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Website Exemplar

GCE D&T Resistant Materials.

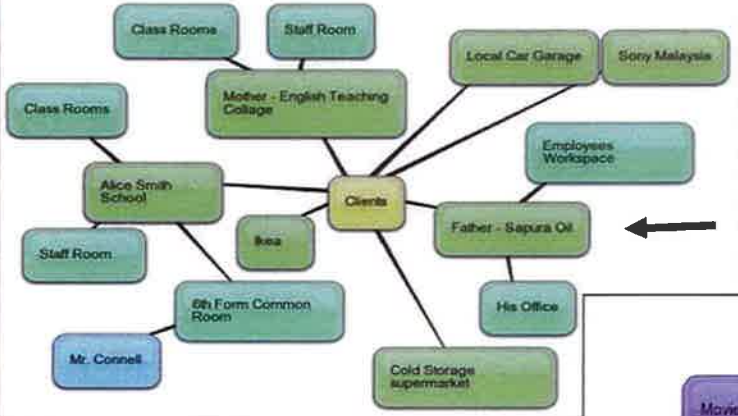
Unit: 6RM04.

Topic: Magazine Display Rack.

Edexcel GCE
Design & Technology: Product Design (6RM04)
Unit 4 – Commercial Design

Finding a Client

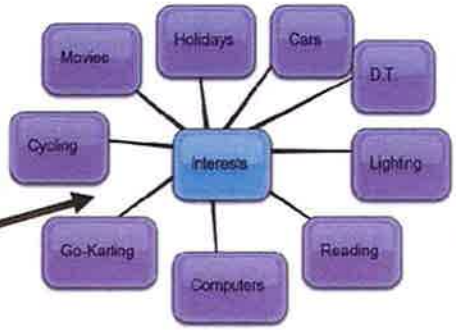
The spider diagrams below show possible clients and the areas for which a project can be based on, and my interests for which the project should try to match up with.



Review of Clients

These are all the possible clients I had considered for my DT A level project. Straight away it seemed apparent that some of these clients would not be suitable for this product. Companies such as Sony Malaysia, Cold Storage and Ikea would be too busy and thus would be hard for me to keep in contact with managers. I then compared the remaining clients to my interests in order to come up with a project that would be both suitable for me as well.

After comparing clients and interests, I narrowed the list down to my school and the car garage nearby. The car garage had expressed their need for a new desk and lighting equipment not too long ago. I knew that the school also needed equipment for various rooms. After trying to contact the car garage it became apparent that communication would be an issue as only 2 of the staff spoke English, and they didn't always answer the phone. The school would be very easy to contact as staff are always willing to help. After deciding to go with the school, I reviewed parts of the school that would benefit from a new product that would fit in with my interests. Lighting seemed like a good idea as some of the rooms suffer from lack of direct lighting. Other rooms required storage for reading content. Another room that came to mind was the 6th form common room. This seemed like an ideal place to manufacture a product for as it is soon to be renovated and styled as a modern learning space. It is also a space where I spend a lot of my time so a fair amount of personal interest will be involved.



The 6th Form Common Room

The 6th form common room is what I have chosen to design a product for. This area is going to be renovated in the near future as a "modern learning centre" and will require suitable surrounding that fit in with this style. The area will need interesting surroundings to prevent it from looking like a dull office block, but not so interesting that they look out of place and ruin the smart learning atmosphere. Even thought the building has not yet been renovated, it is apparent that some extra products will be needed besides tables and chairs.

Lighting. Middle section of learning - natural light. When stormy - appears dull and gloomy. Direct lighting in this area is needed.

Possible Products

Storage. No places to store reference books/ magazines. Some kind of community book storage would good.

Displays. A way of displaying any events happening.

Music. It has been mentioned that music does help to improve a teenager's memory. Speakers with an integrated mp3/CD player dock would be good.

A ranking of ideas:

3rd
2nd
1st
4th

I can now compare my ideas with any ideas my client has, and come up with a product to design.

Client and Initial Interview

After deciding what location I was designing a product for, I needed a suitable client. The client had to be someone that was actively involved in the new common room design, but also had a good relation with students in order for me to be able to talk to them about the product. Mr. Connell, the head of 6th form, seemed like the best client. He has already taken part in the design in the new common room and would know exactly what was needed and what would ruin the atmosphere of the new area. He agreed to be my client and immediately answered any questions I had regarding the renovation work.

What will be needed in this new working environment?

Mr. Connell said that they were already sorting out tables and chairs, and that no more would be needed, nothing else had been planned as far as unique furniture/furnishings. However, he then stated "We are looking to feature various magazines somewhere around the learning area, but at the moment we have no way of displaying or storing them". This was shown by his ranking of possible ideas. A storage project that has some kind of built in display will fulfil these needs.

Any thoughts about lighting?

"We have already planned to upgrade the current lighting in order to brighten certain parts of the area" He said that they had addressed the issue of it seeming gloomy when dark. He went on to say that they are trying to avoid floor standing lighting as the wires and light itself present certain hazards and take up space. As they have planned to change the lighting after renovation, this project idea would no longer be effective. Also with concerns of safety it does not seem like such a product would be welcomed into the common room.

What about storage?

Mr. Connell mentioned that there is no planned storage for any kind of paper or magazines/reference books yet. By looking at his ranking of ideas, we can see that this is something that he wishes to include in the 6th form area and is a very valid idea for a project.

Are there places to display notices/work?

He stated that they already have plans for cork boards where notices can be stuck using pins. Later he said that they would like to display magazines, but this cant be done on cork boards. The idea of combining display and storage is great. This is high on his ranking of the projects and in the middle of my ranking.

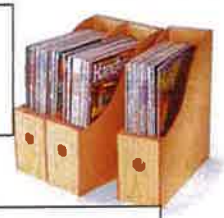
What would make a product suitable for the new learning area?

The furnishings around this renovated area must fit in with the design we have planned. We (the people involved in the renovation) don't want things that ruin the look of the new area because of poor styling. This is an important point to remember during development later. The style of the project must fit in with the proposed colour schemes and furniture. It must get peoples attention without looking to out of place.

It became clear that there was a need for some kind of magazine display and magazine storage unit for the 6th form common room. I had a look on the internet for rough ideas of what kind of displays are currently available. I could then use these ideas to make suggestions to my client during our second interview about how we could display magazines, and how to store them.

The "storage bin" idea can be useful for old magazines that still contain useful information

These designs incorporate magazine display and storage.



A more "modern" way of displaying magazines

Second Interview with my client Mr. Connell

A second interview with Mr. Connell was necessary in order to verify that the project would be a product used to store and display some kind of media. I started off by asking him what kind of material he wants on display. Mr. Connell explained that he was pushing the 6th form students to look more at the word around them. This led to the idea of displaying informative material such as magazines from national geographic or international newspapers. He liked this idea very much and said it would be great to be able to display and store magazines such as "National Geographic" and "The Scientist" and other work related magazines. These would fit well with the learning area concept of the common room. We talked over basic requirements for such a display, and Mr. Connell made it clear that it must fit in with the planned renovation theme. He also said that he would like to store previous copies of the magazine from at least half a year back.

Brief

It is apparent that a magazine rack is needed that can both display and store a variety of magazines whilst fitting in with the style and colour scheme that is planned for the new 6th form learning area. There are designated spaces for which this product will fit into in the proposed floor plan.

Initial Specification

After meeting up for the second interview, I came away with a set of initial specification points that I will use to base further research on:

- It must be able to display at least 6 magazines
- 6 copies of the latest magazine should be stored in a convenient place for easy access.
- Storage of the past 6 months magazines must be located within the magazine rack.
- The magazine rack can be placed against either a wall or corner.
- It must match the proposed furniture styling.

Size

- The display section and the immediate storage of this month's magazines should all be located in easy to reach areas.
- People must be able to see the magazines available from a distance.
- The length and depth of the product all depend on the renovation, as it is hard to gauge from the above floor plan.
- It will be against a wall, and possibly in a corner meaning that it could have a triangular shape.

Study area:
This is a general study area. Magazines would be used to aid the study of people working in this area. This area has a curvy styling to it which would have to be followed. The design would fit into a corner, as this would prevent it from using lots of space and looking out of place.

Quiet learning:
This is an area where silence is enforced for study. May not be the best place for magazines as people already have work.

Possible Locations

We looked at the possible locations for such a project and any styling that would suit that area:

Learning Cafe:
This is a relaxed study area located in the middle of the 6th form area. It has no definite style other than being smart/modern. More people would borrow magazines in this area, so more would need to be stored, and the design would have to be more durable.

Balcony:
This is a more relaxed area. Styling of the product can be more casual, but matching the wooden deck would be great. Would be outdoors – weather must be considered when choosing materials/ designing storage. For those reasons it may not be the best place for such a product.

The "Learning Café":
This is a more relaxed area for students to work in groups or just relax.

Magazines can be of a more general interest and more people may want to read them. This means more magazines would need to be stored so that more people can read the same one. There are no corners available as the plan above shows – they are taken up by desks. Could consider a free standing design.

There is no designated styling for this area, just smart/modern styling. High tables/desks will be used round the outside of the room as seen in the picture to the right, so a product of similar height would blend in better.

The Study Area:
This is a focused learning/working area for students to come during their free time. It is meant to be quiet in order for people to concentrate.

This a good location as magazines here would be used to aid peoples learning, as it's meant to be a focused study area. It would help them and provide any necessary information. It shouldn't be too distracting or ruin the look of the area, perhaps fit in with the surrounding curved dividers.

I don't think it would need to store 6 copies of each magazine as not that many will be borrowed in this area as most people are working. It can fit into the corners of the room, as there are no plans to fill up the corners with furniture.

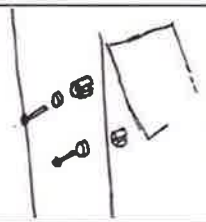
Based on the locations available and the type of product my client wants, it would be best if I aimed to design it for the study area and learning café. Both areas would benefit from a magazine stand, as it would help the students with learning and to relax. There is also sufficient space, unlike in the quiet learning section of the learning centre. The balcony is not a suitable location due to it being outside, as so exposed to weather and bugs. This would not only be bad for any wood used, but could also damage the magazines on display.

