Cambridge International AS & A Level Design & Technology 9705

Component 2: Project 1

General comments

The presentation of the design process in A3 format is shown quite clearly although it is suggested that the Design Brief would be more effective if placed at the beginning of the folder.

Criterion	Comments	Mark
Identification of a need or opportunity leading to a Design Brief [3]	A drawing and photographs help to clearly describe the design need, including the situation and users. The candidate has decided to state the Design Brief later on page 22, but it must still be taken into account as part of this criterion.	3
Analysis of and research into the Design Brief which results in a Specification [7]	Several existing products are described in detail, with the evaluation of each being combined on the following pages. The research of anthropometrics and ergonomics is considered in detail with very clear and helpful illustrations. The results of the questionnaire have been used to create the Specification. More information on items to be held in the unit could have been provided.	6
Generation and appraisal of design ideas [16]	Details of a range of design ideas are provided with a straightforward description of each. The appraisal and evaluation of these ideas is then shown through the identification of advantages and disadvantages of each in tabular form. Some development of the chosen idea is then provided.	14
Modelling of ideas [14]	A wide range of modelling methods is shown including a computer model and full-sized models in resistant materials. The placing and use of the unit is also modelled quite effectively. Practical modelling techniques are, however, somewhat limited.	11
Total [40]		34

Design and Technology

Storage Unit For School Sports Hall

Candidate name:
Candidate number:
Centre number:

Syllabus code: 9705 **Component:** 02
Syllabus name:
Oct/Nov 2019

Index

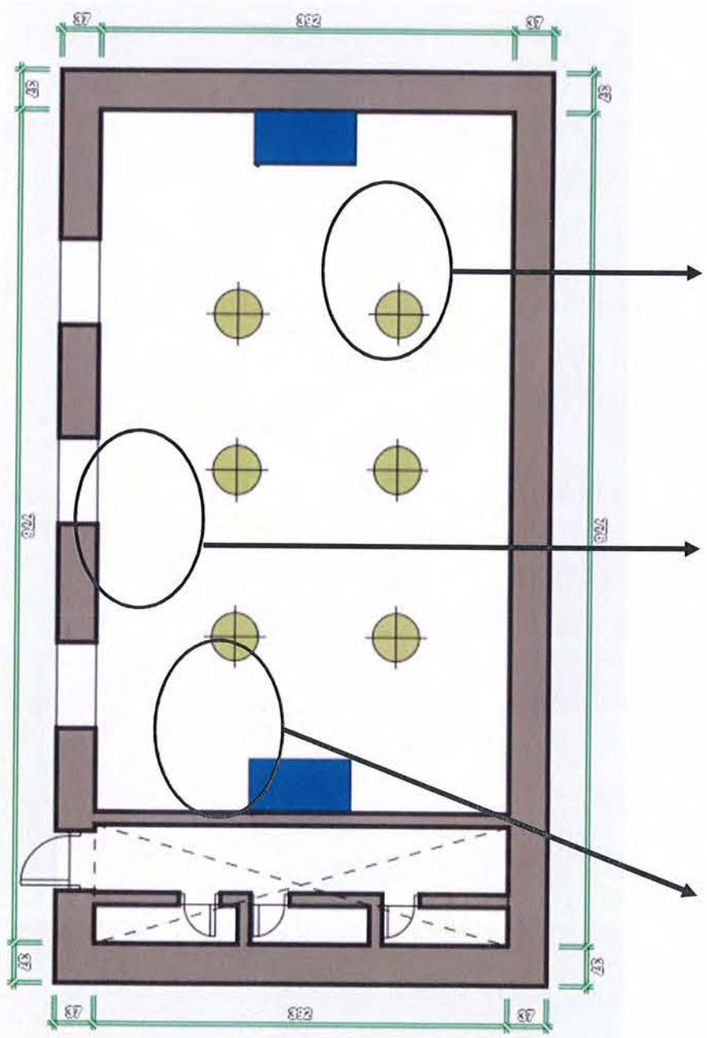
Situation:
Background Context & Setting

When we have **break times** the whole school community uses both the **patios** and our **multipurpose hall**. In order not to spoil the wooden floors, pupils must either play with tennis shoes (change shoes) or in their socks.

This leads to **generalized chaos** when the bell rings back for lessons. **Jumpers** and **shoes** are amalgamated together & **mixed** or **lost**.

Organization is a **vital tool** for our student life. Besides organization in our academic/ study life, we should also strive for organization in the other areas of our school life.

Building a storage unit to be placed inside the hall will give the chance for students to be able to **place their stuff somewhere safe**. My plan is to find a **solution** that will store the students shoes, their jumpers and also fleeces in a **single artefact.**



Floor plan of the sports hall

Fig 1.

Fig 2.

Fig 3.

Research and Analysis:
Existing Products I and II

Existing product I:

Description: Buolo wooden coat rack is multi-functional corner garment rack that has enough storage space to meet various demands. This coat rack can bear much heavier load and more durable while being used.

Use: Total 2-tier of shelves to store folded clothes ,accessories, quilt, storage boxes ,shoes etc.

Dimensions: (not identified)

Material: Made from wood

Price: (not identified)

Existing product II:

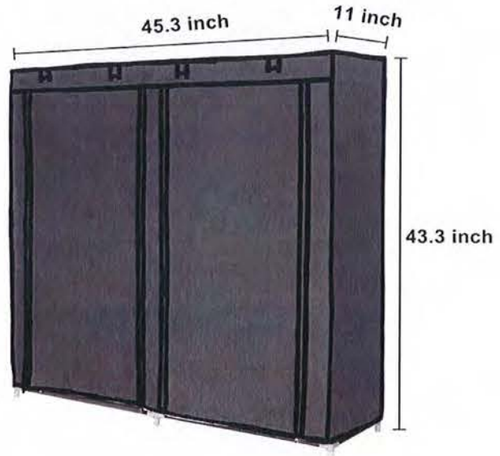
Description: Blissing shoe rack, is a storage organizer cabinet that is mostly used to store shoes but, it can also keep clothes, toys and much more. It has a fabric "door" that protect the belongings inside so they are not always showing all the time. It consists mostly of shelves.

Use: The unit provides generous storage space to neatly arrange clothes, toys, shoes and more, can suit storage needs in various settings

Dimensions: L115 x H109 x W27

Material: Constructed from water-proof durable fabric shelving, steel tubes and strong plastics connectors

Price: 27,65 €



Research and Analysis:
Existing Products III and IV

Existing product III:

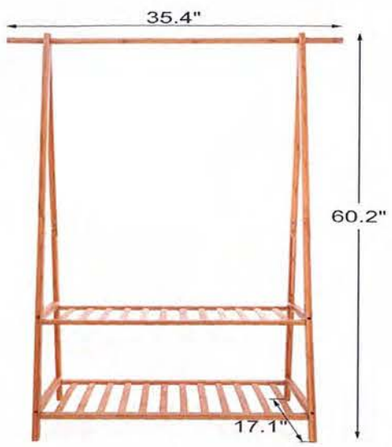
Description: Finnhomy clothes rack is a portable extra large garment rack that is eco-friendly. It's a perfect choice to organize your entryway, bed room, or front door. A shape - fashion and simplicity design and there's no wheels so it's more efficient and the main pole is lengthened instead of the hooks, makes the rack looks more elegant and holds more.

Use: The artefact can be used as a shoe, clothes, coats, handbag and hats keeper.

Dimensions: 152 x 69.5 x 42.5 cm

Material: Made out of high quality natural bamboo. The wood is strengthened with steel in some parts.

Price: 42.82 €



Existing product IV:

Description: The slat wood wardrobe by Whitmor offers a wide space for storage of clothes such as long or short garments due to the metal hanging bar. It is easy to assembler and offers a nice aesthetic.

Use: It can be used to place clothes, shoes and accessories.

Dimensions: 2.125L x 44W x 68H

Material: Solid wood wardrobe, 5 shelves in a natural lacquered finish and metal hanging bar.

Price: 61,28 €

Research and Analysis:
Existing Products V and VI

Existing product V:

Description: IRIS metal garment rack is a convenient clothing storage that has an angled frame that keeps clothes from hitting the wall and provides a sturdy base. The weight tolerance is 22lbs.

Use: Both artefacts are an easy solution to clothing storage in small spaces. Wooden shelves on bottom and side of the clothes rack are for storing shoes, accessories, and more.

Dimensions: 64W x 38.5 D x 154.5 H /101L x 40 W x 151 H cm

Material: Both functional objects are made of wood and metal

Price: 61,27 € /67,19 €

Existing product VI:

Description: Singaye clothes rack has an unique tree stand coat hanger design, this is great ideal for entrance, living room, bedroom, balcony, home office etc..4 caster wheels, 2 of them come with brakes, easy to move. Work normally without the wheels if no need of move .

Use: 7 side round-headed hooks for hanging clothes, jacket, umbrellas, hats, scarves, and handbags, 1 bottom shelf for storage your shoes or boxes.

Dimensions: 171 x 85 x 44 cm

Material: Made from anti-rust carbon steel

Price: 39,97€

Research and Analysis:
Evaluation of Existing Products

Existing product I: 	**Advantages:** • Transportable • Does not occupy much space (corner-like structure) • It is made of a hardwood so its properties are stronger	**Disadvantages:** • Does not have much storage space • It looks somewhat unstable due to the thin wood rods • With aging, the material will get weaker
Existing product II: 	**Advantages:** • Big storage space • It is very spacious inside meaning any type of shoes will fit (boots included) • As it is made of fabric, it makes the space look comfortable	**Disadvantages:** • Can only store shoes (no hangers) • The artifact is quite big so it will be hard to place it in small areas • As the fabric in the exterior is not dense, it can easily fall apart or tear if an accident happens
Existing product III: 	**Advantages:** • Eco-friendly • More stable due to the cancelled wheel • Aesthetically pleasing	**Disadvantages:** • Not a very strong structure • It looks appropriate for a bedroom but not for a sports hall • Not quite spacious, meaning that it is suitable for 1 person to use not a whole school

Research and Analysis:
Evaluation of Existing Products

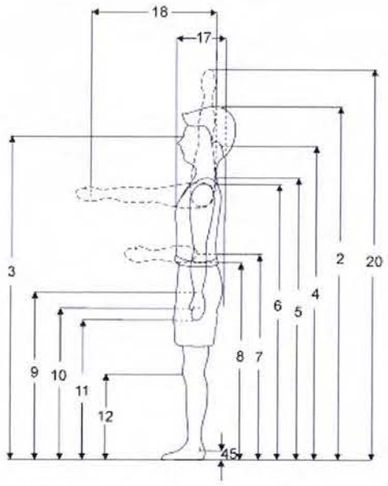
Existing product IV: 	**Advantages:** • Can store any type of clothes, any coat length, any shoes etc.. • The shelves on the side can be used to hold water bottles (as in my situation for the sports hall) • It looks pleasing and well achieved	**Disadvantages:** • The artifact is quite spacious, meaning it will take up a lot of room space • It is not that cheap even though it is made from pinewood • Small space available to store bags
Existing product V: 	**Advantages:** • Has pins to hang bags and hats • The hangers can be secured together if more needed, can only be 1 or 2, as much as needed • It looks functional	**Disadvantages:** • The pricing for this product is quite expensive probably due to the material and size • It is not easy to replicate • The clothes are not protected from the exterior, so there's a chance the clothes could get ruined
Existing product VI: 	**Advantages:** • Transportable due to the wheels • Has a hanger for bags • It is made of anti rust carbon steel so it is quite durable, won´t get spoiled easily	**Disadvantages:** • There isn´t much place of storage for shoes, can maybe hold up to 4 pairs • There's only 2 wheels with brakes so it has a probability that it can still move when the artifact is stationary • Not suitable for a sports hall

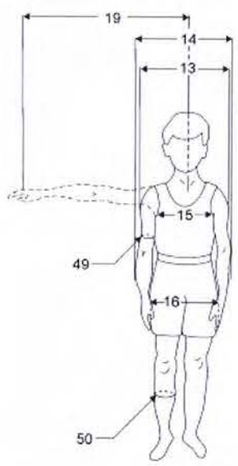
Research and Analysis:
Anthropometric and Ergonomics

In order for me to produce the artifact, I needed to research some **major dimensions** so that I can have an idea of the size the storage unit will have. **Anthropometric** and **ergonomic data** helped me a lot.

Anthropometric is the study of the human form in relation to size movement and strength.
It also can relate to distance, length, height, weight, and angles of reach and/or vision.

