprene, once it arrived I cut it out, ready to be pasted onto the neoprene pouch.



Step 9: 10 minutes

Process: Now it was time to add finishing touches and add the logo to the neoprene pouch via epoxy glue that showed to connect the two quite well.

Evaluation: Unfortunately the logo was lost when the product was being tested, showing that the glued neoprene was not nearly as strong enough and the logo should have been sewn on beforehand.



Step 10: 5 minutes

Process: Now that the print was finished, it was time to sand any extra filament from the base.

Evaluation: Unfortunately this has left many scratches on the base of the bottle holder, this is likely because the sand paper was not fine enough



Step 11: 10 minutes

Process: I attached the straps to the base by looping it around the slots designed on the side of the holder, and then sewing it together.

Evaluation: This had to be re done 2 or 3 times due to sizing problems, as the surface this would be attached to had different sizes from the top and bottom.



Step 12: 5 minutes

Process: Now that the straps were attached, I used a soldering iron to burn the loose edges of the straps so they don't fray.

Evaluation: Similarly to the previous step, this had to be re done 2 or 3 times due to sizing complications.



Step 13: 30 minutes

Process: The final step of the production process was using extra neoprene to the inside of the holder. This was a last minute decision after I received feedback that smaller bottles made lots of noise on the inside, this neoprene padding should prevent sound from the bottle hitting the sides.

Evaluation: after implementing this feature, I received positive feedback from testers saying this greatly reduced the noise.



Production planning

Tool	Hazard	Possible injury	Risk (1-5)	Controls
Sewing Machine	Needle	Needle piercing fingers	4	Keep hand a out of the path of the needle, teacher or adult supervision when being used
3D Printer	Hot Extruder Tip Fumes	Burns	2	Wait for the print to cool down before removal, get a supervising teacher to remove the print for you
Epoxy Glue	Contact with skin Fumes	Damaged lungs Skin contact	3	wear gloves to protect hands and wear mask to prevent inhaling fumes
Soldering Iron	Hot Tip Fumes	Burns Damaged lungs	3	Adult supervision when in use, wear protective gear such as masks to stop fumes

3.0 Evaluation



3.1 Record and application of evaluation procedures throughout the design project. Term 4 Term 1 Term 2 Term 3

Project proposal and management

I found this initial part of the portfolio to be the hardest, when I first started I really struggled to find a problem that I was interested in, but when I eventually found my problem focus through mind mapping and swot analyses, it was a much smoother ride from there, although I was already behind due to how long it took me to find my problem area, but from there I was able to catch up, hence why I was able to be back on track come term 1. Through all the extra work I did in the holidays and surveying, I was ready to start manufacturing my final model a lot earlier than I expected, largely due to the simplicity of my design, but also because of the resources I had on hand that made collecting research and survey responses for dragon boating a breeze, this was also helpful later on when I needed my product to be tested.

Product development and realisation

The development of my final product was very smooth, hence why I added the neoprene pouch as I had already had my final model completed part way through term 2. Despite my success with the physical model, I would say my biggest struggle was my portfolio, also I found it difficult to complete each section due to a lack of structure, this resulted in me having to crunch the 2 weeks before the due date to finish my portfolio, with the help of a structure it made it a lot easier, but I would say the coherence of my portfolio was definitely my weakest area throughout this project.

3.2 Analysis and evaluation of functional and aesthetic aspects of design

Functional analysis

Functionality

Overall, I think the product completes the function to a high degree. It's a simple problem to solve, but it does it well. Through testing some people found their bottle was too big but this was a rare case. As for the pouch many people found it as a very positive addition that had little to no drawbacks apart from being a bit difficult to unzip at times, but overall the functionality works really well, the only problem I found was the fact that it would be more effective as a drink holder, similar to my previous designs, although I do agree, I think this model is better suited for individual use.

Ergonomics

The design is very simple, and hence people found no problems or difficulty using it with or without the neoprene pouch, some people found that the design was a bit clunky and the pouch a bit out of place due to the size difference, but this feedback was mostly expected. Overall the product was simple to use and understand. Another problem I find is the slots to insert the pouch are a bit too small, making it difficult to feed the buttons through sometimes.

Quality / Durability

The product is made of medium to low quality materials, despite this the product is quite durable, so far, through rigorous testing and multiple people using it for testing, it has not faltered, the only parts that have sustained some damage are the buttons on the neoprene pouch due to my poor manufacturing. The only problem I found was due to there being no padding on the back, it sometimes scrapes against the centre support, especially when it is rough waters, this doesn't pose too much of a problem but can be damaging to both the boat and product. Overall, this product showed that it can definitely hold up against the harsh environment it is intended for.

Target Market

This model would be very available to the target market, and at a cheap cost due to the low input cost, this is beneficial to the target market as it makes the product more accessible for such a large community. Although this can also be damaging as it could give off the impression that the product is cheap. Despite this, due to the overwhelmingly positive feedback I have received, I'd say this model is very suitable for its target markets.