Analysis Points	Where to find the information for this point
F	
How many magazines would it need to hold?	Ask the client what ideas he has about what magazines he would like the students to read. Look at existing products to see how many magazines are displayed Ask other staff what their departments need
Do any magazines need to be stored?	Ask the client how many of each magazine, and to what date they should be stored until. Look at existing products to see how many magazines are stored Go to book shops and make notes to solve this point
Would any reference books need to be displayed /stored?	Ask the client if he would like certain books to be available Which products he wants to exhibit more prominently
Does there need to be space to post notices?	Ask the client if there is a need for a display area/notices Ask other members of staff if they think this is a valid point
Safety:	
Does the product need to be suitable for a variety of age groups or just 6th formers?	The client will be able to tell me if any other year groups will have access to the learning centre. Ask if other members of staff would be interested in having a similar magazine display
How can a product be made more stable?	Look at existing designs and see how the product is kept stable. Looking at wardrobes/desks will be a good place to start as they can be top heavy and need to be stable
Materials:	
Would wood be preferable? Or plastic or metal instead?	Look into the proposed colour schemes and furnishings of the learning centre and see what materials would match best. Also the client may have an idea of what type of wood they want to use for various doors/furnishings and note this down in my final specification
Are there any colours/colour schemes that the materials must follow?	The client and architect are yet to decide on a colour scheme, and so I will be able to find out once it has been renovated
What materials provide good resistance to weather/insects for outside use?	Look into different properties of wood from text books/the internet. See if different finishes have better resistance to insects/moisture for prolonged durability.
Manufacture:	
What processes are suitable to manufacture such a product?	Look at what is possible with the manufacturing processes available to me. See what processes are effective for different types of design/construction. Taking pictures of gcse/AS level products to see the extent of what can be done
Cost:	
What is the budget for a magazine display unit?	Ask the client what the budget is for certain furnishings, see if the budget can be changed depending on the quality of the final product
Would the budget be increased for environmentally friendly materials?	Ask the client if he would consider raising the budget for more environmentally friendly products that go with the schools idea of being 'green'
Sustainability:	
Should the product be made out of environmentally friendly materials at the expense of good aesthetics?	Show the client the look of the more sustainable materials and see if he thinks it would or wouldn't fit in with the learning centre style. Show other people in the 6th form the available materials and record responses in a questionnaire format
Compare prices of recycled materials to that of new ones. E.g. recycled aluminium and plastic.	Find out prices of all materials, and see if it is feasible to construct a design out of recycled materials.
Social/Moral:	
Are the components required made from a reliable source? Eg. Not by child labour	Check with the design department where the wood is supplied from
Environmental/Aesthetics:	
Should it fit in with the proposed styling of the learning area?	Ask the client
Are there any particular styles the product should follow? Eg. Modern	Get in contact with the architect and take notes on what he proposes the new area to look like and what style he is basing the area on
Ergonomics/Anthropometrics:	
How tall should the product be?	Find out the average height and reach of teenagers
How do you remove sharp edges from the materials?	Look into how finishes are applied to different materials from previous A level projects and from IKEA. Take photos of possible finishes for proposed materials and see what other members of the 6th form think
Transport:	
How would you transport the product up stairs or over long distances?	See if there is a way to design the product so that it can be assembled at the location, then disassembled and packed flat like IKEA products. Photograph what temporary joining methods are used and where different products join. Look into different wheels that could be used for moving it small distances.
Is there a way of storing it in a compact way?	Seeing how flat packed furniture is stored as flat as possible. Photograph how curvy/large designs are stored flat.

Product Analysis

The product analysis features pictures of existing products that fulfil some of the points found during the second interview with Mr. Connell. I will compare these products to the initial specification.

This magazine rack is made out of acrylic panels. Because the sides of the rack are see through, it does an excellent job at displaying the magazines, making it easy to see the front covers of all the magazines displayed.



As this design only uses one material, production would be very simple. The panels would be cut out using a CNC machine from a large sheet of acrylic and then secured to the acrylic base with screws. The middle sections holding the magazines have been bent, possibly by a hot wire bender, into a shape that securely holds about 5 magazines.

The main flaw with this design is that it cannot hold many magazines at all. It will hold 3 different magazines, and maybe 6 copies of each. This is not enough when compared with the initial specification, which not only asks for more to be put on display, but to also be able to store many more elsewhere. This design could be described as a point of sales display, not a long term magazine display and storage solution.

One disadvantage is that dust will be very noticeable. The magazine rack will have to be cleaned at least once a week in order to keep it looking clean.

The other specification points include being able to place the rack against a wall and that it must match the overall styling of the room. Due to the base sticking out from the rest of the display, it could not be placed flat against a wall. This may result in the product looking slightly out of place, depending on its surroundings.

An advantage about the acrylic is that it would fit in with any colour scheme, due to it being see-through. The colours of the wall behind would be very visible, even with magazines in the display. The design would fit in with many themes and styles of furnishing, particularly modern themes, which is what the new common room is being styled as.

This is a more traditional type of magazine rack commonly found in libraries. It is made of either MDF or chipboard which is then veneered in plastic. Manufacture of this will be cheap and easy as it is joined together by dowel joints. The wheels on the bottom give some aid in transportation, but it will be located in the same place while it is in the common room.

It can display a number of magazines well, and can store at least 3 on top of each other securely. While this fulfils the first specification point, it fails to meet the next two points. There is not enough storage for current magazines, and no storage for past archived magazines. It is able to be placed against a wall and not stick out very far, completing the forth point.

However, this design will fail the 5th point. It looks like it has been taken out of a community library and will not fit in with the new, modern look that the "6th form learning centre" is going for. It will look like someone put it there as a way of filling space, not thinking about if it will match the surrounding furnishings. I feel it would not be suitable due to not being able to store magazines and not matching the proposed common room theme.

Nothing on this product endangers people's safety. It doesn't extrude far from the wall, and has flat sides/no sharp corners.

This is a modern looking magazine rack. Straight away, people will realise that it has been designed for a modern environment, not for any library or book store. It easily fulfils the 5th point in the specification. It also fulfils the 1st point well, displaying the front cover of different magazines in a unique and eye catching way. It is easy to remove magazines from this kind of rack, as they simply slide off the frame.

The downside to this kind of rack is that it can only hold up to 8 magazines at once. This is a problem as it is nowhere near the amount specified in the 2nd and 3rd specification points. This is a product for upmarket coffee shops and bistros, where style and looks are important.

This product is fairly safe as it does not extrude far from the wall. However, if someone were to accidently walk into it, the poles could cause a lot of damage to the body and face.

Another problem is that the frame looks like it is attached to the wall. This would make its location permanent, and would be a hassle to move around should the common room be rearranged. This does have an upside, as it looks more well thought out, as if the designer meant for this product to be part of the room, not just an extra.

The second magazine rack displays magazines on a fold out frame that can fit into a bag when not needed. This is great for transporting and storing the rack if needed. The overall design looks simple, although the folding mechanism may make it look messy when viewing it in person.

This mechanism may make it harder to manufacture as it must be assembled in a particular way.
The number of magazines that can be displayed is large, as each level can hold 2 magazines and magazines can be displayed on each side, so a total of 12 can be displayed. This doubles what is required by the initial specification. However, being able to fold it up means that the panels are very shallow, not being able to securely hold 2 magazines stacked on top of each other. It fails the second specification point. And like with the first rack, it lacks any storage for archiving old magazines.

This magazine rack isn't very aesthetically pleasing.
It looks cheap, mainly due to the fold up mechanism.
It could look out of place in a well-designed modern environment, which would then ruin the look of the whole area. It does look cheap and so may not be appropriate for the new common room.

This rack could be placed against a wall, but it would have to have its side facing a wall or else the double sided display feature becomes useless.

The rack is flimsy and could fall over if knocked, damaging either people or objects surrounding it.

Both modern and functional are the main points for this magazine rack. The magazine rack is deep enough to hold at least 6 copies of each magazine, while holding 6 different magazines in total. This fulfils the first and second points on the initial specification. However like most of these magazine racks, it would fail the third point as it doesn't have large enough storage for archiving old magazines.

This is a wall mounted rack, so it doesn't stick out very far. This fulfils the 4th point on the specification which is that it must be able to be at least put next to a wall. The only problem with this is that its location becomes fairly permanent. Having to screw it to the wall, or hang it off nails can be an inconvenience when rearranging the room.

The overall design and the finish of the wood make the design look modern. I feel it would fit in very well with the surrounding environment, as the doors and other furnishing will be wooden.

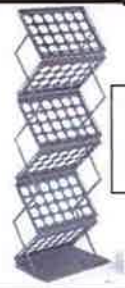
This product is very safe, as it has a tiny side profile, making it hard to walk into. The ledges that hold books in would have to be sanded to a curve so that people don't scratch their hands on it.

Thoughts on ideas:
It is evident from these designs that large storage space may be hard to incorporate into a magazine rack. I like the idea of the large wall mounted magazine holders, but that is not an option for my design as it needs to be easily moved.

Mr Connells Thoughts

He liked this, saying that "no colour means it will not detract from colour scheme in place". However, Mr. Connell stated it looks too "plastic". Glass could be an alternative.

"Fine to look at but would change the colours" Mr. Connell had no dislikes for this design.



"Nothing much too it and no steel" (in the new 6th form learning centre) means that it would look cheap and out of place.

He liked how it was very futuristic, but said that the common room is going for modern, not futuristic, and may look out of place.

Mr. Connell liked the looks, and the fact that it doesn't take up much space. But, he said it "looks hard to get the magazines out" and will become worn quickly.

Questionnaire

I handed out questionnaires to members of the 6th form. Their responses to these questions would give me a better idea about what kind of magazines I should display, if I need to display any books and most importantly if a magazine rack is wanted in the common room in the first place.