I researched the dimensions of my **target group** which are people aged from **5 to 18 and adults**. (primary to high school and teachers)





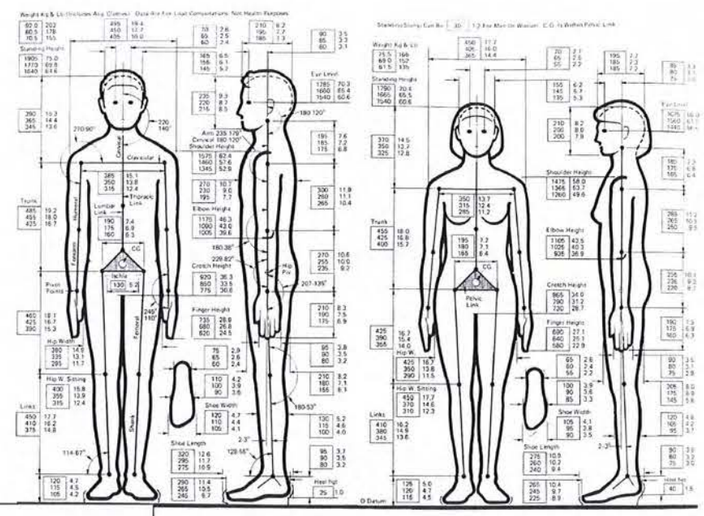
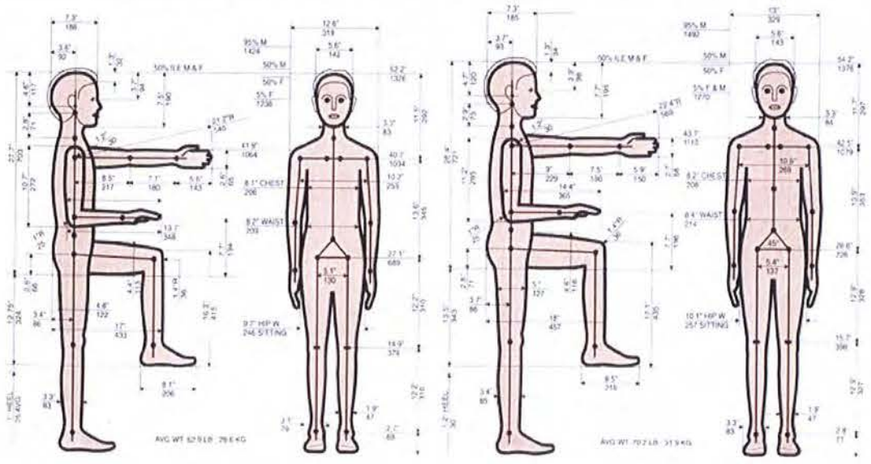


Fig 7.
Anthropometric data of an **average adult**

Fig 8.
Anthropometric data of a **primary school child**



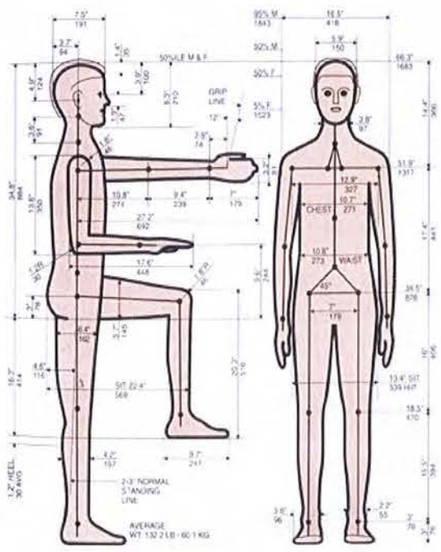


Fig 9.
Anthropometric data of **9, 10 and 17 year olds**

Research and Analysis:
Anthropometric and Ergonomics

Ergonomic is the study of human interactions with objects and environments.
It is based on scientific study and involves many different disciplines such as anatomy, physiology, mathematics and engineering. It even involves elements of psychology to attempt measuring physical and emotional connections to the physical world: including the touch, aesthetics, sound, light and smell.

As I am producing a type of shoe rack for the sports hall, I had to check the **depth** the artifact needs to have in order to fit any **foot size**, I needed to check the dimensions of someone **bending down** to reach the bottom part of the artifact and I also had to know the dimensions of an average sized **hanger**, as my rack will have a clothes hanger incorporated.

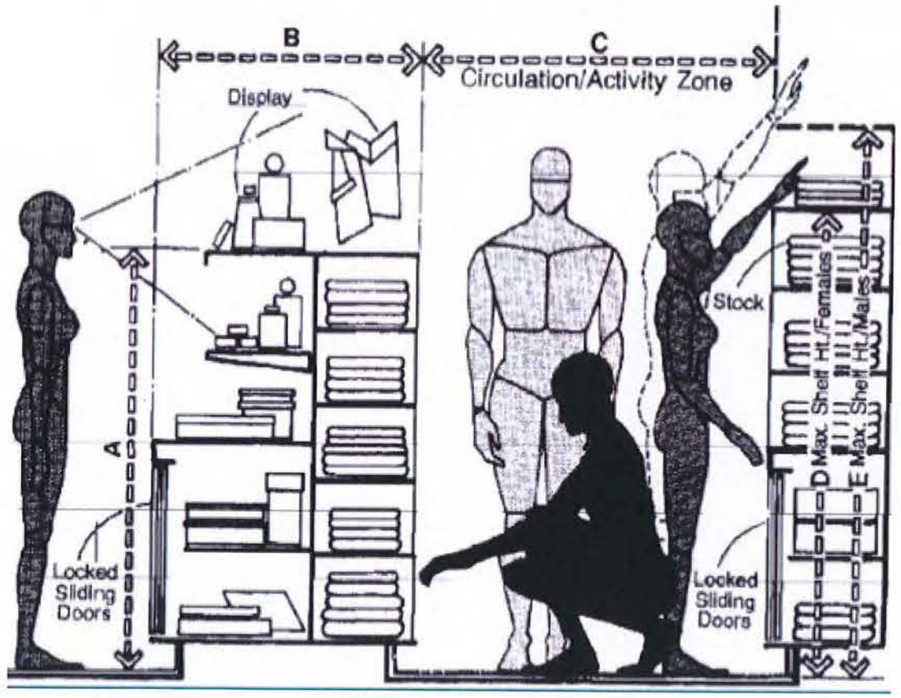


Fig 10.
Ergonomic data of a a person in **different positions**

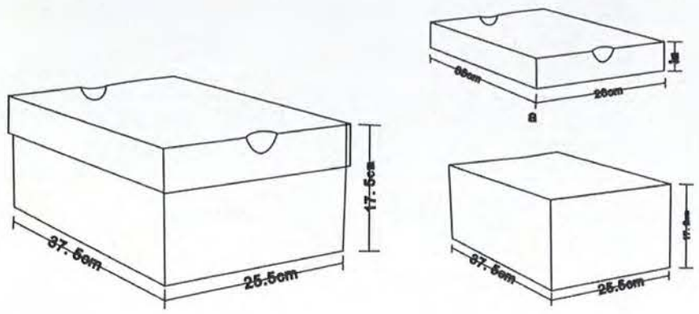


Fig 11.
Ergonomic data of a a **shoe box**

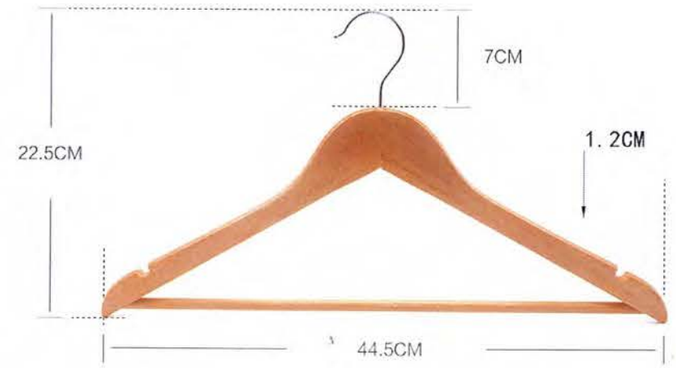


Fig 12.
Ergonomic data of a **clothes hanger**

Research and Analysis:
Ergonomics of Target Group

I decided to carry out an **investigation** of my **target group**. I collected students from different ages and found a **cart** that would perfectly help me understand the **specific requirements** my artifact will need.

I made them try different **positions** (bend down to take shoes or pour water in cups/ water bottles) to see if my ideas would **actually work.**

Individual 1 is currently attending the **second year of primary**. She is **1210mm tall** and as we can see this cart provides an **easy mobile movement** for her to pour water/refill cup during her PE lessons while bending down. I also noticed that she uses her **knee support** while pouring the water.

Fig 14.
Cart with about **600mm** of height

Fig 13.

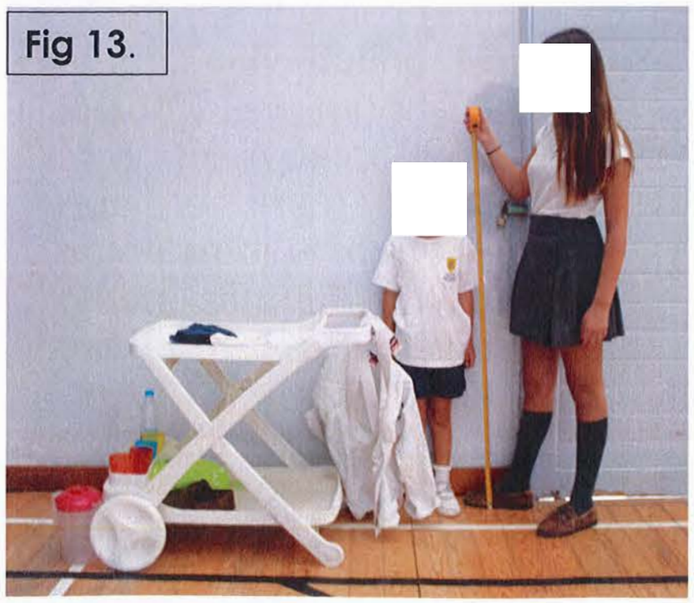


Fig 14.

Fig 15.

Fig 15, 16.
Individual 1 pouring water in a cup and removing shoes from the cart.

Fig 16.

Research and Analysis:
Ergonomics of Target Group

Fig 17.
Details of individual grabbing shoe


Fig 17.

Individual 2 is also on the **second year of primary education** and he is **1250mm tall**. What I noticed different from individual 1 is that this boy is **supporting his knee and hand** on the floor while the girl is on her feet when bending down.

Fig 18.
Me measuring **individual's 2 height**


Fig 18.

Even though children from primary level won't use the hall that much, **only during PE lessons**, it is important to do this type of study due to them being **much smaller than the other students**. With this, I am sure that the artifact I will produce will be the **right size** so that everyone can **use it easily**.


Fig 19.

Fig 19, 20.
Individual 2 bending down to take shoes from cart and pouring water into a cup


Fig 20.

Research and Analysis:
Ergonomics of Target Group


Fig 21.

Fig 21, 22.
Details of **ergonomics** and **height** of individual


Fig 22.

Individual 3 is a girl attending her **year 6**. She is **1380 mm tall**. The cart's height goes by her **hips** which makes it the **perfect size** for her to reach the upper and bottom part **without difficulties**. In **fig 23.** we can analyse that **individual 3** uses the floor for **knee support** when placing the shoes inside the cart but while pouring water, shown on **fig 24**. her position is somewhat **different**, she no longer uses the **knee support** but uses her **leg strength** and **bends her knees.**

By this research stage, I know that my **multipurpose sports rack** needs to have **different levels**. Maybe a **bottom part** for the primary kids to place their shoes and a **middle, upper part** for the older students so that they **don't need to bend down** as they are taller.

Fig 23, 24.
Individual 3 removing **shoes from rack** and **pouring water** in a cup


Fig 23.


Fig 24.

Research and Analysis:
Ergonomics of Target Group

Fig 25, 26.
Individual 4 detail picking up shoes and his **height**


Fig 25.

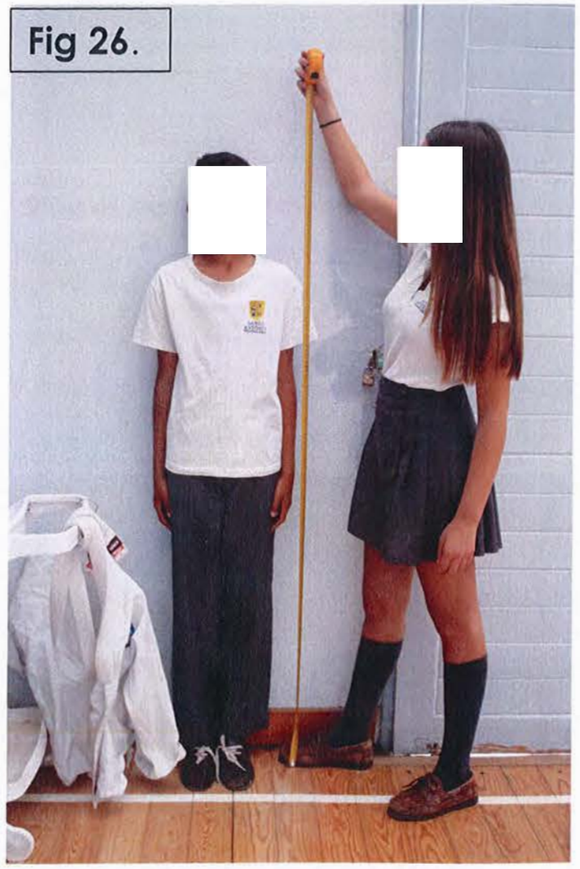


Fig 26.

Individual 4 is a boy from **year 7**. He is **1440 mm tall**. As you can observe, individual 4 is **much taller** than **individual 3**, as the cart's height goes by his **legs**. In **fig 27**. it is obvious that he **struggles more** to place the shoes inside. He uses **both knees** on the floor and stretches his hand . This position is **not convenient and practical** for an **everyday use**.