Aesthetic analysis

The aesthetics weren't a main focus for this project due to its main problem being function based, despite this i found despite the simple design of the model, it was well favoured among testers, as well as this people like the sleek design of the neoprene pouch, despite this, although appreciating the work i put in creating a logo, many people found that it was too small and slanted to be readable, and looked very "smooshed". In future I would make the logo a lot simpler, likely making my own rather than using the standard dragon boating one, as well as using abbreviated letters to represent the name rather than the full word. Overall the aesthetic of the design despite not being a focus was well favoured and in future id likely make more models with more colours to add variety and flare.

3.3 Final evaluation with respect to the project’s impact on the individual, society and the environment.

<u>Individual</u>	<u>Social</u>	<u>Environment</u>
<p>This product will benefit individual paddlers by creating a more convenient way to access water while paddling and greatly reduce the dangers of cross contamination with late water. It's a niche need, but it is a much needed quality of life product to make dragon boating a more enjoyable sport, giving paddlers one less thing to worry about when they want to refine their technique and have fun. The Bottle holder also offers a way safely carry your phone in the boat without risk of it being lost, not only will this be beneficial to older members of the sport who like to take photos on an early morning paddle, but is laos beneficial for coaching purposes, as they often need their phone on water for timekeeping. Overall, this product offers a lot to the individual.</p>	<p>Unfortunately, this product does not have as much of an impact for the wider community outside of dragon boating, especially as this product is designed specifically for dragon boating and won't have any use in other sports. Despite this it does have a positive impact on the dragon boating society for the previously mentioned reasons, as well as being an item that clubs are buying for their team members, especially due to the simplicity of the product, i intend that it could be customisable with custom jobs for larger requests, it could be an item that clubs have to further present their logo and team.</p>	<p>As for the impact on environment, this product , despite not being made of natural resources, is intended to have a long life cycle to minimise damage to the environment, as well as this it is designed to be easily renewed at the end of its life cycle to that it can go towards other similar product, further reducing its environmental impact. It also lacks any materials that are harmful to the environment. Overall, doing its best at having as little negative impact as possible.</p>

3.4 Relationship of the final product, system or environment to the project proposal

Restatement of Design Proposal

For my major project I plan to design and create a water bottle holder that is designed to hold a variety of water bottles with different sizes and shapes, through my research I have found that despite many people finding or creating their own makeshift solution to this problem, there is no mainstream, universal solution to this problem, as well as a solution that does not hinder the paddling ability of the user or others. Hence I have identified a need for this solution. Through my experience in prototyping, sketching and 3D modelling, as well as experience in Dragon Boating and knowledge of how a boat functions, I plan to create a bottle holder that adequately holds a bottle without getting in the way of the user or other athletes paddling.

Final Evaluation

I believe I achieved my goals for this project, as well as going above my originally set targets. I was able to create a product that is able to hold a wide variety of water bottles to benefit paddlers in a variety of ways, by creating a mainstream solution to a common problem found in dragon boating, as well as being able to create an extra accessory that further benefits paddlers with phone protection and storage. Overall making this a successful design project. If I were to move forward with this project. I would likely test the limits of this product by making one that is injection moulded, as it is intended to be, and if that were to come out as successful as this one is likely go forward with a patent for the product to start producing them, especially with all the positive feedback and support I received from the dragon boating community. Overall this project has come out very positively. The main problem area I saw with this project was its simplicity, in future I would solve this by adding extra utility to the design so its not as simple, like what I've done with the neoprene pouch, but to a higher degree. In future I would also try to keep more on top of my portfolio instead of focusing all my energy on the physical model.

Professional Evaluation

9 August 2023

A common issue in dragon boating is managing hydration on the boat while also minimising the impact on paddlers, sweeps and drummers during training. Currently dragon boaters take their water bottles into the boat and need to adjust their foot position to allow for the water bottle to sit on the bottom. The key issues with this from a performance perspective are that paddlers are sometimes required to adopt suboptimal foot position to be able to leg drive effectively, and bottles can move during paddling which can negatively impact them in small ways such as just being loud and annoying but also bumping into feet - having the feeling of a stubbed toe mid-set is definitely not fun.

The water bottle holder is a simple and elegant solution to most issues associated with bringing water bottles into the boat by raising the water bottles off the floor of the boat and securing them in place. Using the holder is immediately more convenient than the previous 'make-do' of bringing a water bottle on the boat. For those paddlers who train on bodies of water where the water is not exactly 'hygienic' this also has the added benefit of minimising the likelihood of any lake water finding its way into the bottle.

In its current state it is definitely helpful but would also benefit from some refinements. The size is only sufficient for one small water bottle so, dragon boating being a sport where two people sit side-by-side in each bench, only supports half of the water bottles in the boat. Replacing the hard plastic casing with something softer and lighter (but still rigid) would also be preferable to make sure no damage is caused to the boat and make less noise. Adapting them to allow for synergy with other items such as a speaker system ("cox-vox"s) would also be quite useful. It is worth noting the current prototype works very well for paddlers but sweeps and drummers would need an alternative solution for their position in a boat to secure their water bottle.

If affordable and easy to store I can see clubs buying these in bulk, especially those clubs that own their own boats, or state bodies to support their dragon boaters.

Tom Wicks

Australian 24U Dragon Boating Coach and ACT Premier Head Coach