This is a copy of my questionnaire. I will show the responses to most of these questions graphically and then explain them and what they mean for my project.

When you are in the common room, what do you spend most of your time doing?
- (●) Studying
- ( ) Reading
- ( ) Socialising
- ( ) Eating
- ( ) Relaxing
- ( ) All of the above
- ( ) Other: _____

How often do you read books/magazines in the common room?
- ( ) Never
- ( ) Rarely
- ( ) Once a week
- ( ) 2-4 times a week
- ( ) Everyday

How often do you use magazines or reference books to aid your study?
- (●) Never
- ( ) Rarely
- ( ) Once a week
- ( ) 2-4 times a week
- ( ) Everyday

Would you read more magazines/books or use them more often for your study if a variety was availble in the common room?
- (●) Yes
- ( ) No

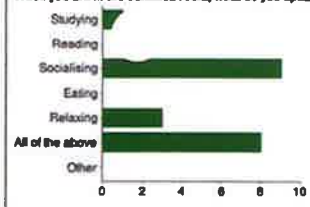
Are there any brands/genres of magazine you would like to be availble to you in the common room?

_____

Would you feel more willing to work in the common room if reference books were availble there, instead of in the library?
- (●) Yes
- ( ) No

Would you be more likely to use magazines for studying? Or for reading?
- (●) Studying
- ( ) Reading
- ( ) Other: _____

When you are in the common room, what do you spend most of your time doing?

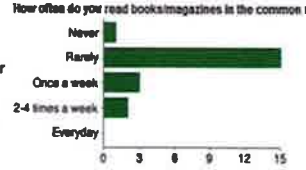


Studying	1	5%
Reading	0	0%
Socialising	9	43%
Eating	0	0%
Relaxing	3	14%
All of the above	8	38%
Other	0	0%

This first question is important, as it effects where my product will be placed. From the r I can see that more people spend their time talking with fr relaxing. This means that the learning cafe may be a more suited place for this product, as it is where people can sit and chat in a relaxed working environment. It also gives a good idea about what type of magazines are needed. Less study orientated magazines will be needed if most people just want to read casually with their friends.

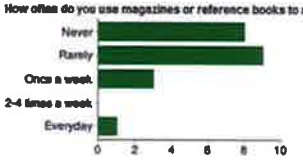
The answers from the next two questions show that not many people read/use books or magazines at all during their time in the common room. This could be because a very limited number of magazines are available, the magazines that are available are of no interest to anyone, or because they go elsewhere to read magazines and books such as the library. All three of these points are things I want my product to improve on, bringing more readable content to the new 6th form common room.

How often do you read books/magazines in the common room?



Never	1	5%
Rarely	15	71%
Once a week	3	14%
2-4 times a week	2	10%
Everyday	0	0%

How often do you use magazines or reference books to aid your study?



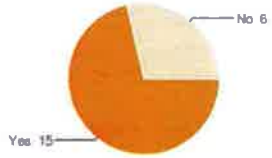
Never	8	38%
Rarely	9	43%
Once a week	3	14%
2-4 times a week	0	0%
Everyday	1	5%

Would you read more magazines/books or use them more often for your study if a variety was availble in the common room?

Yes	20	95%
No	1	5%

This is the most important question. It shows that there is a real need for my product in the 6th form common room. It is likely that almost all of the members of the 6th form would appreciate some form of magazine display and storage. This confirms my points for the graphs above, that the reason nobody is using magazines is because none are available for them to use.

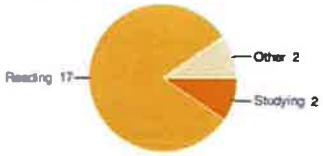
Would you feel more willing to work in the common room if reference books were availble there, instead of in the library?



Yes	15	71%
No	6	29%

This shows that it may be a good idea to incorporate some kind of storage for reference books. A large percentage of people would be more prepared to work in the common room if those books were available. The school wants more people to work in the new common room, and so this seems like a great way to persuade them to. Even more storage would have to be incorporated into the final design, a problem that was seen in the product analysis.

Would you be more likely to use magazines for studying? Or for reading?



Studying	2	10%
Reading	17	81%
Other	2	10%

This confirms that the best location for my proposed product is in the more relaxed "learning cafe" area. Most people relate magazines to casual reading, and so it makes sense to put it in the more relaxed area. It also confirms that the type of magazines needed should be of more casual genres.

Are there any brands/genres of magazine you would like to be availble to you in the common room?

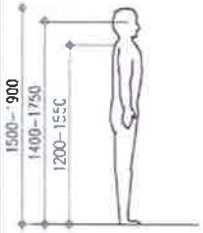
_____

Not as many people answered this question as I had hoped. Many people didn't seem to know any specific magazines that they would prefer. There were one or two mentions of "fashion" as well as "Top Gear", but none related to study such as National geographic. This goes with the results seen in the above chart.

Anthropometrics

It is important to consider the sizes of people when designing a product like this. Everything on display must be easy to reach, this means magazines cannot be too high or too low down, or in awkward to reach positions.

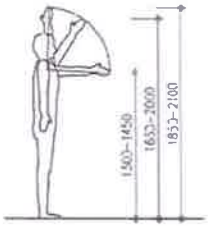
By taking the average reach and height of people my age, I will be able to build a display which is best suited to their size.



Height	1500mm – 1900mm
Eye	1400mm – 1750mm
Shoulder	1200mm – 1550mm

The average height of people is important as it will determine how high up and how low down the magazines can be displayed while still being viewed comfortably. Height is also important when combined with reach, as it will determine how low down the magazines can be placed before people have to crouch.

Figure A1 - Dimensional Data to an Average Person



Max. Reach Up	1850mm – 2100mm
Oblique Reach Up	1650mm – 2000mm
Forward Reach	1300mm – 1450mm

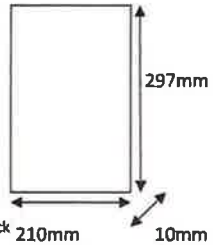
Reach is a very important factor. It states how far a person can reach up or down without having to lean over or tip-toe to grab something. Taking this into consideration will tell me how low or how high the magazine display and storage must be.

Further Research

Magazine sizes

It is important to look into magazine sizes. They will determine the sizes of all the parts of my design. The largest and most common size for a magazine is A4, which is 210 by 297 mm. There is a huge variety of sizes that are smaller than this, ranging from magazines that are only slightly smaller than A4 to pocket size magazines. This will need to be considered when designing my product. Another important aspect is the thickness. It will determine how large storage space needs to be in order to hold the required number of magazines. With magazines, the thickness varies greatly. Some are only a few pages thick, while some total 150 pages and are just over a centimetre in thickness.

Also, the storage space must be slightly deeper then the thickness of the magazines. This is so that they can be removed easily, as 6 thick magazines in a 6cm deep container can be a pain to remove.



Magazine types

Magazines come in both paper back and "hardback" versions. The hard back is normally thick card, while paper is just coated paper. It is important to take these different designs into consideration as they will not be as flexible as each other, and some may scratch or wear away faster.

Anthropometrics and Ergonomics

It is important that magazines are easy for people to reach. They mustn't be too low down, too high up or in awkward locations for people to reach. A good location for magazines is from just about eye level down to just below the bottom of the hand. These levels would be ideal as most people will stand in front of the magazine rack when choosing a magazine. This also means that storage of magazines shouldn't be too low down or else they will be awkward for people to reach.

How the magazines are held is also important. People will find it hard to reach magazines that are stuck behind wood, such as in the picture to the right. Also, magazines resting against a slanted board may be hard to pick up.

Wall Fixings

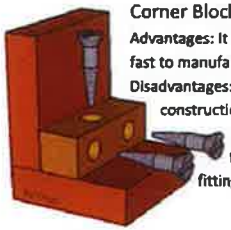
If the product is attached to the wall, it will have to be done securely, and in many locations so that if the product is knocked, the force is spread out through the wall and doesn't just damage two locations.

The easiest way to attach something is via screws into plastic plugs. Screws force the plugs open, giving it a grip on the hole in the wall, without cracking the walls surface, like a self-tapping screw would.

Alternatively, if the wall is hollow, a cavity fitting can be used to secure the design to the wall. This may be a better option as the learning centres walls are plasterboard and not concrete. They require a smaller hole then the plugs, but will not be able to hold as much weight.

Transportation and Storage

My product must be easy to store and transport. To do this it will be best to make use of knock-down fittings so that it can easily be taken apart and moved around.



Corner Block Fitting

Advantages: It is easy to assemble and disassemble. It's strong and fast to manufacture.

Disadvantages: It looks cheap and ugly. Normally used for construction of carcasses where they are out of view.

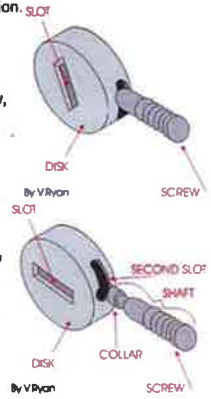
Conclusion: Not such a good idea as it ruins the look of the design. Won't be the best KD fitting for frame construction.

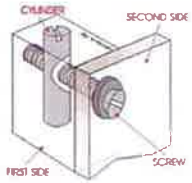
Cam Lock

Advantages: Is mostly hidden from view, only showing a metal disk. Is easy to install and disassemble.

Disadvantages: Is not very strong compared to other KD fittings.

Conclusion: A lot of these would be needed to support my design. They also leave a noticeable sized circular disc in the materials. Could be used for some parts of my design.





Scan Fitting

Advantages: Does not affect the overall look of the product. Is strong and can be used as a permanent joint.

Disadvantages: Holes must be drilled accurately to ensure the cylinder is flush with the surface.

Conclusion: Would be useful for a lot of my design if it is to be fastened with KD fittings. It is not very visible, so it won't ruin the overall look.