Most students in **Santo António International school** are about individual 4's height so it is right to say that he could be the **sample student** to analyse. Most students who use the **sports hall** to play football or basketball **are his age and height** as it is a fact that children like him are the **most active**. So, by this kind of students being **our target group**, I'm going to focus mainly on his **ergonomics** but **not forgetting** the other students.


Fig 27.

Fig 27, 28.
Individual 4 picking up shoes and pouring water


Fig 28.

Research and Analysis:
Ergonomics of Target Group

Individual 5 is a boy attending **year 8**. He is **1750mm** tall (taller than me) and the cart is obviously **way smaller** than him. This made me realize how important it is for me to **adapt** my artifact for **all heights.**

Fig 29.

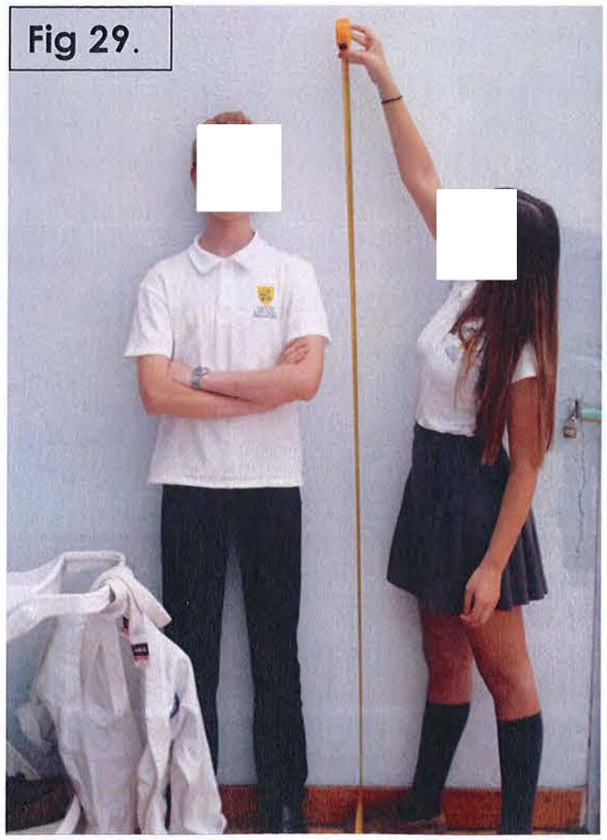


Fig 30.
Details of **individual** placing the shoes

Fig 30.

In **fig 32.** we can see that the boy, for him to place the shoes inside the cart needs to **bend all the way**, even minding his head or else it would **hit the cart**. There is no doubt that this cart's height will **not work** for him as it is **not easily functional** for him. Also, **fig 31.** made me realize that the place to pour water is **too low for the individual** due to the top part **cutting the sight** as his head is taller. I will have to **re-think** the size as this is **not ergonomically perfect.**

Fig 31.

Fig 31, 32.
Individual 5 pouring water and **placing shoes** on the rack

Fig 32.

Research and Analysis:
Ergonomics of Target Group

Fig 33.

Fig 33.
Me **measuring individual's height**

Fig 34.
Individual 6 placing shoes

Individual 6 is a girl in **year 8** (same year as individual 5). She is **1650mm** tall. I decided to **re-test year 8** as the last boy could be the tallest of his year and my **target group average could be uncertain**.
The cart goes by around the height of her **upper legs** which is not that bad/**disproportional**. In **fig 34.** we can also see that the top layer of the cart also **blocks the individual's view** while placing the shoes on the bottom layer. Also, she uses the **knee for support**, which I noticed that it is quite **common**.
In **fig 35.**, I decided to test instead of pouring water on the bottom layer, to try it on the **top layer**, but only for the taller students. I then understood that it is **easier** for them to pour water that way instead of having them **bending down.**

Fig 34.

Fig 35.
Individual 6 pouring water while standing up

Fig 35.

Research and Analysis:
Ergonomics of Target Group

Fig 36.
Me measuring **individual 7's height**

Fig 36.

Individual 7 is a girl attending **year 12**. She is **1680mm** tall. The cart's height is about a little **higher than her knee**. I also decided not to measure her bending down to place shoes on the bottom layer due to it being **unnecessary** as I already understood I need to find a solution for the **taller students**, so that they can **comfortably and easily** use the rack on their **day to day basis.**

Another thing to keep in mind is that the **upper end** of the school (students taking **A-levels** specially) don't use the sports hall that much during their free time, they **rarely** use it as most of them spend their time available **studying** in the common room or **doing homework.**

Fig 37.
Me measuring the **height** of the cart if it had an **extra layer**

Fig 37.

I also decided to test **how would the cart be if I added another top layer**. Would it solve the problem for the taller students? Most probably **yes.**

Research and Analysis:
Ergonomics of Target Group

Fig 38.

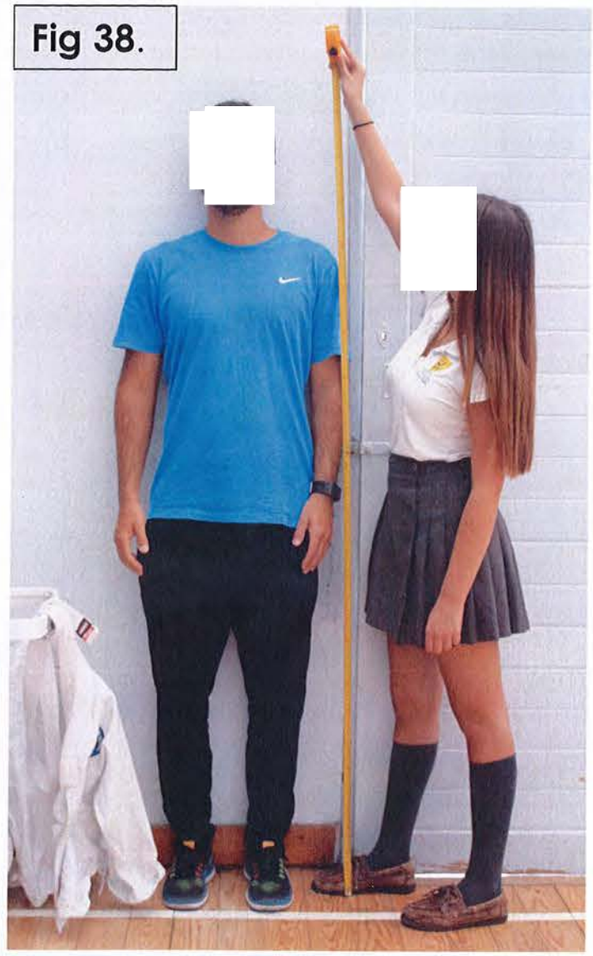


Fig 38.
Me measuring individual 8's height.

Individual 8 is a **PE teacher**. He is **1810mm tall**. As he uses the sports hall quite **often** due to his profession. I decided to also test him to **make my rack also suitable for adults like him** (as there are also sport practices/training for older people after school). With this individual, I got curious on how he could place shoes on the bottom layer. This made me realize that by **bending your knees and supporting only your feet on the floor**, it's quite **practical and not difficult** for someone that tall.

Fig 39.

I also tested with **individual 8,** the cart's height if it had an **extra layer**. This looks quite **suitable** and maybe something to **consider** if people that tall (adults) are going to also use the rack as it not only gives **more space** to store things but also it makes it **more easy to use** the rack for people that aren't short

Fig 40.

Research and Analysis:
Questionnaire

	Individual 1	Individual 2	Individual 3	Individual 4
Q.1 : Do you play in the school's hall during breaks?	No, I play in the primary playground	No but we use the hall for PE lessons	Yes I like playing football	Yes I'm a football and basketball player
Q.2: Do you have problems in finding your belongings when you finish playing in the hall?	_____	_____	Sometimes yes when there's too many people inside	Yes, specially the shoes. They get all mixed up
Q.3: Have you ever lost any belongings in the hall while playing?	Yes my water bottle during a PE lesson	No but I once had trouble finding my fleece	No	Yes once It took 10 minutes to find my shoe
Q.4: Would you like the hall to have a multipurpose rack so that you can store your) while you're playing in the hall?	yes	yes	yes	Why not yes
Q.5: what type of belongings would you store?	My water bottle	My jacket and water bottle	My shoes	Shoes and fleece

I decided to carry out a **questionnaire** to see how **convenient** would my artifact be and to also **analyse the problem**, more specifically to make sure I'm producing something that will actually be **useful** and solve an existing problem.

Individuals assessment:
Individual 1's answers were quite **vague** due to the person's **age** but I was able filtrate the information needed.
Individual 2's answers were quite **similar** due to them being from the same **class.**
Number 3 gave also **simple** answers but, never lost anything in the hall which quite **surprised** me.
4's answers were quite **useful** and gave me **further explanation** which made it **easier** to understand the problem.

Research and Analysis:
Questionnaire

	Individual 5	Individual 6	Individual 7	Individual 8
Q.1 : Do you play in the school's hall during breaks?	Yes I like to play basketball	Yes	No, because I'm not that sporty	No, but I use the hall a lot as I'm the PE teacher
Q.2: Do you have problems in finding your belongings when you finish playing in the hall?	Not really	no	_____	_____
Q.3: Have you ever lost any belongings in the hall while playing?	No but once my friend accidentally took my fleece	no	_____	_____
Q.4: Would you like the hall to have a multipurpose rack so that you can store your) while you're playing in the hall?	That would be useful actually	yes	Even though I might not end up using it it's a good idea	That would be good during my PE lessons for students to store their belongings
Q.5: What type of belongings would you store?	My shoes and jacket	Maybe my shoes	_____	Sporting material when im giving lessons

My questions were answered by **students** and a **teacher** at my school. 2 kids from the **primary** were interrogated (boy and girl), other four were from **secondary education** (two times 1 boy and 1 girl from the same class), 1 girl taking **A-levels** and a **teacher** (most specifically a PE teacher due to the fact that he uses the hall for lessons).

Individuals assessment:
Individual 5's answers were okay, he gave the right information needed.
Individual 6's answers very direct and no additional information was given, making my analysis harder.
Number 7 as it doesn't use the hall, their answers were somewhat pointless
8's answers were very important as I could understand that the PE teacher could also benefit from the artifact, I didn't expect that.