Safety

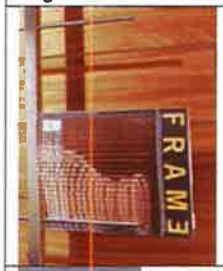
As my product is for a school it must be safe to use. Ways of making a product safer are to chamfer the edges, so that there are no sharp angles which can chip/be worn down and cause scratches. The product must also be stable. To insure it doesn't topple over it must have a wide base, such as a large sheet of thick plastic or wood. Also any screws/bolts should be flush with the surface of the product.

Materials

Woods: This looks more aesthetically pleasing than most materials. They mainly come in planks, but come in boards if they are manufactured woods such as MDF and rubber wood. Would match the wood veneer of the new learning centre. Problems are that it can be heavy and is not as durable as plastics or metals, and that it can be very heavy. They would be useful for this product.

Plastics: Clear plastics go well with any colour scheme, as the colours of the wall behind show through. Coloured plastics can look cheap and would make the product look out of place. Plastic comes in a variety of sizes and thicknesses, and can easily be cut, bent and drilled. This material will be useful for my product.

Metals: These look modern and can be finished in a variety of ways. They are harder to work with then plastics and metals, but are stronger. I don't think this will be a good material for my product as it won't fit in with the 6th form learning centre colour scheme and furnishing.

Method of holding/displaying magazines	Advantages	Disadvantages	How well it is suited for my product.
	The whole front of the magazine is displayed. Magazines stored in a way which is easy to remove. Very modern looking.	Only holds one magazine on each pole. May cause damage to inside of magazine after lots of use.	While it looks modern and would fit in with the modern theme of the new learning centre, it can only store one magazine on each pole, and in order to store more than 10 magazines the design would have to start looking a mess.
	This also looks very modern. It is wall mounted and has a very small profile, so does not block much of the wall behind it.	It does not show much of the magazine on display; only a quarter of the front page. It will also eventually leave a crease in the middle of the magazines, particularly thin ones. It too does not have much storage, only holding four magazines in this picture.	While it does offer a unique solution to displaying magazines, I feel it does not have good functionally. It does not do a very good job at displaying magazines and so would not be very suitable.
	Lots of magazines can be stored on this design, without it taking up too much space. Magazines can be stacked.	You cannot see the front cover at all of this design. It would be hard to store magazines that are smaller than A4 size.	This would be a good option for storing lots of magazines, as they are easy to remove. However they would not be good for display purposes as you cannot see the front cover.
	This looks very simple and takes up minimal space. It is a very unique concept that would make any area look smart.	The method of holding the magazines would damages the magazines after lots of use. I think it may take people a while to figure out how these work.	While it is an interesting idea, I feel that it would ruin the bottom of the magazine, and that magazines would fall off occasionally.

Further Research Continued

Wheels

In order to aid transport around the new common room, the design should have wheels. This will mean that one person can move it around without much effort. However it is important that the correct wheels are chosen, as the design could be quite heavy and the floor is carpeted.

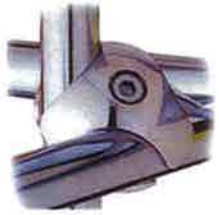
The large size of this wheel means it will easily roll over carpet and any small bumps. However, at over 4 inches high it will add an unwanted sight to the bottom of the design, and could cause stability issues.

This type of design is usually used for "wheelie" chairs, thus proving reliable. But it requires complex fittings and these may wear away over time, preventing it from moving properly.

This wheel is more discreet, and also features locks on it which keep the product firmly in place. They come in a variety of colours and are easy to attach.

Alternative Fittings

There are other fittings that can be used to hold a product together. The ball clamp on the right is used to keep a frame design in one piece. It could be described as a knock down fitting as is it is easily removed. This fitting also allows the design to be rearranged depending on the client's requirements.



This is a clamp that fits around a tube in order to hold something up. This fitting is easy to add or remove when required. It takes up little space and more than one can be used to hold up heavier objects.

Alternative Materials

A material that could come in useful for this kind of product is perforated metal. It is covered in small holes that allow you to see through. While this metal loses strength, it also loses weight, making it easier to move around and carry. The holes will also allow clips and pins to be stuck in them, which could be used for displays or to hold something up.

See through Materials

There is a variety of materials that can be used which are transparent. The most readily available is clear acrylic. It comes in a range boards and thicknesses, as well as coming in different see through colours. Acrylic is cheap compared to alternatives and finishes fairly well. It is easy to work with and can be melted and moulded at low temperatures.

Glass is an alternative to clear acrylic. Its finish is a lot better and looks a lot more professional then acrylic. It is stronger as well as more transparent (in certain conditions). However, it costs more and is harder to work with, as well as being fragile when thin sheets are used.

Specification

Specification heading	Specification points
Form	• The magazine display and storage unit must match the colour scheme/theme of the new learning centre so it does not look out of place and ruin the overall look of the centre. • The display should be easily placed against a wall, while not sticking out too far so that it doesn't obstruct walkways. This is so that people do not accidentally trip over it, and so that it does not cause long queues of people trying to get past. • The display should look modern so that it fits in with the surrounding furnishings, as otherwise it will look like a last minute addition to the learning centre, not something that was planned. • The display could feature curves, making it look more futuristic and stand out. This would also allow it to blend in nicely with the dividers present in the learning centre.
Function	• The design must display at least 6 magazines at once, so that most people will see something that interests them from far away instead of having to walk up to a pile of magazines and sift through them. • The design must feature storage of 6 magazines near each magazine on display, which is easy to access. If one magazine is particularly popular a few may be used at once, or one is left out. People still need to see what magazines are available straight away even if some are being used. • The design should have a space for storing older magazines. Magazines like National Geographic will always be useful; regardless of how old they are, so there should be an appropriate place to store them. • There could be a space to display books, such as the year book. • The display could be adjustable, so that the arrangement of magazines can be changed. This would be to keep the design interesting, making people notice what's available as the display was different from before.
User Requirements	• The design must fit in with the surrounding environment, as otherwise it will look badly designed. • The design must be safe for people to use, as it is a school, and the school will be held responsible for any injuries caused by furniture. • The design should feature different materials. This will make it look more interesting as some products made with one material look boring and cheap. • The design could incorporate some detailing from a CNC machine. • The storage of older magazines could be contained in a detailed box or use some kind of organisation system, to make looking through them for something easier.
Performance Requirements	• The design must not look worn after a few uses; it should be durable so that it lasts a long time. No one will want to repair the product once it has been put upstairs, so it is important that it stays in good condition for as long as possible. • It must be stable so that it doesn't fall over when knocked, which could possibly cause damage to both the product and the people/furniture around it. • The design should be easily assembled and disassembled so that if it is decided that the display should be placed in a different part of the school, it is not a hassle to carry as one large design. • The design could be "flat-packed" in order to save space when being stored.
Material & Component Requirements	• The materials must not wear easily; otherwise it may give splinters or break eventually. • The materials used should not look cheap, as this will prevent it from fitting in with the rest of the common room furnishings. • The materials should use a varnish finish for any wood that is used to provide better durability against wear, humidity and insects. • Different types of wood/plastic could be used to provide an interesting overall finish/look.
Scale of production and cost	• The design should be assembled easily with one or two people working together. This is so that when someone wants the product to be stored or moved, it doesn't require a large number of people to stop working and help out. • The design could use parts brought in from suppliers, for parts that require advanced processes. This would speed up the production of the product.
Sustainability	• The design should be made out of materials that are good for the environment. Materials that have been recycled are ideal as they do not impact the environment as much. • The manufacture should be planned thoroughly so that as little material is wasted as possible. This will help reduce costs to the manufacture and costs to the environment.

Design	1	2	3
Function	Myself: 8/10 Client: 7/10 User Group: 5/10	Myself:8/10 Client:8/10 User Group:9/10	Myself: 1/10 Client:1/10 User Group:2/10
Aesthetics	Myself: 5/10 Client:6/10 User Group: 8/10	Myself:8/10 Client:6/10 User Group:7/10	Myself:6/10 Client: 2/10 User Group: 8/10
User Requirements	Myself: 7/10 Client:6/10 User Group:6/10	Myself:8/10 Client:7/10 User Group:7/10	Myself: 3/10 Client: 1/10 User Group: 4/10
Total	Myself:20/30 Client:19/30 User Group:19/30	Myself: 24/30 Client:21/30 User Group:23/10	Myself:10/30 Client:4/30 User Group:14/30

Client Feedback: Design 1

My Client liked the idea of the bars at the front; he said it was a unique way of showing magazines and "goes with the uniqueness of the common room". He agreed with me that the storage section at the back is too bulky and would need to be changed "I think it needs to sit flatter against a wall" was another opinion he gave.

Design 2

The idea a modular design interested my client Mr. Conneil a lot. He mentioned that "we won't always have 6 magazines to display at one given time". However, he said there was already plans for wall space to be used for notice boards, and the fact this design is so wide and takes up a lot of wall space was a bad thing for him.

Design 3

He didn't like this design as there was not enough space for either displaying or storing magazines. "It looks like something in the news-agent s". Mr. Connell also mentioned that the plastic might start to look tacky after a while as it starts to collect dust and scratches.

User Group Feedback: Design 1

My User group liked how there was different ways to store magazines either hanging or stacked at an angle. But the large "box shape" storage was not very appealing to them. Someone suggested that it was too angular to fit in with the new common room.

Design 2

The user group felt a wall mounted design would take up a lot less room then many of the other designs I showed them. The adjustability of the design was also a feature they liked, as more or less parts can be added as needed. One person said that the storage part sticks out too far, and if it is placed low down people might trip over it if they aren't watching where they are going.

Design 3

"[illegible] was the response from my user group. The clear [illegible] was a feature they liked so they [illegible] see the parts and how they fit together. This made it appear futuristic.

Design 1

Slants keep magazines in place

Welded aluminium tubing

2000mm

This design features "arms" that display magazines in a unique way, showing the whole front of the magazin while making it easy to remove.

Behind the magazine display is storage for magazines or books. The storage slants inwards to keep everything neat and tidy.

Inspiration from internet picture

One problem is that the bottom of magazines may become crumpled after continuous removal and replacement.

Front view

Manufacture

The main storage is made from rubberwood. Square sections in the middle would be held in place by dowel joints, this helps to lower cost. The front display would be made from aluminium bars and aluminium rectangular tubing. The tubing would be welded together at the joint.

Would be cheaper to use steel tube and then chrome plate it afterwards

Magazines are displayed on "branch like" displays that are stuck out in front of the main storage unit.

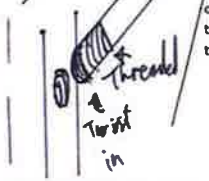
The storage part is too bulky, contrasts modern feel of front display.

This type of display is quite ergonomical, as it is easy to remove the magazines. Anthropometrics say that between 1.5/2 meters is good height.

Comparison to spec.

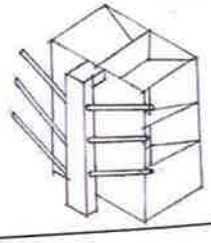
This design fulfils the storage and display part of the specification, it can easily hold the required number of magazines, as well as store plenty more behind the display. It does fit the modern theme of the learning centre, but the storage is quite bulky. If the magazine display was full, the size of the storage would be hidden behind the magazines.

The poles are threaded so they can be easily removed while the product is being transported

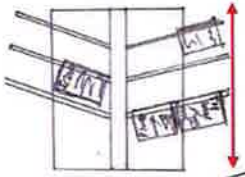


Alternatively, a cheaper way to attach the poles is to braze them to a place, which is then screwed into the steel

Idea 2



Front



Longer poles, more magazine storage

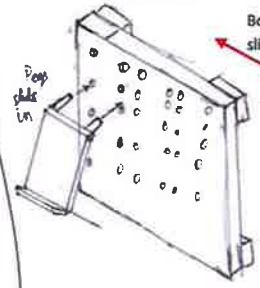
1700mm Height from anthropometric research

Possible materials for the wall include bea er wood, or veneered MDF. My research sta any type of wood would be good as it fits in well with the new learning centre... The grooves would be lined with metal (steel) to increase durability and ease of moving the displays across. The design shouldn't be made of metal, as I feel this would be less aesthetically pleasing to look at.

A design that uses pegs instead of grooves could offer a wider range of display placement. This may not look as good, but would be cheaper to build. Perforated steel could be used instead as it already has holes.

2500mm

Will be very heavy if made from 20+mm Rubber wood.



Boxes/ displays slide across

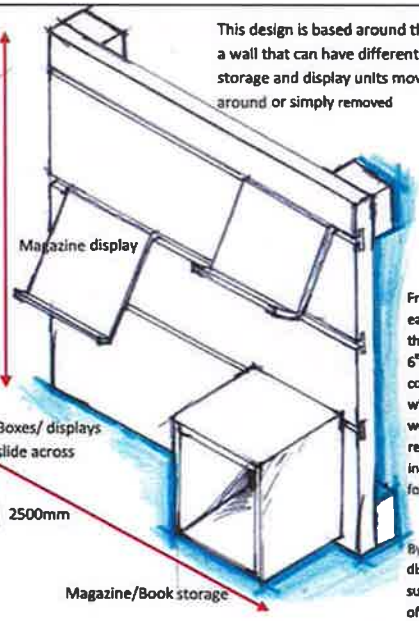
2500mm

Design 2

This design is based around the idea of a wall that can have different types of storage and display units moved around or simply removed

It will be wall mounted via screws that are drilled into the wall behind it.

Could consider a free standing base instead of wall mounted, but would require a large base.

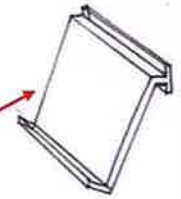


Free standing would be easier to move which I think will be better for the 6th form environment. It could also be put on wheels to aid transport. I would refer to my research for the information about wheels for bases.

By having the grooves in this shape, the display stands will not need any extra support, as the grooves can take the weight of the display.

Comparison to spec.

When compared to the specification this design does quite well. It can display the correct number of magazines, and store plenty. It is also aesthetically pleasing to look at, and fits in with other wooden furnishings. If it is wall mounted it will fail to be easy to transport. Although no assembly is required



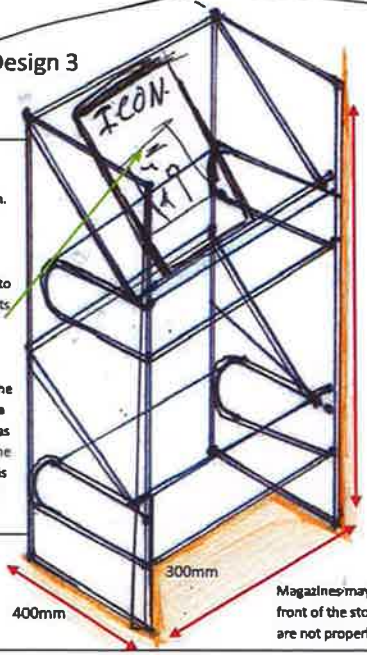
The shape is very hard to make as one piece. A different way to make it is needed.

Manufacture

This design will be very simple to manufacture as it as a square wood board. A CNC router with a special drill bit will be used to cut the grooves into the design. This is a cheap process that also saves time. The display units can be made from acrylic that is bent on a hot wire bender, or from Rubber wood that is assembled using dowel joints.

By casting the grooved section separately from aluminium, then screwing a piece of acrylic to it, the display piece will be made much more easily.

Design 3



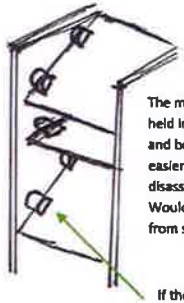
10mm acrylic may be too heavy for this design, thinner plastic may be needed to save weight, but at the expense of rigidity. Alternative materials such as MDF or perforated steel could be used, but the unique look of clear acrylic is lost.

2000mm

Magazines may fall out the front of the storage if they are not properly stacked.

Comparison to spec.

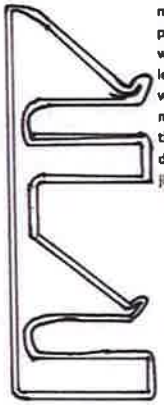
An important part of the design is that it's see through. This allows it to fulfil a specification point, which is fitting in with the modern environment. It is also easy to assemble as it only has 3 parts to it. It does not display a sufficient number of magazines at one time, or store the amount stated in the specification. This would be a large problem for the client as he would need more than one of these displays, and there is limited space in the learning centre.



The middle sections can be held in place with clamps and bolts. These make it easier to assemble and disassemble, saving money. Would need to be brought in from supplier.

If they are made in the workshop, they could be casted and turned on lathe.

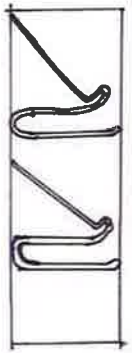
Side View – Idea 2



Idea 2, whole display is made out of one long piece of acrylic, which would need to be at least 7 foot long. It would be very hard to make and require a well thought out process and different shaped jigs/moulds.

These methods would be ideal for mass production, but as a one off design it would be very expensive.

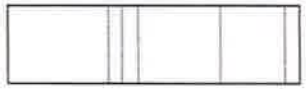
Side View



Manufacture

This design is made completely out of acrylic. The middle sections are made from 10mm thick acrylic cut into a rectangular sheet, then bent on a hot wire bender to achieve the shape. To save money, the length and width of the side panels would be the same as the display sections, so simple cuts on a band saw will be all that's needed.

Net to show the bend lines for one display part of the design.



Design	1	2	3
Function	Myself:5/10 Client:3/10 User Group: 5/10	Myself:2/10 Client:3/10 User Group:3/10	Myself:5/10 Client.3/10 User Group: 5/10
Aesthetics	Myself: 6/10 Client:3/10 User Group:4/10	Myself:6/10 Client:8/10 User Group:8/10	Myself:7/10 Client:2/10 User Group:6/10
User Requirements	Myself:3/10 Client:3/10 User Group:4/10	Myself: 4/10 Client: 5/10 User Group: 4/10	Myself: 5/10 Client:2/10 User Group:6/10
Total	Myself:14/30 Client:9/30 User Group:13/30	Myself:12/30 Client:16/30 User Group:15/30	Myself:17/30 Client:7/30 User Group:17/30

Client Feedback: Design 1

Mr. Connell liked the originality of this design, but later went on to say it looked a bit like a "washing line for magazines". He said that with some development this product could look really good, but as it is now it looks a bit odd.

Design 2

He liked how the design had a curve to it. "It goes better with the new learning centre if it features curves". Although he pointed out that storage and display were very limited, unlike what we had discussed in the specification

Design 3

My client didn't have much to say about this design, he said it was boring and didn't fulfil much of the specification at all. "The curves look like a small attempt at making it seem futuristic".

User Group Feedback: Design 1

My user group also thought it looked like a washing line, like the magazines are being left out to dry. The alternative 'z' design had more interest. They mentioned that storage could be added underneath.

Design 2

The user group felt the curves made it fit in better with the new learning centre. They said it is "simple and elegant", but nothing special.

Design 3

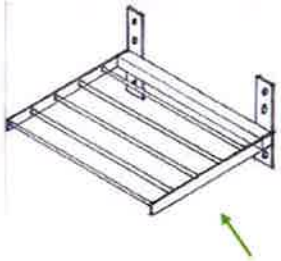
The shape was said to be interesting by the user group. They liked how there appeared to be a divider, but it was only a frame to hold the display parts up. Some users suggested combining metal and acrylic, to give it a more futuristic look.