Research and Analysis:
Questionnaire Results

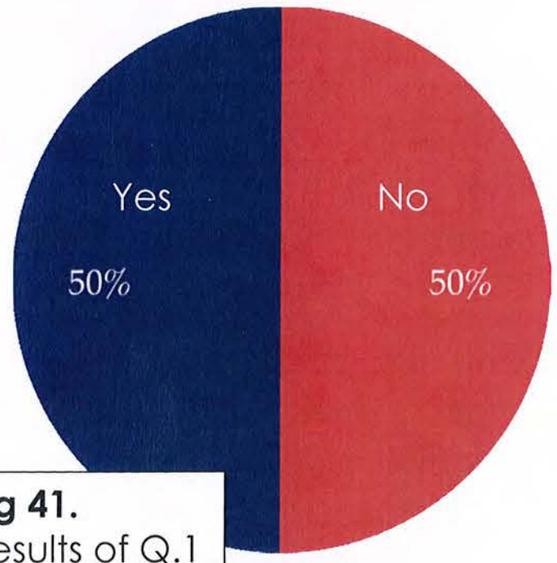


Fig 41.
Results of Q.1

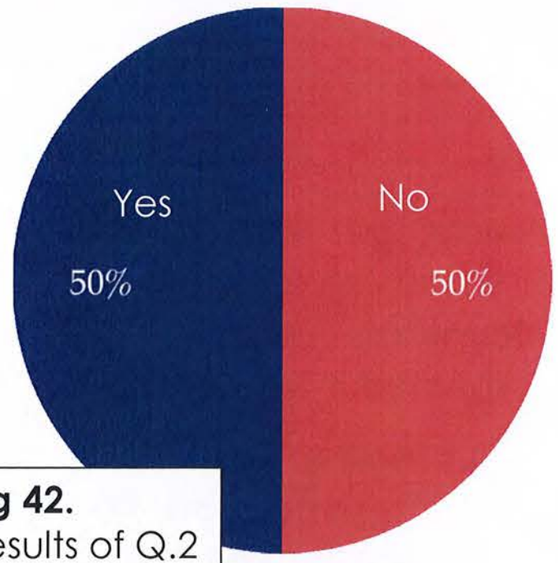


Fig 42.
Results of Q.2

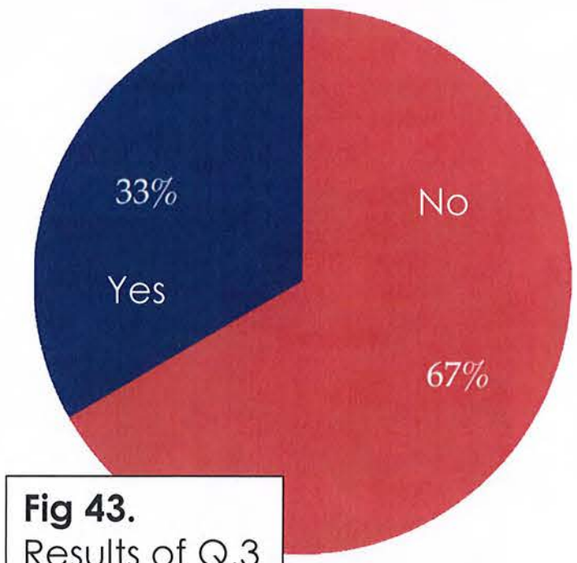


Fig 43.
Results of Q.3

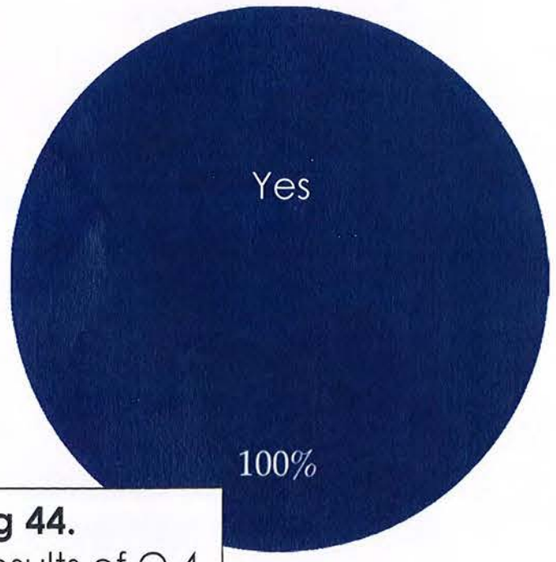


Fig 44.
Results of Q.4

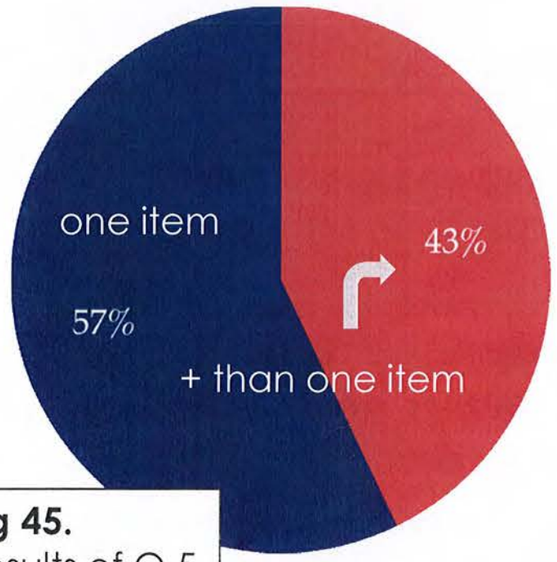


Fig 45.
Results of Q.5

I decided to put the data I collected into **pie charts** so that it is **visibly easier to interpret**.
In **question 1** and **question 2** the answers were **not obvious**. On the first one, I understood that the **younger the student's the more they play in the sports hall**. **Question 2 and 3**, the **younger the student the more likely he is to lose stuff in the hall** even though **question 3** has more **"No's"**.
On **question 5**, it was almost a **draw** but more students only named 1 item but thee named items were **almost the same**.

Design Brief

I intend to design and make a **storage unit** which will be **useful** and **practical** for the students who use the school hall. A **simple** yet useful and **transportable** rack.

This will **diminish the untidiness** and mixed up shoes on the floor, **reducing the disorganization.** There are other products in the market, but I am gathering data, so I can decide on the **improvements** that I will apply on my own product.

The time spent in designing and manufacturing this product will be 25 weeks.

After all the data from the questionnaire is **analysed,** we then decide the final product design.

It should be a **reliable choice**, doesn't occupy much space and store all the shoes and jackets needed.

Pictures of the **hall's disorganization** during **break times**

As you can see, there are some places inside the hall that are **accumulated with student's belongings**.

Fig 4. has some shoes and a **backpack**, which I wasn't expecting to see.

Fig. 5 is only a **lineup** of mixed up shoes. This type of disorganization is the one that I found **most common during break times**.

Fig. 6 are a bunch of jackets and bags **on a bench**, outside the hall. I noticed that outside the hall things are more tidy.

Fig.4.

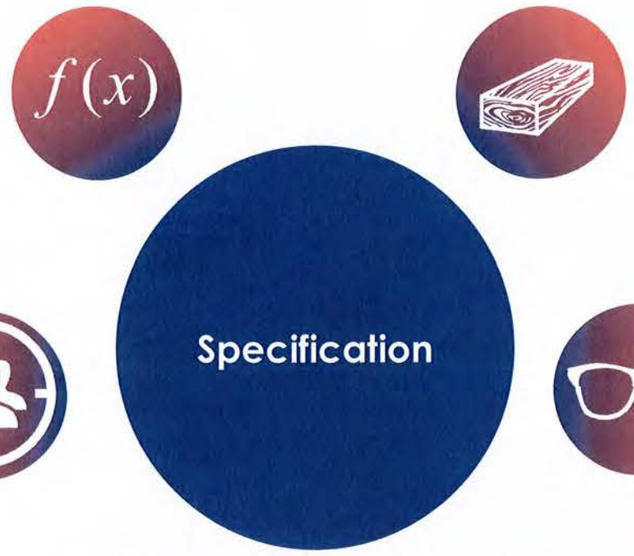
Fig 5.

Fig 6.

Specification Requirements

SP.1: **Function**

My **artifact** will be **multifunctional** and have different uses; **store shoes, store jumpers/ clothing, store water bottles and bags.** It should be **easy to use** (ergonomically functional) and to **move**, have wheels, **strong** but **lightweight**. Also, the product I am to design should be **adapted to a multipurpose sports hall**



SP.2 : **Target group**

The target audience I intend to attract are students; **Boys and girls aged from 5 to 18**. In consequence, my product should be **unisex**. **Teachers** are also supposed to use the rack.

SP.3: **Dimensions**

The product I am to produce, has to be large enough to store all the student's belongings, because of this I have already carried out anthropometric and ergonomic research in order to finalize my measurements. My multifunctional rack should be around **120mm in height, 80mm in length and 90mm in width**.

SP.4: **Materials**

The material I chose for my unit is **manufactured board , more specifically OSB – oriented strand board**. The benefits of using this material is that it is **dense**, it is **less prone to chipping and breaking**. An added bonus is that it is **environmentally friendly**

SP.5: **Aesthetics**

My product has to be aesthetically **attractive** for both **genders** and **ages too**. So a **neutral toned wood** not painted that also goes well with the **hall environment**. Edges and corners must be smoothed off, varnished applied.

SP.6: **Weight**

The furniture unit should be somewhat **light** so that it can be **transportable** (with wheels) easy to move. It should also be **steady** so that the pieces of wood do **not break easily** when too much **weight** and **objects** are applied, or when it is pushed around.

Generation and Appraisal of Ideas:
Proposal 1 and 2

Fig 46. represents **idea 1**. It is a **multipurpose rack** as one side can **store clothes and bags** and the other side can keep **sports equipment**. It has **wheels** and the major dimensions are **1400mm** of length and **1200mm** of height.

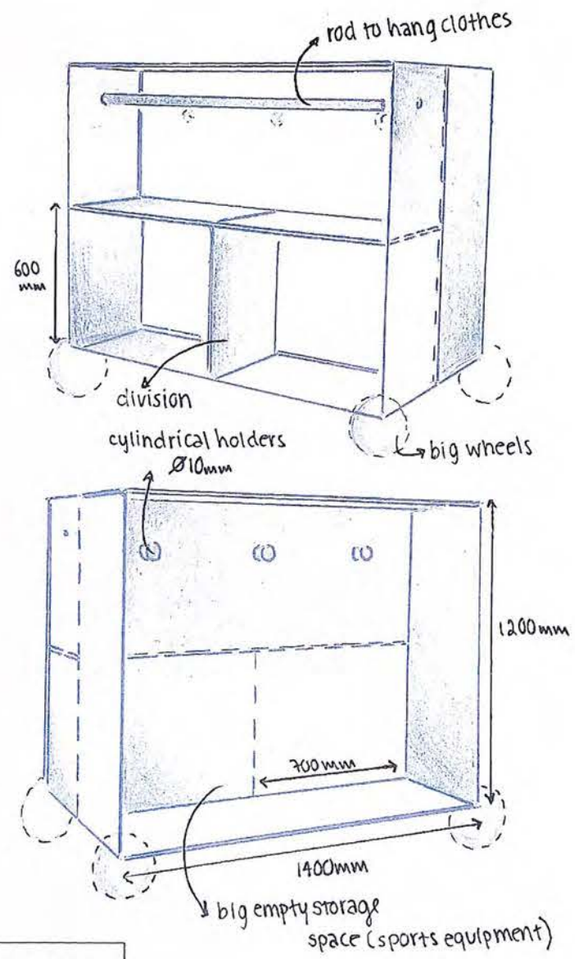
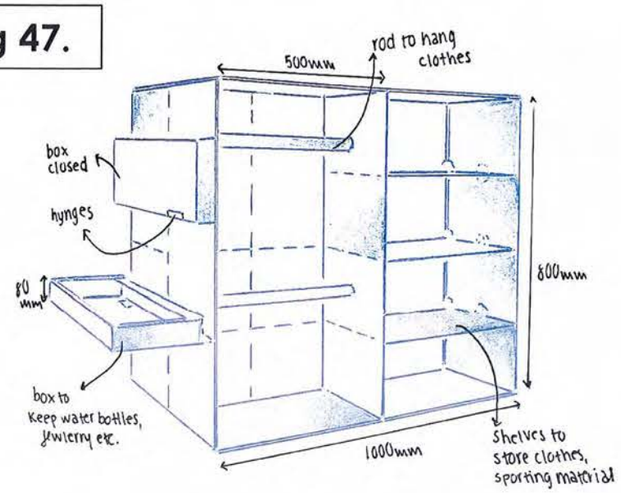


Fig 46.

Fig 47.



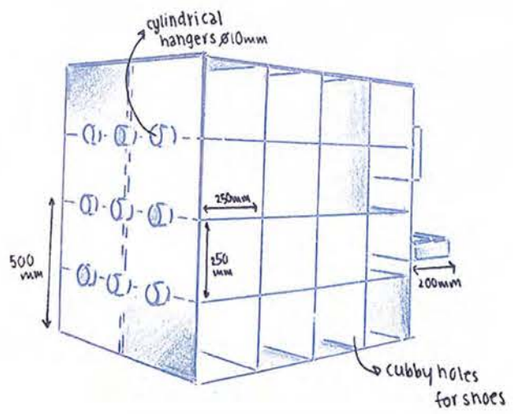


Fig 47. is **idea 2**. it has **2 rods** to hang clothes, has **3 shelves**. On the other side, it is constituted of **cubby holes** for shoes and the laterals are **cylindrical hangers** of 10mm of diameter. Also, the other lateral has **2 "boxes"** that can fold when not being used. It can store **jewelry or water bottles**. Its major dimensions are **1000mm** of length and **800mm** of height.

Note that **these ideas** are **not as specific** as they could be as they are only **proposals**. At the end, I'll choose one of these ideas for my **final design** and specify more about the **dimensions counting with the wood thickness.**

Generation and Appraisal of Ideas:
Proposal 3 and 4

Fig 48. is a proposal for **idea 3**. It has **1200mm** of length and **1050mm** of height. It also has **wheels** and **cylindrical holders** of 10mm on 1 lateral. The front has **32 holes** to store shoes and the top of the artifact has **3 wooden plaques** so that students can **throw their jumpers** and jackets for a more **quick and effective** way of storing **while they play.**

Fig 48.

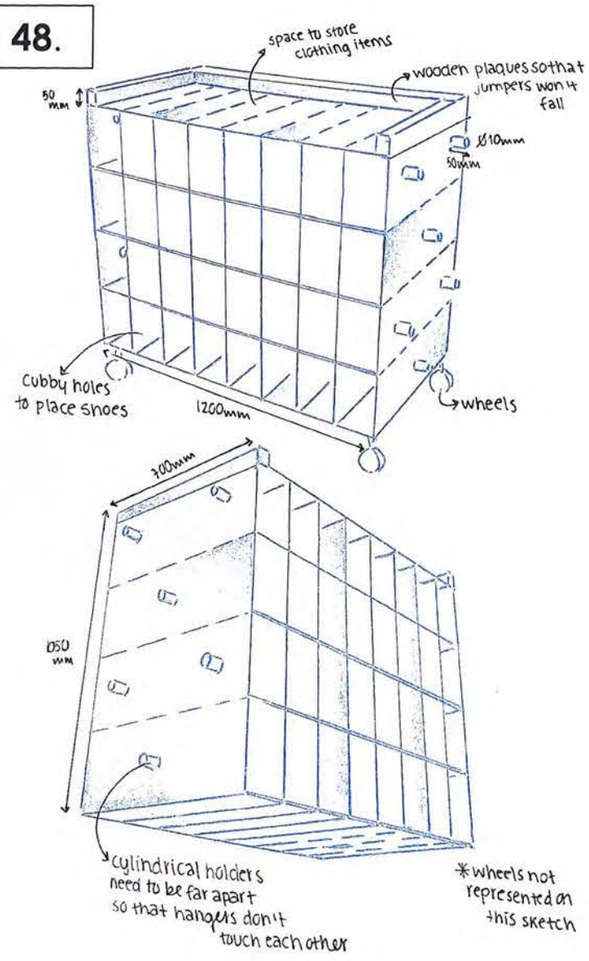


Fig 49 .