Design 1

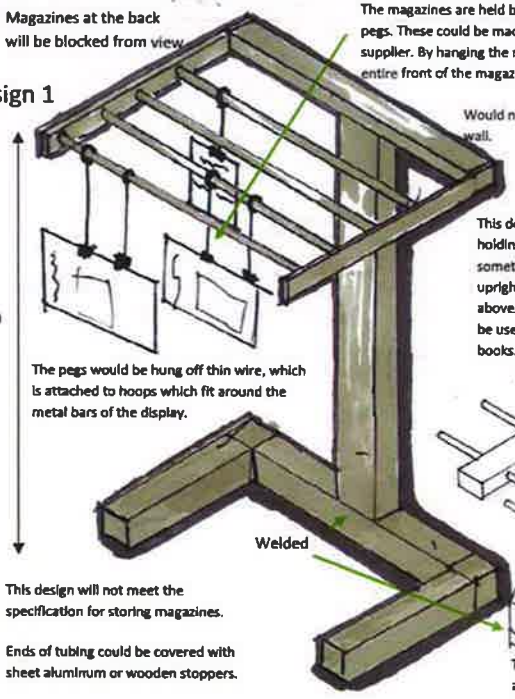
Magazines at the back will be blocked from view.

The magazines are held by these spring loaded clips, like clothes pegs. These could be made in a workshop or imported fr supplier. By hanging the magazines, people will see ain entire front of the magazine.

Would need to be bolted to wall.



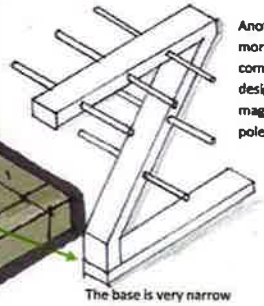
Comparison to spec.
This design fails to meet the specific for storage. It is strictly for displaying magazines only. It displays the magazines well, although it is hard to see the ones at the back. It is not that aesthetically pleasing either, a large metal frame would not go well with the common room theme. It would also be hard to transport as the aluminium frame is heavy. It fails to meet more specification points than it meets.



This design has a different approach to holding magazines. Instead of something keeping them propped upright, magazines hang from a frame above. Space underneath can always be used as storage for magazines or books.

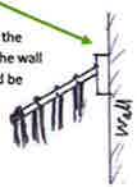
To save space, the design could be wall mounted, meaning that other storage can be placed underneath without having to worry about the frame holding the display up.

The pegs would be hung off thin wire, which is attached to hoops which fit around the metal bars of the display.



Another design is to have it look more like some large antenna. This combines the idea from the other design sheet with this one, where magazines slide on and off the poles.

To solve magazines at the back not being seen, the wall mounted display could be slanted.



Welded

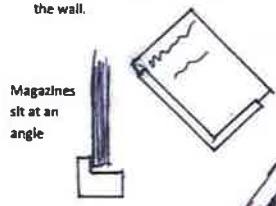
This design will not meet the specification for storing magazines.

Ends of tubing could be covered with sheet aluminum or wooden stoppers.

The base is very narrow and so unstable, would need to consider a wider base.

Manufacture
The main frame of this design is made from rectangular aluminium tubing. This is to lower the weight of the overall product. The tubing would be welded together where need be. The poles which the magazines hang off would also be aluminium. They could either be welded into place or threaded and screwed in, however that would take more time and cost more money.

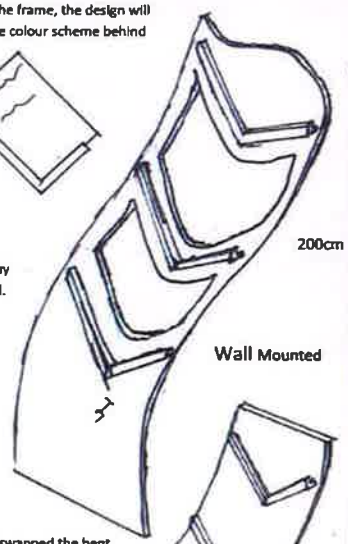
By removing some of the frame, the design will blend in better with the colour scheme behind the wall.



Magazines sit at an angle

If it was free standing, would need a wide base to make sure it is stable

Small magazines may not stand up so well.

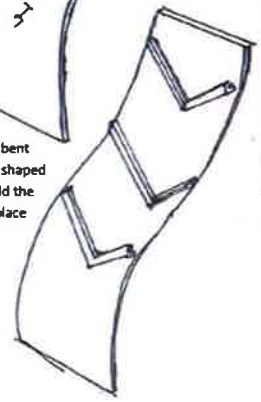


Wall Mounted

I feel that this design is not very interesting, despite being very different from the original inspiration. The original seems almost better, as it is simple.

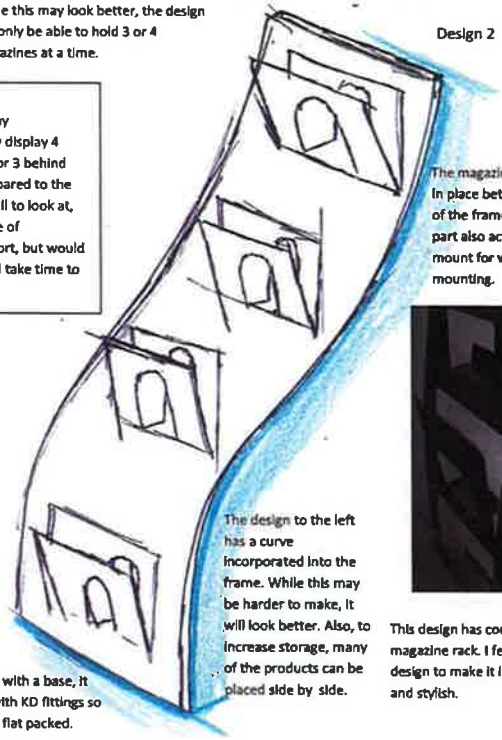
Manufacture
This design is made from one sheet of aluminium that is cut into an S shape by a CNC router. Many of these shapes can be cut from one rectangular piece, to save time and money. The parts that hold magazines can be cut out using a CNC router then bent into shape over a mould. This process is fast and suitable for mass production.

I swapped the bent aluminium for shaped ledges that hold the magazines in place



While this may look better, the design will only be able to hold 3 or 4 magazines at a time.

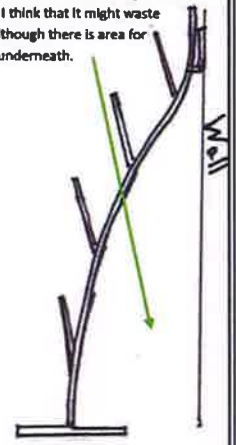
Design 2



Comparison to spec.
This display does not fulfil many specification points. It can only display 4 magazines, and store about 2 or 3 behind those. This is not enough compared to the specification. It is also quite dull to look at, being made from a single piece of aluminium. It is easy to transport, but would be wall mounted and so would take time to set up and take down.

The magazines are held in place between parts of the frame. The same part also acts as a mount for wall mounting.

The idea to the right is bent outwards instead of to the side. It's a different concept from the original design I came up with. I think that it might waste space, although there is area for storage underneath.



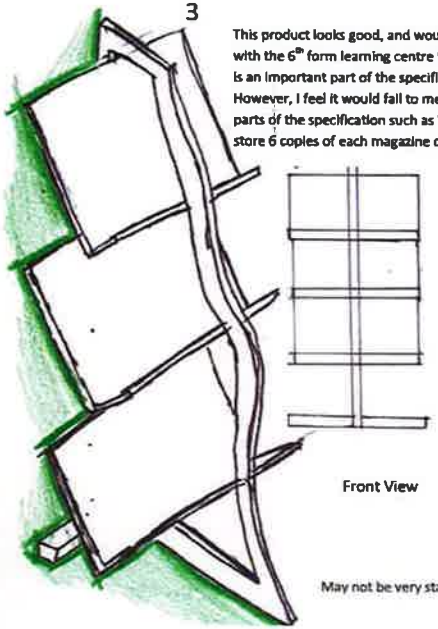
The design to the left has a curve incorporated into the frame. While this may be harder to make, it will look better. Also, to increase storage, many of the products can be placed side by side.

This design has come from an existing magazine rack. I feel I can change the design to make it look more interesting and stylish.

If I was to make this with a base, it could be attached with KD fittings so that it could be sold flat packed.

This design features long magazine holders that stretch to both sides of the rack. This makes it cheaper to make, as less pieces need to be cut out.

Design 3



This product looks good, and would go well with the 6th form learning centre theme which is an important part of the specification. However, I feel it would fail to meet other parts of the specification such as being able to store 6 copies of each magazine displayed.

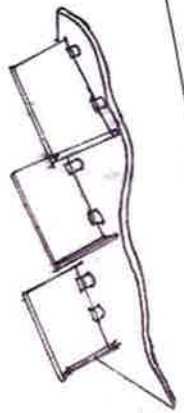
Front View

According to research, this should be about 170 cm tall.

May not be very stable

Manufacture
All the parts of this product would be made from plastic, either acrylic or PVC. This would be to keep costs down and to help it blend in the new learning centre, as these plastics can be coloured, or see-through. The displays would be attached to the frame by bolts and a type of bracket attached to the back of the frame. All of these parts would be cut out on the CNC router, as this is quick and cost effective.

Comparison to spec.
This is a very aesthetic design; it appears to be very simple, while displaying magazines quite well. The magazine displays are deep enough to hold 6 magazines at once. The design should also be easy to transport due to its simple frame. It is quick to manufacture as well.



An alternative design features a solid middle section, with magazine holders extending out the side of the middle. This could be done on both sides, giving similar functionality as the original design.

Design	1	2	3
Function	Myself:7/10 Client:5/10 User Group:5/10	Myself: 4/10 Client:2/10 User Group: 4/10	Myself:5/10 Client: 4/10 User Group: 6/10
Aesthetics	Myself:7/10 Client:6/10 User Group: 7/10	Myself: 3/10 Client: 1/10 User Group:1/10	Myself: 9/10 Client. 7/10 User Group: 3/10
User Requirements	Myself:5/10 Client:5/10 User Group: 4/10	Myself:5/10 Client:2/10 User Group:3/10	Myself:5/10 Client:5/10 User Group:4/10
Total	Myself: 19/30 Client:16/30 User Group:16/30	Myself:12/30 Client:5/30 User Group.8/30	Myself:19/30 Client:16/30 User Group:13/30

Client Feedback: Design 1

My client said that the idea of putting a logo onto it was not needed. He said "there isn't any need for it, as everyone in the common room knows what school they are in". He also said that the divider sticks out too far and blocks people from seeing what is on the other side, and that it sticks out too far from which ever wall it is placed against.