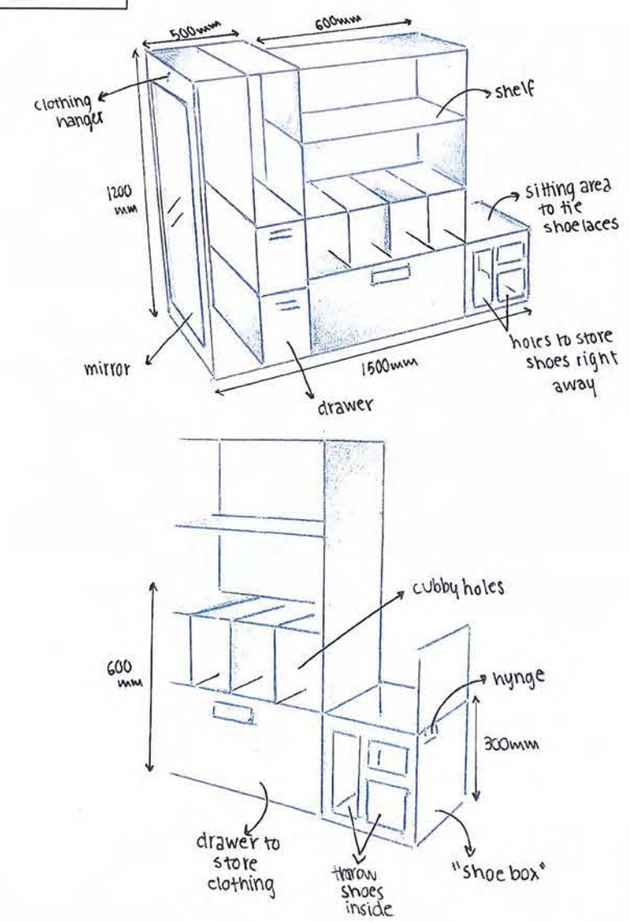
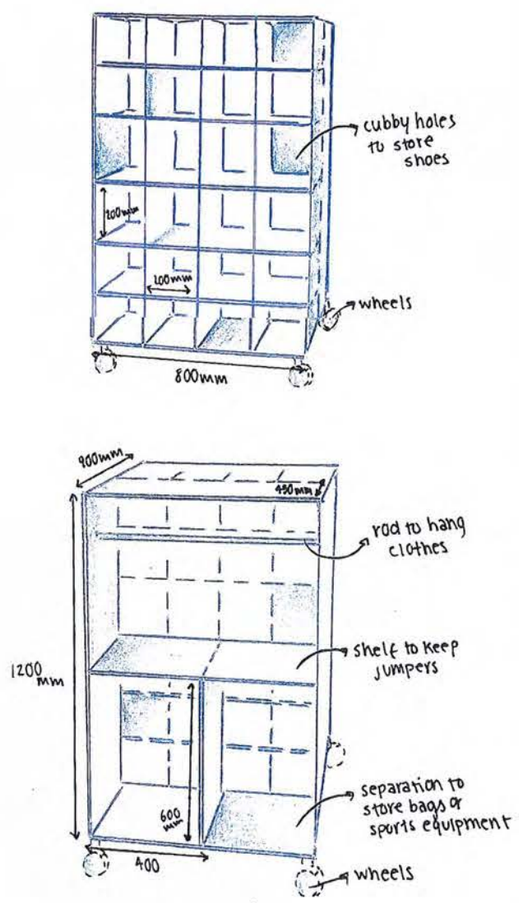


Fig 49. is **idea 4**. It is constituted of **3 objects joined together**, the small **box** to **keep shoes** and you can also **sit down** on it, the **big shelves and box** storage unit and the **box and clothes hanger** that also includes a **mirror**. Its height is **1200mm** and length **1500mm.** With this, students can sit down to **tie their shoes** and look at the mirror while **dressing their jackets, hoodies, jumpers etc.**

Generation and Appraisal of Ideas:
Proposal 5 and 6

Fig 50.



Idea 5, represented on **fig 50**, has **24 cubby holes** to store shoes, and at the back (other side) it has a **rod to hang clothes**, **1 shelf** to also store **folded jumpers** and **2 bottom spaces** to keep **bags** and **sports equipment**. There is no lateral hangers but it has **4 wheels**. Its measurements are **800mm** of length and **1200mm** of height.

Fig 51.

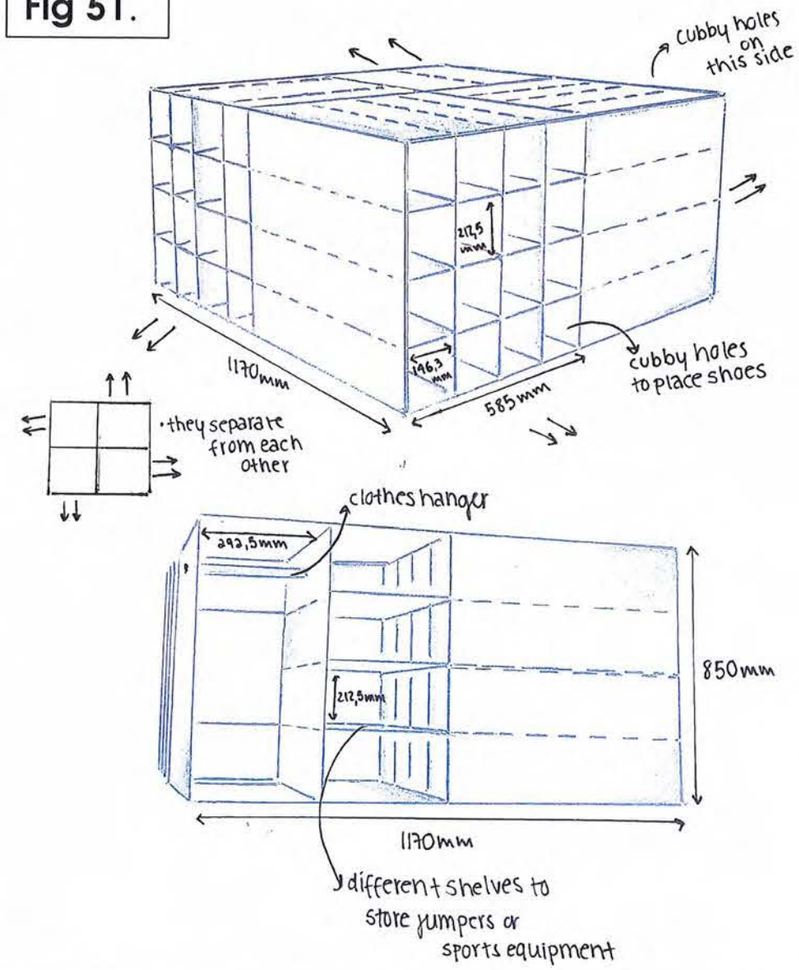
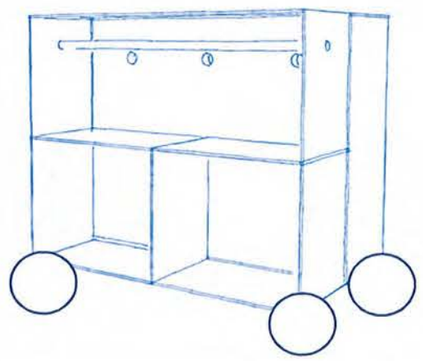
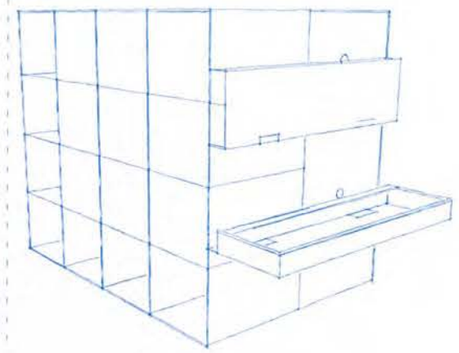
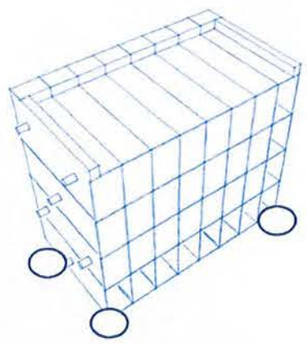
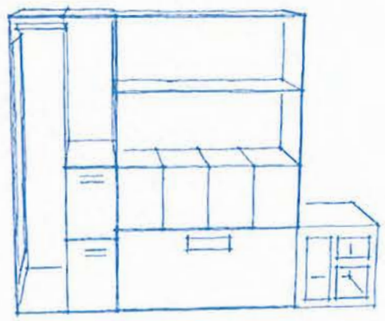
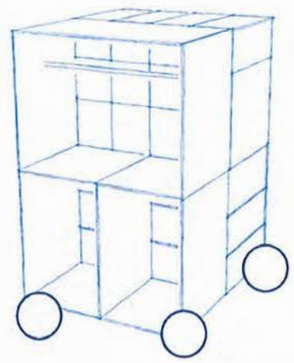
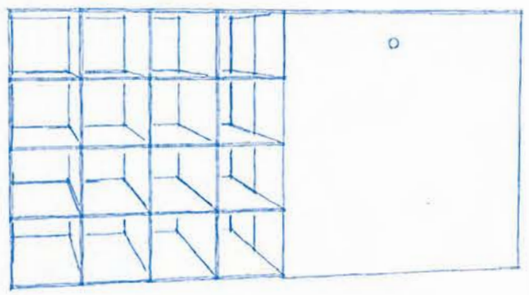


Fig 51. or also can be called **idea 6**, is a **low rectangular** shaped artifact that can be **separated into 4** to become smaller. It has **3 spaces of cubby holes**, each **16 gaps** for the shoes, meaning all together **48**. One of the sides constitutes a **rod to hang clothes** and **3 shelves** for **sports equipment** and **additional clothes**. It has **850mm** of height and **1170mm** of length.

Appraisal and Evaluation of Ideas:
Proposal 1, 2 and 3

	**Advantages:** • Transportable (has wheels) • Can hang clothes so they don't crease when folding • Has a lot of space to store sports equipment (1 whole side)	**Disadvantages:** • Doesn't have much space to store shoes • Small height space for hanged clothes, meaning big coats can´t be hung • Wheels are too big
	**Advantages:** • The 2 lateral boxes are practical to keep small objects so they don't get lost • 2 rod hangers allows more space to hang clothes so they don't crease • 9 hangers so many bags can be hung	**Disadvantages:** • The boxes can be too big in width and if someone accidentally throws a ball, it can break • The hangers are too close together, it will be difficult to hang too many bags • The rack is big so it will be difficult to move
	**Advantages:** • Can be easily moved (due to the wheels) • The holders provide an unique space to store bags so more inside rack space for shoes • Practical area to keep clothes (just throw)	**Disadvantages:** • Maybe 32 cubby holes can be too exaggerated as not that much people play inside the hall • By throwing the jumpers, they can crease or get mixed up • The width of the cubby holes can be too profound

Appraisal and Evaluation of Ideas:
Proposal 4, 5 and 6

	**Advantages:** • Has a place for students to sit down so they can tie their shoes • Has a lot of storage space • Has height to store big coats	**Disadvantages:** • The small box only provides a small number of shoes to be stored • Dimensions too big (in length) • It is a permanently space object (can´t be moved easily to change location)
	**Advantages:** • Students can easily move the object around to use both front and back spaces (due to wheels) • Simplistic design • A good amount of cubby holes (sufficient)	**Disadvantages:** • Can only store small sized jumpers (no big coats due to the height) • Shelf provides additional storage clothes space • Not too big compared to other ideas
	**Advantages:** • They can separate from each other, to get smaller, even to place them at different places in the hall • Can store many shoe pairs (48) • Looks very aesthetically pleasing	**Disadvantages:** • Small in height so that even smaller students can easily reach the top • Hard to separate each cube as there's no wheels • There could be 1 extra space to store sports equipment

Generation and Appraisal of Ideas:
Development of Final Idea

After evaluating all the **6 ideas**, I think **Idea 5** is the most **suitable** due to it being the **most simple** to produce, has wheels so it has an **easy mobility** for the students, has a **fair amount of space storage** (shoes, clothes, bags and sports equipment) and its **dimensions** are the best out of the 6 ideas.

Fig 52 .

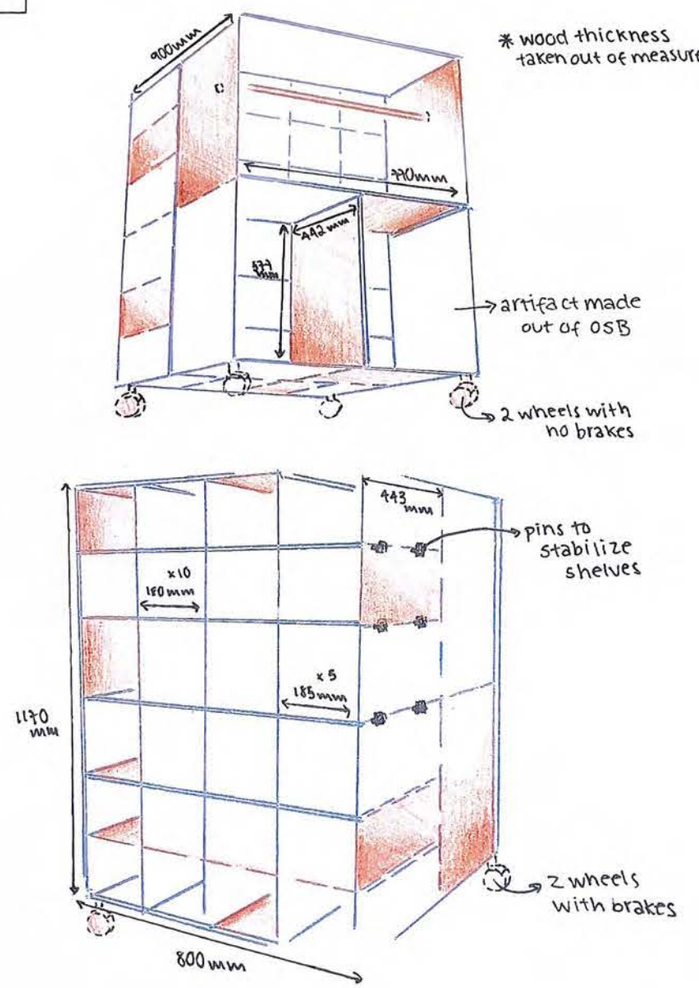


Fig 52. shows the development of my **final design idea specified**. It has the **precise measurements** counting with the wood **thickness** (OSB manufactured board). I also specified how the **shelves** will be **added** to the rack (cut tiny holes to place the pins so that it holds the shelves and they don´t fall when placing shoes inside the cubby holes). I also decided to put **2 wheels with brakes** and **2 wheels without brakes** due to the **price**. As the wheels with brakes are **more expensive** and 4 of the same are **unnecessary**. The space provided for the **bag storage** can hold up to **2** in each section and for the **sports equipment** it can keep **cones, balls etc.** Also, this artifact can keep clothes without having the risk of **creasing**, by hanging them and also you can **keep them folded** on the shelf. Unfortunately it can't store **big jackets** hung but I think no students take them to school as we have to wear **uniform**.

Modelling of Ideas:
Corrugated Card & Clay

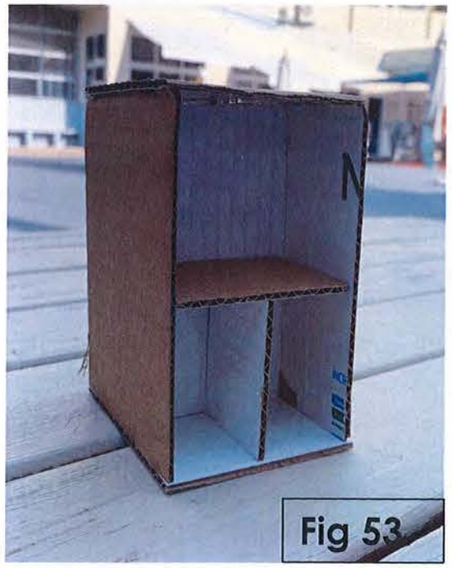


Fig 53.

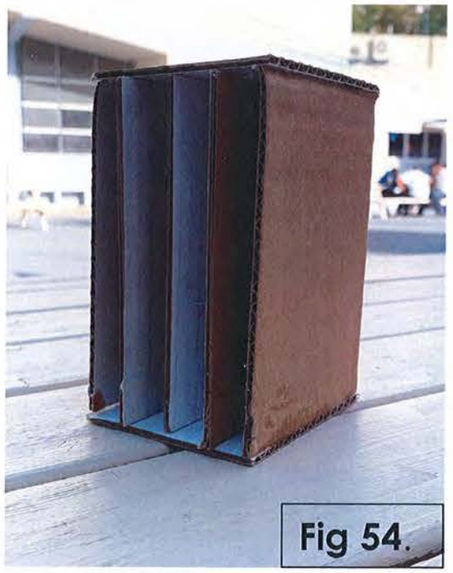


Fig 54.

Corrugated Card Model:

Before I do my **real life size model**, I decided to try out in a scale of **1:10** how it would look like. The **corrugated card model** was quite **easy** to do as a **metal rule**, a **soft pencil** and an **art knife** was all I needed. In **fig 54.** you cant see the **shelves** finished, as it would be a **time wasting** and **hard** thing for me to produce as the **dimensions are very small. This module actually looks quite stable due to the card's properties.** No wheels shown.

Clay Model:

The **second model** I produced is made of **clay**. It is also on a scale of **1:10**. I am not quite pleased with this model as I left the pieces of clay to **dry in the sun** and they were **exposed** for too long resulting in them becoming **fragile** and **breaking** and also becoming a little **bent**. But apart from all that, this model actually helped me to understand the **shape** and if the model would actually work, specifically on the **jumpers and bags side.** I didn't built the wheels as it would be hard to do them.


Fig 55.

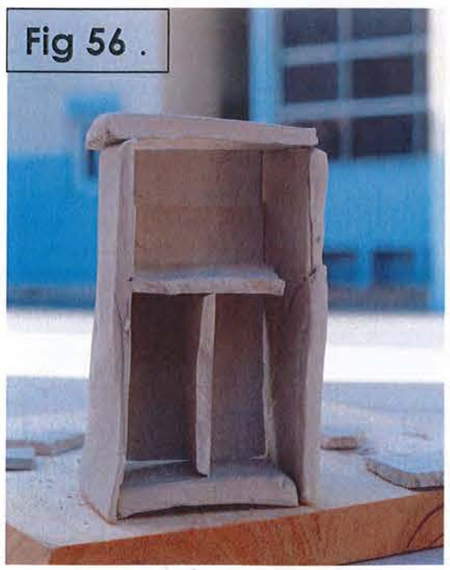


Fig 56 .

Modelling of Ideas:
Styrofoam & SketchUp

Fig 57.

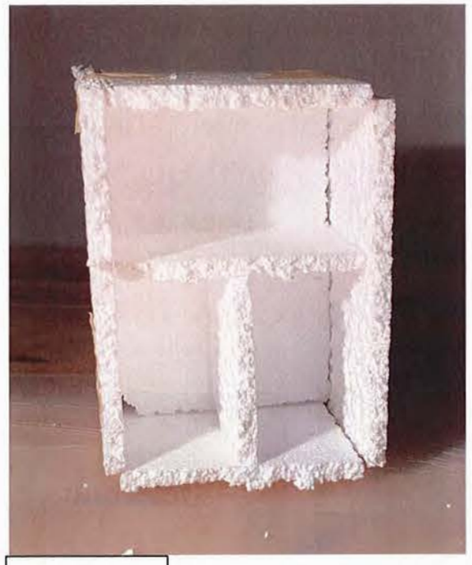


Fig 58.

SketchUp Computer Model:

For a more **precision** and **real life** looking artifact, I used a **computer application called SketchUp**. This app provided a **detailed** and **perfect looking** object, almost the same as if it was in real life. The material of the object is in **OSB**, what I wanted the artifact to be. The **shelves are completed** including a **rod** to hang the jumpers in **Fig 59**. This module took quite some time to produce. Wheels not added.

Styrofoam Model:

The next material I decided to use was **Styrofoam**. This module was actually quite **hard** to produce due to the Styrofoam being **fragile** and **crumbling** every time I used the **art knife**. Also, to **assemble** the pieces together I had to use **duct tape** as the **liquid glue** would **damage** the material. The scale is also **1:10** and in **Fig 57.** you can see that I did **one shelf** as an example of how they would look . Also wheels aren't demonstrated

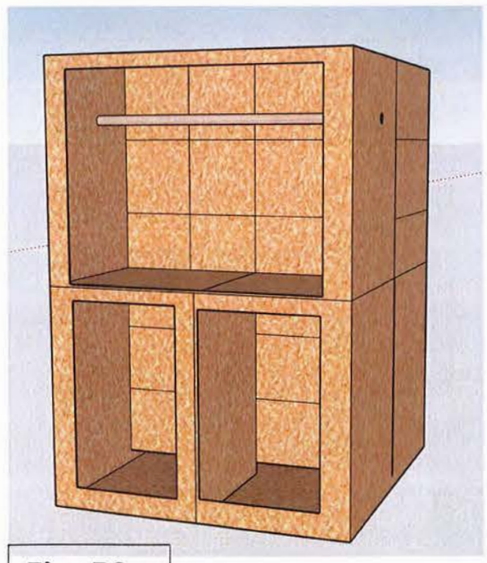


Fig 59.

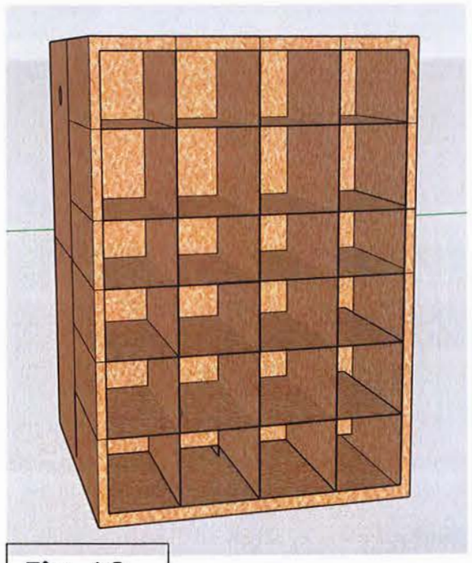


Fig 60.

Production Plan
Final Life-Size Model

To go a step further, I produced a **real life size model** of my idea. Firstly I did a **shopping list** of what I needed, including **measurements** for the wood plaques, nails, PVA (polyvinyl acetate), wheels and some shelf pins. My local shop **already cut the wood plaques** for me which made my **job easier**. What I did next was joining the wood with **PVA** and then fixating it with **nails**. For the shelves I did **holes** for the shelf pins to fit and secure each shelf. The wheels were the last thing I **assembled.**

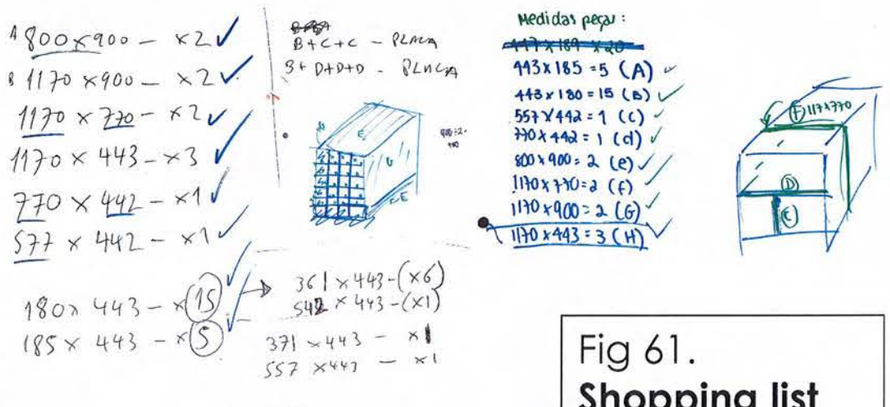


Fig 61.
Shopping list

01. Measuring
02. Cutting
03. Smoothing
04. Finishing
05. Assembling

Fig 62.

Fig 63.

Fig 64.

Fig 65.

Fig 66.
Wheel details

Realisation
Final Life-Size Model

Fig 67.

Fig 68.

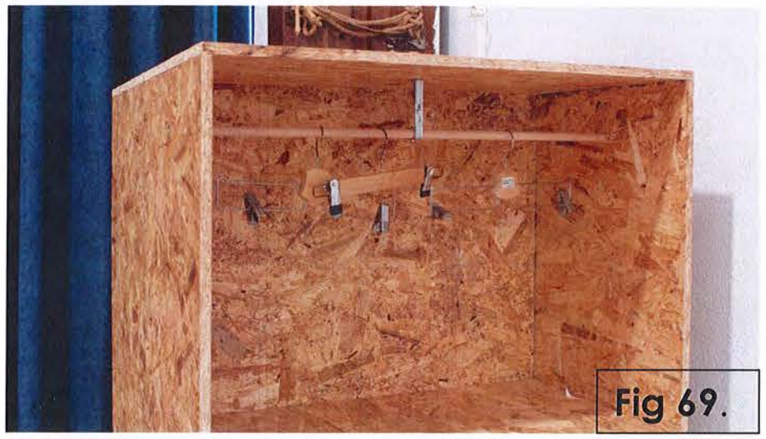


Fig 69.

I did a **life-size model** just because I thought the small scale models **weren't enough** and this one can actually be **used by real people** as now I have a **problem solved** and not just a **solution** for the problem. I am quite **pleased** of how the artifact turned out, even the big spaces that weren't supposed to happen but can now **store boots** during the winter. In **fig 70.** you can also see that there is a **big storage space** to keep **jumpers, PE material, bags and much more such as water bottles**. The size of the artifact is **big enough** for every student in the school to be able to use, so the **space is not limited.**

Fig 70.

I think that the **location** I chose for the project is very **strategic** and **well allocated**. It's **near an entrance door** for the sports hall, so when students walk in its **easier for them** to just place their stuff inside the rack, It is placed in the **corner** so that it **isn't on the way** when students are playing football/ basketball.