Design 2

My client had no comments about this design, but he felt it wouldn't be suitable for the common room.

Design 3

The client thought this was just a variation on design 1. However, he said it was a good improvement and made it look cleaner and simpler. Mr Connell pointed out that there was no space for storage, and this would affect what it is used for.

User Group Feedback: Design 1

"I like this design, its nice" was the comment I got from one member of the user group. They like the idea of the steps, as it looks "cool". They suggested putting something underneath the steps at the back of the design, as there is a lot of unused space there.

Design 2

They didn't really know what to make of this design. "It's just a weird display" sums up my user groups thoughts on this design.

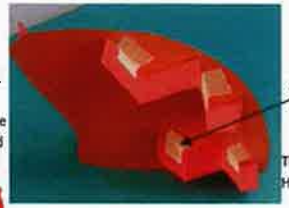
Design 3

My user group said it looked like something from a shop. One IT student said it resembled a point of sales display. They liked the simplicity, but said that the learning centre needed something unique to make it stand out.

Design 1

This design features a step design on eac' of the curved centre. The steps on one s. are continuous, while on the other side they are split into two sections.

The middle section of this design could be made of wood, although this will likely make the product very heavy/hard to move around. An alternative material would be perforated stainless steel. This would reduce weight while maintaining strength. The stainless steel could be chromed, and also lets light through so it interferes less with the colour scheme.

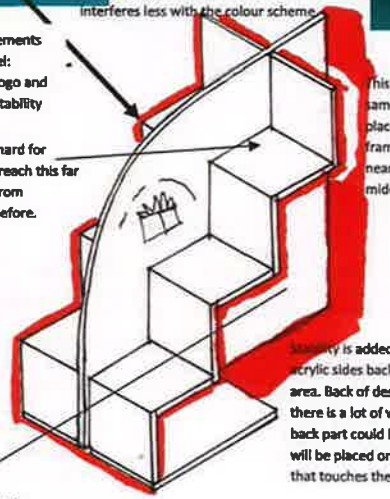


Side view-
This shows the side which has the two separate sections. Magazines are kept in place by the slant on the sections. The only problem with this layout is that you can't see the magazines at the back of the bottom section very well. To correct this a continuous step design would be implemented on both sides.

There is too much wasted space at the back. Holes/ CNC design are a possibility.

Improvements to model:
school logo and added stability

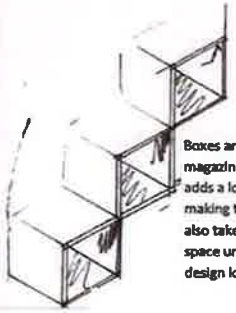
It may be hard for people to reach this far up/back, from research before.



This is a design that uses the same magazine holders, but placed around a rectangular frame. Would not be placed near a wall. Lots of space in middle is wasted.

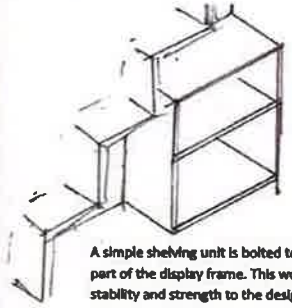
Stability is added in the front by extending the acrylic sides back to create a larger surface area. Back of design is still a problem area, as there is a lot of wasted space. Strength in the back part could be an issue, as a lot of weight will be placed on a small part of the frame that touches the floor.

Ideas for filling space underneath



Boxes are placed under the magazine display part. This adds a lot of storage without making the design look bulky. It also takes up a large amount of space underneath, making the design look sturdier.

Comparison to Spec:
This design does meet the specification for the number of magazines that need to be display and stored, given the changes suggested. It also meets the User Requirements for designs which are that it is safe to use as well as fitting in well with the surround environment of the 6th form learning centre. It may not meet the performance requirements as it will not be completely stable.

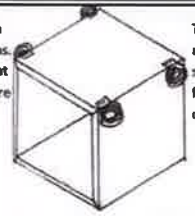


A simple shelving unit is bolted to the bottom part of the display frame. This would add stability and strength to the design, but is not so aesthetically pleasing.

Manufacture:
The middle section of this design is made from Rubber Wood as it is a recycled wood and comes in large sheets. The magazine displays on the side would be made from acrylic and attached to the centre frame by clamps and screws.

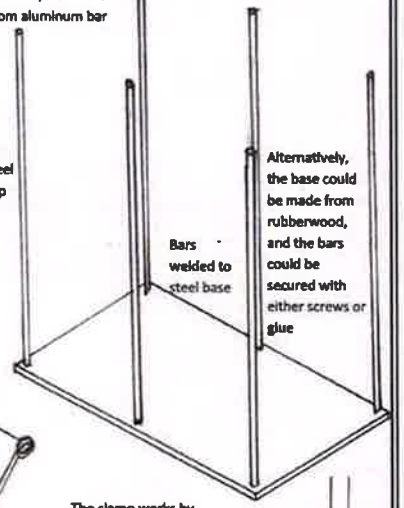
Design 2

Storage – Magazines are ...d in a box which is held in pla... lamps. People would not be able ... see what magazines are stacked unless they are looking directly in the storage.



This idea uses a basic scaffold frame, and allows the client to place the display and storage units he feels necessary on it. The frame would be made from aluminum bar or steel tube

The size of the base could be made larger to accommodate more bars, thus more display/storage modules.



Alternatively, the base could be made from rubberwood, and the bars could be secured with either screws or glue

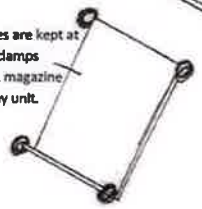
Bars welded to steel base

Manufacture:
The frame will be made up of either a steel or rubberwood base, which steel tubes are either welded too, or secured with KD fittings. The different modules will be manufactured from both steel and acrylic. The clamps will be made by drilling holes into a long steel tube, then threading the holes and cutting the tube up into smaller segments.

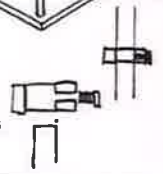
Display idea 1 – Magazines are hung down from a bar using steel string and clips are used to keep magazines up.

Comparison to Spec:
This product does not do so well when compared to the specification. Although it can display enough products by fitting the right amount of display modules, it won't be able to store enough as not enough storage modules will be able to fit onto this design.

Display idea 2 – Magazines are kept at a slant. Would require 4 clamps instead of 2. More than 1 magazine can be put on each display unit.



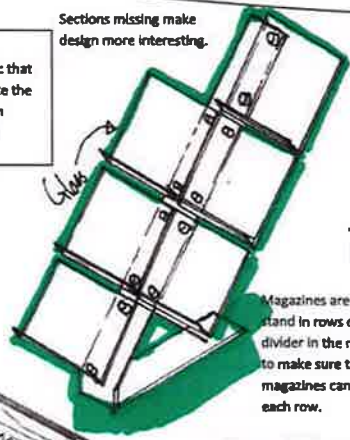
The clamp works by using a screw that pushes against the frame of the design in order to keep the parts in place.



Design 3

Manufacture:
This is made from 1 long piece of acrylic that has been bent in certain places to create the design. The dividers are also made from acrylic but are screwed into place with countersunk screws.

Sections missing make design more interesting.

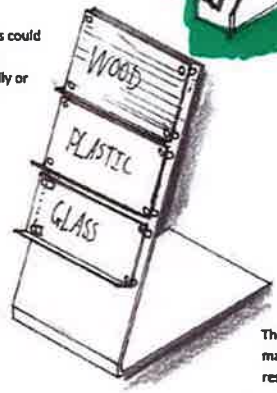


This is a more stylish take on this design. It features glass panels that are attached by small aluminum bars and as a result are raised from the frame. It looks more futuristic. The frame would be aluminum, or chromed steel lower the cost. It may look to modern for the learning centre.

A double sided design

Magazines are displayed on both sides, making it suitable to be free standing in the middle of a room.

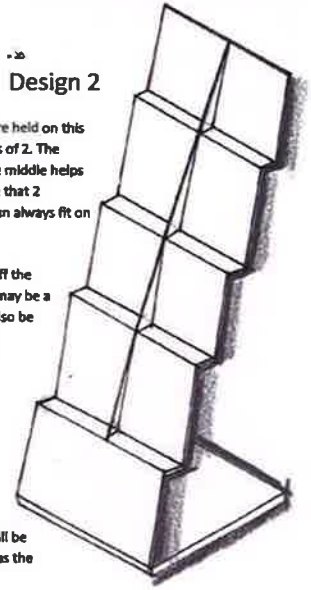
Magazines could be placed horizontally or vertically.



The divider in the middle could be completely removed, and panels could be placed on-top of a wide frame. Small aluminum bars add to the aesthetics of the design. The display parts could be made of glass, acrylic or Rubber wood/Beach.

Comparison to Spec:
I feel this design fulfils all the sections for form listed in the specification. Even though it does not feature curves, it is very aesthetically pleasing and futuristic. It does not fulfill the function and user requirements very well. It can display up to 8 magazines, but only store 2 or 3 behind it. It must be made of at least 2 different materials to fulfill the user requirements.