Realisation - Details
Final Life-Size Model

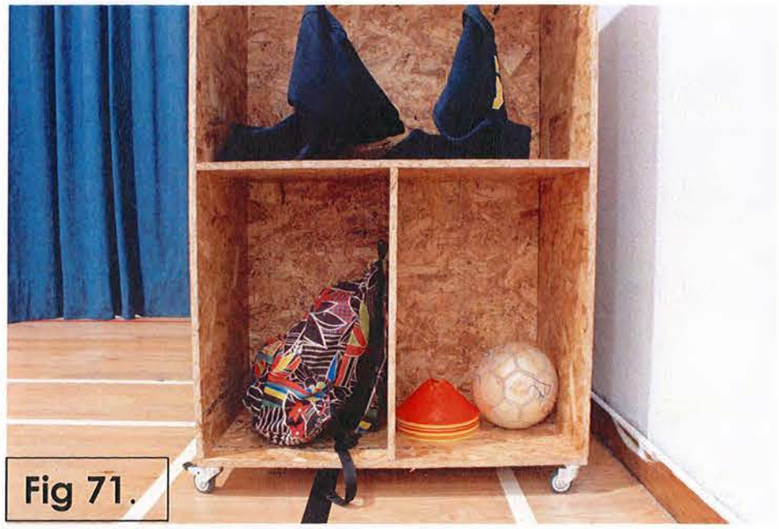


Fig 71.

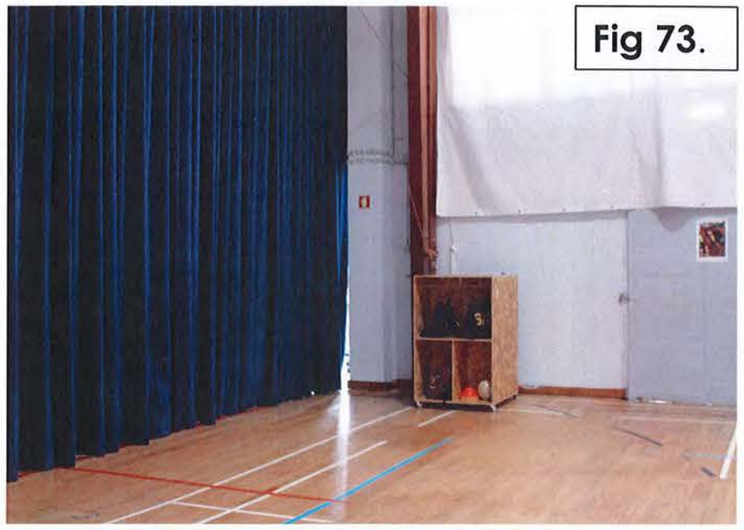


Fig 73.

One thing that could be better is the **size for the hangers, in Fig 72**. It clearly shows that the **jumpers are too big** for the **space provided** for them to hang. But this problem can be **easily tackled** by just **folding** the sweaters instead. Also, in **Fig 74.** demonstrates that the **school's shoes** can **easily fit** in the holes.

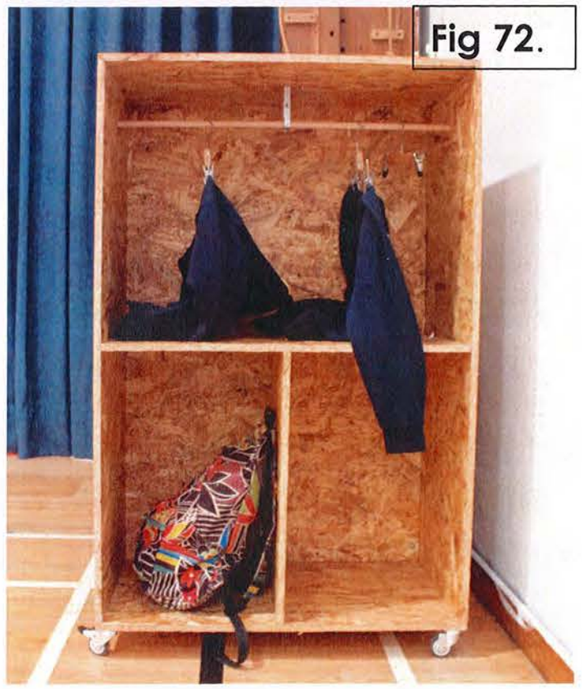


Fig 72.

Furthermore, The **wheels** were also a good idea because I think it made the multipurpose rack a kind of **agile and easy to move object**. With this, students can easily **move around** the object without **asking for help** or **wasting too much time**. As you can see on **Fig 71., sports equipment** for PE lessons are also being stored which just shows me that this artifact **not only positively affected the students lives but also the teacher's.**

Fig 74.

Testing & Evaluation 1
Final Model on Target Group

Fig 75.

Fig 76.

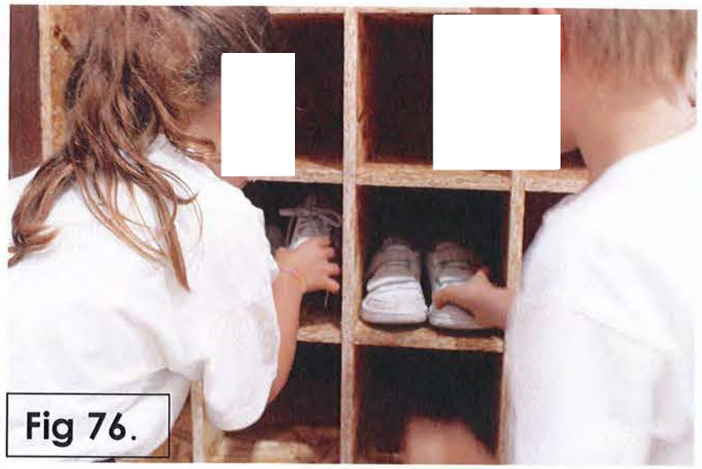


Fig 77.

For a more **specialised evaluation**, I decided to bring back the students (represented as my target group) from the ergonomic research to **test my actual real-life model**. **Individual 1 and 2** weren't present that day, so I picked **2 other students** from the same class and of **similar heights** to test my artifact. They seemed quite **excited and happy** when trying out my rack which made me feel quite **fulfilled.**

Speaking ergonomically, we can see that these **primary students** don't have any **difficulties** in **placing the shoes** and they can do it quite with some **ease**. Their shoes fit **perfectly.** They can reach the **top cubby holes** as well as the **bottom holes**. Also, on **Fig 75.** is that we can see that the **rack** can be used **simultaneously and not 1 by 1.**

Fig 78.

Testing & Evaluation 2
Final Model on Target Group

Fig 79.
Individual 3 placing **shoes** in the **rack** (bottom part)


Fig 79.

Here, we can **see individual 3 and 4** trying out my **multipurpose function rack. Individual 3** can also **easily** place her shoes anywhere and also to **place her bag** shown in **Fig 81.** She only needs to **bend down** a little.

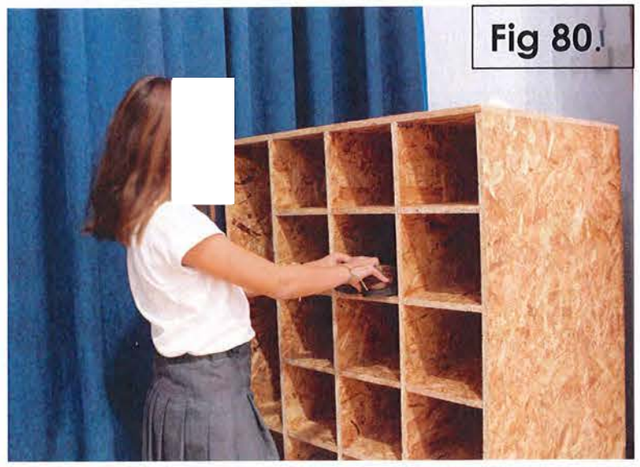


Fig 80.

Fig 80.
Individual 3 placing **shoes** in the **rack** (top part)


Fig 81.

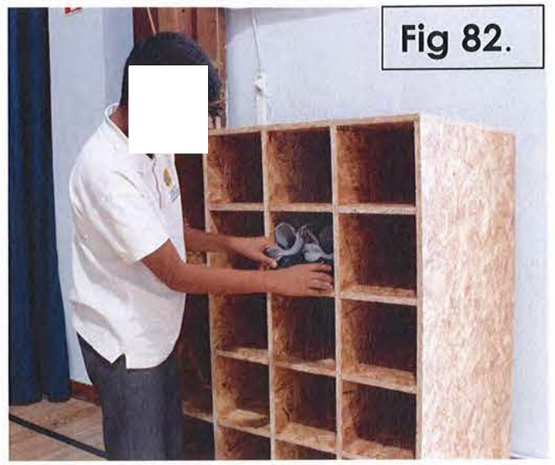


Fig 82.

Fig 83.
Individual 4 placing **shoes**

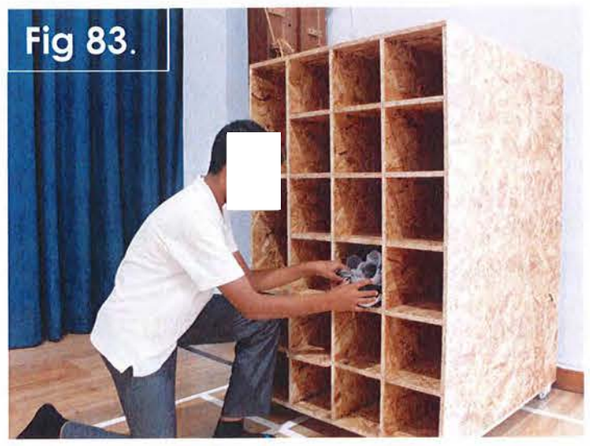


Fig 83.

Individual 4, has **tennis shoes** instead of the **traditional school shoes**, but this doesn't prevent the **shoes from fitting** in the holes. He is **slightly taller** than **individual 3** but the **ergonomics** are almost the same. The only **difference** is that he uses the **knee for support.**

Testing & Evaluation 3
Final Model on Target Group

Fig 84.

Fig 85.

Fig 84 ,85.
Individual 5 placing **shoes** inside the **rack** (top hole and bottom)

Individual 5 uses the rack **sideways**. This is different from everyone I've seen before. This gives us a **different perspective** of how the students place their belongings inside the rack. In **fig 85. and 86., individual 5** uses also her **knee for support** as well as placing her bag on the **other side.**

Fig 86.

Fig 86.
Individual 5 placing **bag**

Fig 87.
Individual 6 placing shoes (bottom hole)

Fig 87. .

Fig 88 .

Fig 89.
Individual 6 placing shoes (top hole)

Individual 6, we can tell that he is the **tallest until now.** The ideal holes for him would be the **tallest one**. Also, when he bends down, the ideas hole is **4th (counting upwards),** more low than that would be **uncomfortable.** Also, he uses the **knee support** like **individual 5** does.

Testing & Evaluation 4
Final Model on Target Group

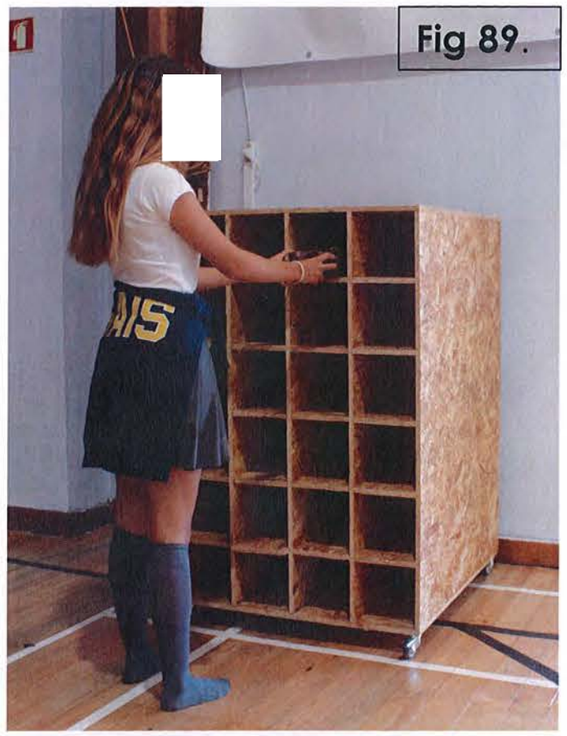


Fig 89.


Fig 90.

Fig 91.

Even though **Individual 7** doesnt use the hall that much, I **still decided** to **evaluate** my artifact with her due to her **age** and **height**. We can see that **individual 7** can easily use the **object**, being on the **top cubby hole** or **bottom**. In **fig 91.** we are able to **analyse** that she doesn't use **knee support** as other individuals do.


Fig 92.

Individual 8, the **PE teacher** is represented in **Fig 92.** placing his **shoes** on the **top hole.**

Individual 7, in this picture, is **hanging her jumper** in the rack. We can see that this **perfectly works.**


Fig 93.

Questionnaire after Evaluation

	Individual 1	Individual 2	Individual 3	Individual 4
Q.6 : Has creating a multipurpose rack helped the organisation of the hall?	yes	yes	Yes everything seems more tidy and neat	Yes its even easier for us to play football and basketball nothing is in the way
Q.7: Do you continue having problems on finding your belongings after playing the hall?	No I keep my water bottle inside the rack so it's safe	No my fleece is nicely stored inside the rack	Not anymore I feel less scared about where I put my things	No, I place my shoes inside the cubby holes so I don't loose them
Q.8: Are you going to use the rack often?	Only during PE lessons	Yes during PE lessons	Yes, every time I play inside the hall	Of course, everyday
Q.9: Are you still worried about your belongings being lost after building the artefact?	no	no	No I feel more relieved	No but it can happen someone accidentally taking my shoes
Q.10: What do you think about the artifact/ how it could be better?	Maybe have a water bottle holder	No, I think its perfect	I think its okay but maybe have more place to store jackets	I think its good like that

Evaluation:
I decided to carry out a **second questionnaire** so that I know the **honest target group's opinions**. Also with this, I can **evaluate** what I did **good** and what I did **bad** in this project. I think, for what I can tell, that the students were quite **pleased, excited and thankful** about the artifact. They gave me some **constructive opinions**, including the PE teacher.

Questionnaire after Evaluation

	Individual 5	Individual 6	Individual 7	Individual 8
Q.6 : Has creating a multipurpose rack helped the organisation of the hall?	Yes its good because now we don't trip and things are not in the way	yes	Yes I sometimes I pass by the hall and there's little disorganization	Yes as I've seen this week kids are more responsible for their belongings
Q.7: Do you continue having problems on finding your belongings after playing the hall?	Not anymore	No actually	———	———
Q.8: Are you going to use the rack often?	Yes ill always keep my shoes there while I'm playing	Yes especially to store my bag	Maybe during PE lessons so my fleece doesn't get lost	Yes to store PE equipment while I'm giving lessons
Q.9: Are you still worried about your belongings being lost after building the artefact?	No	No	Not anymore	———
Q.10: What do you think about the artifact/ how it could be better?	Its very pretty don't need to change anything	I think its good	I think its perfect maybe just the place for the hangers could be bigger in height	Maybe it could be smaller in width, it is somewhat big

Evaluation:
The **older side** of my target group **didn't give as many ideas** to better my artifact as I expected. I thought for the youngest they wouldn't give and **constructive opinions** but gladly they did. Now keeping this in mind, ill have to **think** in ways which I could **improve** so that next time I'll have more **experience** but, I'm quite pleased to see that everyone liked my project.

Questionnaire 2 Results

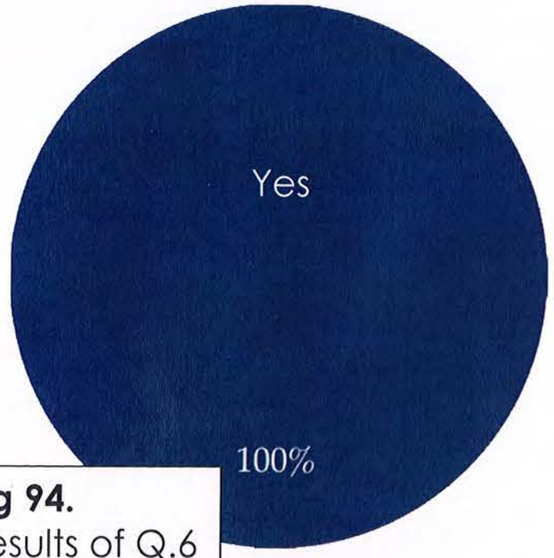


Fig 94.
Results of Q.6

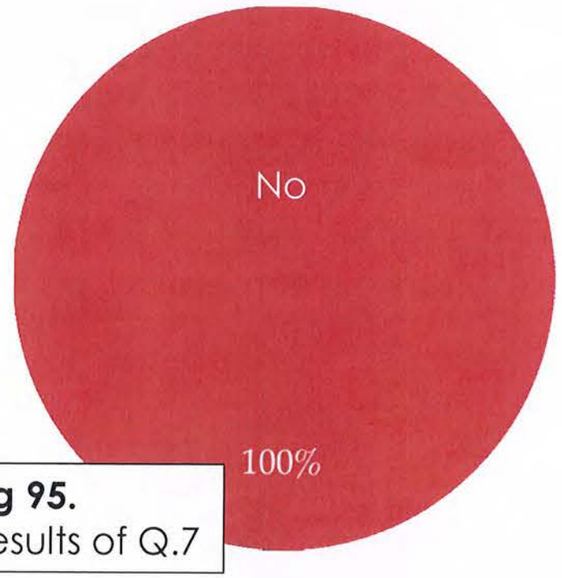


Fig 95.
Results of Q.7

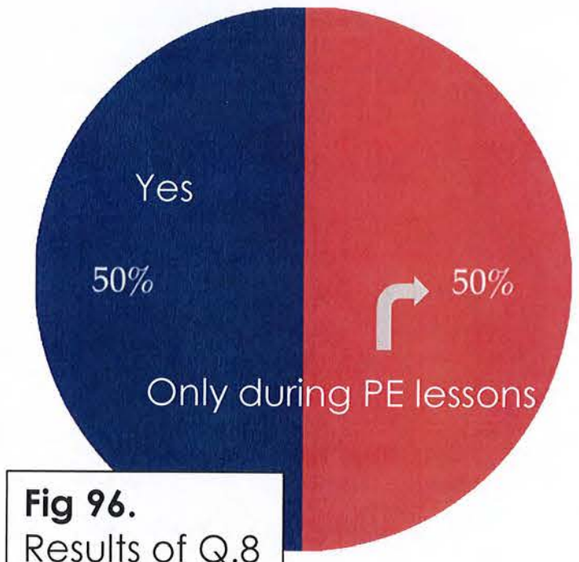


Fig 96.
Results of Q.8

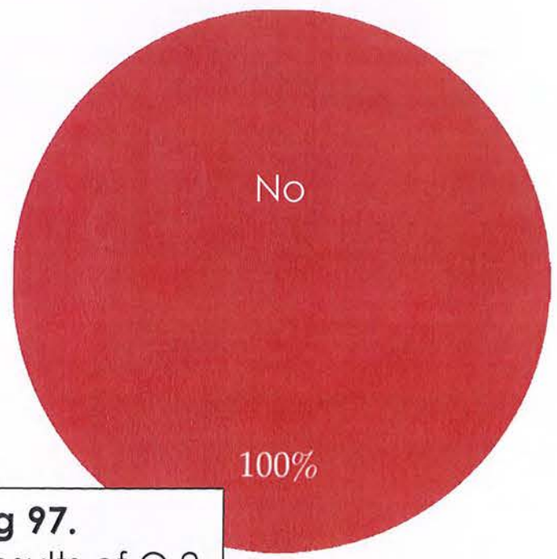


Fig 97.
Results of Q.9

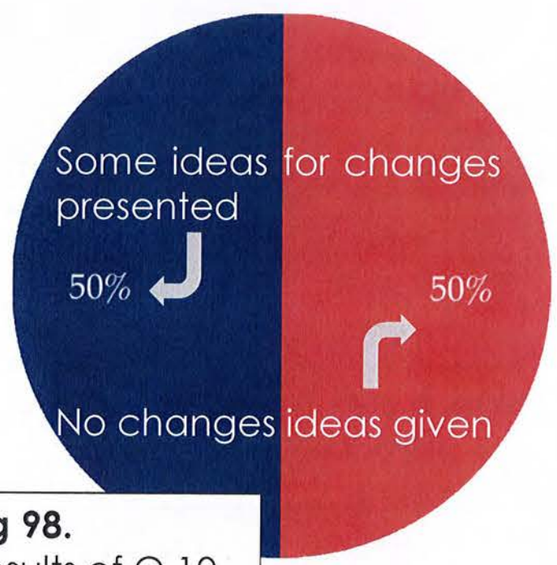


Fig 98.
Results of Q.10

I decided to put the data I collected into **pie charts** so that it is **visibly easier to interpret**.
In **question 6, 7 and 9** everyone answered the same, meaning that they think the **hall is more organized** and **no one is anymore worried about loosing their belongings.**
In **question 8** everyone is going to use the rack but **half only during PE lessons** due to them not usually playing in the hall.
Question 10, half the individuals **gave ideas** and half thought the rack was **perfect** like that.

Improvements:
Future Development of Design

After the **feedback** my target group gave me during the **second questionnaire**, I had the idea to produce a **computer module**, using SketchUp again. This is the **improvement of my final design**. It has a **cup holder** on the side and it also has **3 wooden plaques on the top** so that students can also store their clothes (jumpers etc.) so that they can just throw it up, (to be more practical).

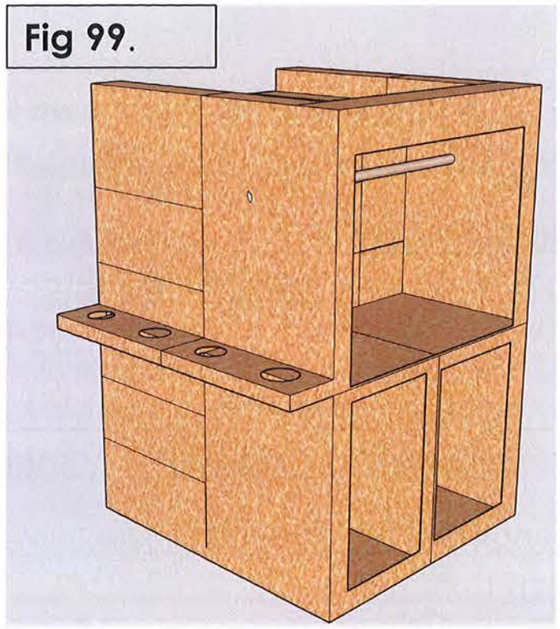


Fig 99.

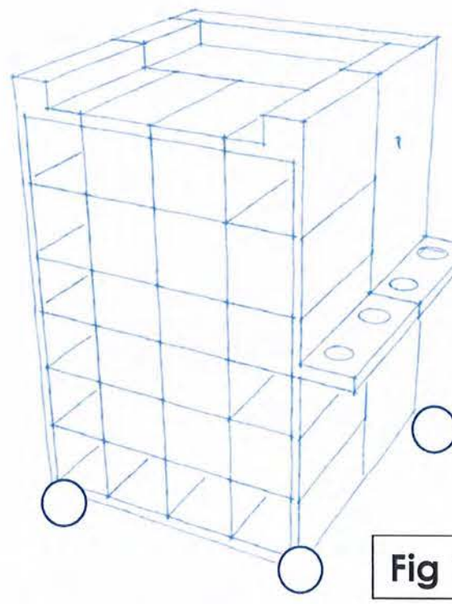


Fig 100.

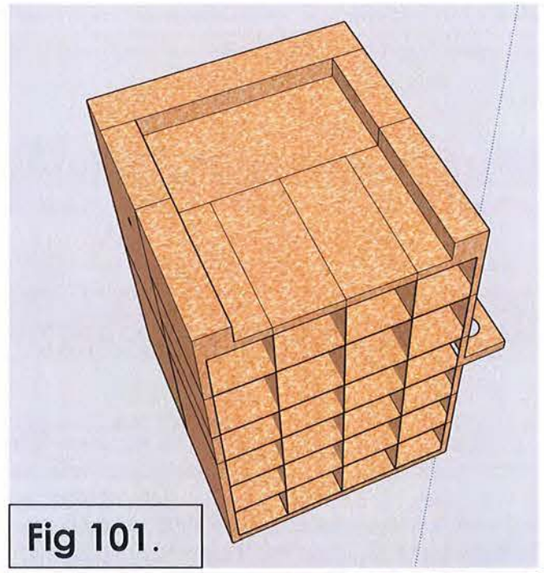


Fig 101.

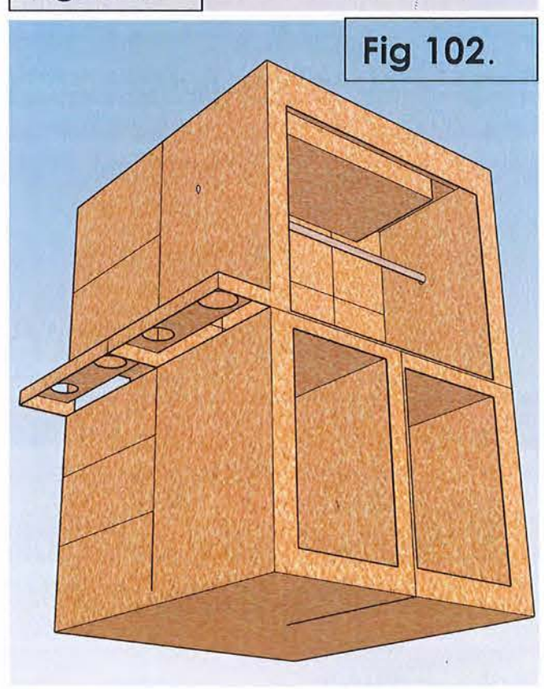


Fig 102.

In **fig 99.** you can see the **lateral cup holder**. It has **4 holes** and can store **cups** and **water bottles**. Its height is **577 mm**, counting with the wood **thickness**. By being this height, it is **accessible to everyone**, even the smallest person in school. The height of the artifact is **1250 mm** counting with the **plaques**, **Fig 101.** By having this, it provides a **safe place** to put the jumpers, **not letting them fall** from the rack.

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