Design 2

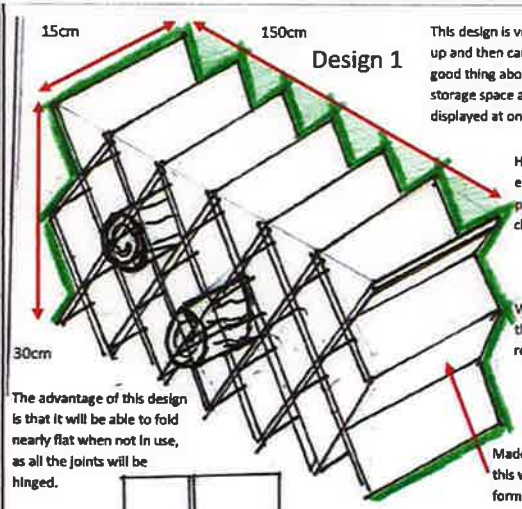


Magazines are held on this stand in rows of 2. The divider in the middle helps to make sure that 2 magazines can always fit on each row.

Magazines falling off the side of this design may be a problem. It could also be hard to hold flimsy magazines upright.

The stand/base of this design will be made from the same materials as the rest of this design.

Design 1



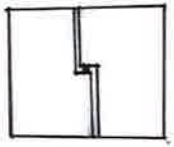
This design is very similar to a wine rack. Magazines are rolled up and then can be slotted into place in a compact way. The good thing about this design is that the display offers a lot of storage space at the same time, as so many magazines can be displayed at once.

However, one problem is that the magazines will end up all bent after a few days in this rolled up position. This idea may not be preferred by the client.

Would be wall mounted, as research shows that people would be uncomfortable reaching so close to the floor.

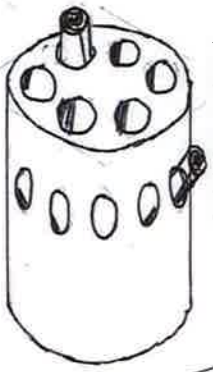
Made from Rubber- wood, as this will go better with the 6th form learning centre

The advantage of this design is that it will be able to fold nearly flat when not in use, as all the joints will be hinged.

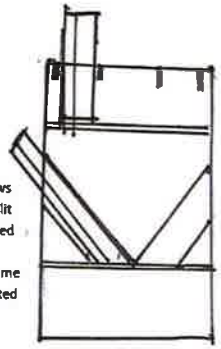


An alternative way of storing a magazine rolled up is in this cylindrical design. Magazine would be sticking up from the top, as well as at an angle from the side of the design.

Not much of the magazine will be shown while it is rolled up. This means people would have to take magazines out, just to see which one it is, as many magazines that are released monthly have the same kind of styling.



The diagram to the left shows how the design would be split into several layers. The angled magazines could be kept in place by PVC tubing. The frame could be made from laminated plywood or aluminium. However, that may make it look like a recycled oil drum.



Lot of space wasted. Could be used for some sort of storage.

Manufacture

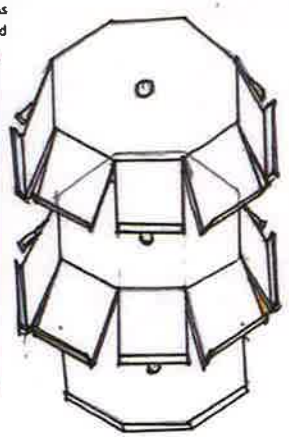
This product would be manufactured from Rubber wood, or veneered MDF. This is in order to keep cost down as a lot of material will be used in this design. The parts would be cut to size on a band-saw; many will be the same size so a CNC router could be an alternative. The hinge would work by having a steel bar that is threaded on each end. This would run the full length of the wood, in holes drilled through the wood. Bolts would be attached at each end to keep the bar in place.

Comparison to spec.

While the design does match the colour scheme, it wouldn't match the theme of the learning centre, as it looks too much like an old wine rack. It displays more than 6 magazines, but it does not display the magazines well as they are rolled up. Storage is a big issue, as all the storage is visible, and there is not much of it. It would not be very sustainable, because so much material is being used to manufacture this product.

Design 2

This design has two rotating levels that display the magazines all the way around it. As the design can rotate, it can be placed in a corner and still all magazines can be viewed if someone is standing in front of it and wants to look at them all.

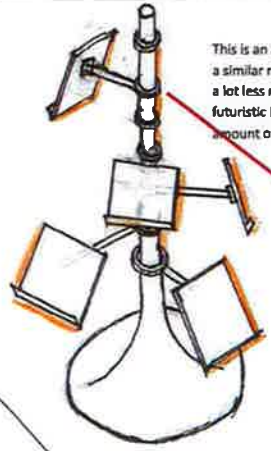


This design is quite plain, featuring small magazine stands that are attached to an octagonal base.

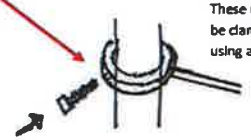
The design is quiet 'bulky'. It takes up a lot of space without providing much storage at all.

Manufacture

This design would be manufactured from Rubber wood that is cut on a CNC router into three octagonal pieces. The magazines would be displayed on bent pieces of acrylic that would be attached by self-tapping screws. The design is supported by a steel tube that runs through the middle. In order for the levels to rotate, a ball-bearing mechanism is used where the bases meet the tube.



This is an alternative design that has a similar radial inspiration. It displays a lot less magazines, but has a more futuristic look. It takes up the same amount of space, but looks less bulky



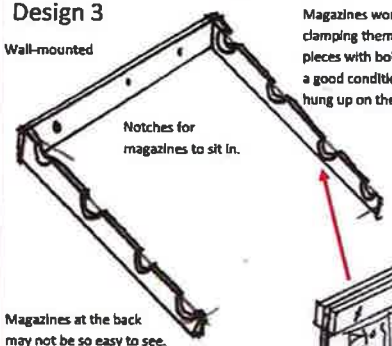
These display parts would be clamped into place using a screw.

Comparison to spec.

This design does not meet many of the specification points at all. It is too bulky to fit in with the 6th form environment, and it has no storage space despite its size. It also uses up a lot of resources, which makes it less sustainable. It does display over 6 magazines at once, however not all can be seen at the same time as the design displays them at all angles. I also feel that the rotating mechanism will not be that durable, as it will eventually wear down.

Design 3

Wall-mounted



Magazines at the back may not be so easy to see.

Magazines would be displayed on this design by clamping them in between two wooden (beach) pieces with bolts and wing-nuts. This keeps them in a good condition while allowing them to be easily hung up on the display

The frame of the design could be more vertical instead of horizontal. This would make it easier for all the magazines to be displayed at once.

Manufacture

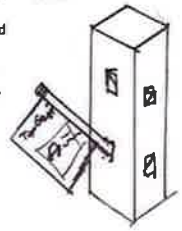
The manufacture of this product would be quick as it uses a very small amount of materials. The beach frame consists of 3 parts, two of which have notches in them. The back piece has holes drilled in, in order to allow it to be wall mounted.

Comparison to spec.

This magazine display takes up little space and is very sustainable as it uses a small amount of materials. It would be able to display 6 magazines with a small amount of development. However, there is no storage which means it fails a vital part of the specification.

The design could be changed to an upright style. This would make it easier to see all the magazines, and more can be displayed at once.

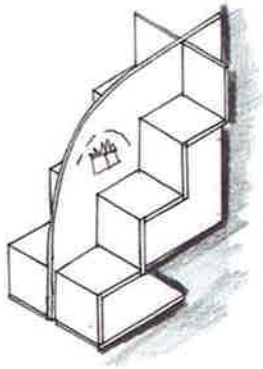
Would need to be place on some kind of stand, too low down.

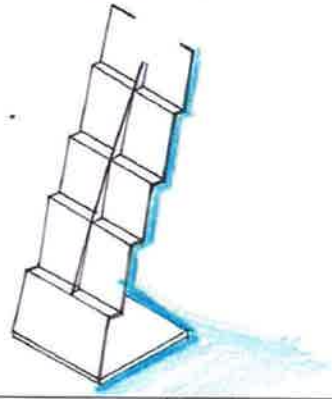


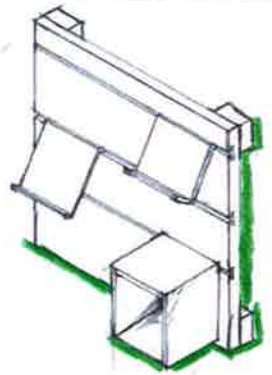
	Design 1	Design 2	Design 3
User Group feedback	My user group agreed that this looked like a wine rack, they said the idea of rolling up the magazines was "casual and easy".	"It looks like two umbrellas, which hold magazines". My user group didn't like this design at all. However, they did like the alternative design, saying it looked very futuristic.	My user group thought this was a very plain design. They didn't have much to say, apart from that the wooden pieces used to clamp the magazines will get in the way of reading the middle of the magazine, which is a big problem.
Client feedback	My client said that this would more likely be put on a table top then wall mounted, as he would be worried about the weight of it. Mr. Connell didn't like the idea of rolling the magazines up, as he felt it would ruin them after a lot of use, particularly "hard backed" ones.	My client said he wouldn't consider this design, but like with the user group, said the alternative design was good. He liked that it could be viewed from all angles. " would it be possible for the displays to rotate?" this would be something I need to consider in development.	Mr. Connell said there was a thing like this in the staff room for news papers. He mentioned it was good for the durability of the magazines, but lacks any sort of aesthetic appeal.

Design Evaluation against Specification

I have taken my favorite and the clients favorite designs, and compared them againsts the specification



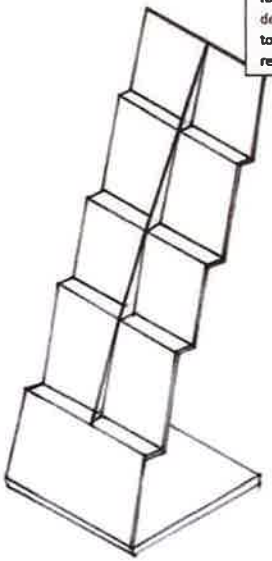




Form: • The magazine display and storage unit must match the colour scheme/theme of the new learning centre so it does not look out of place and ruin the overall look of the centre. • The display should be easily placed against a wall, while not sticking out too far so that it doesn't obstruct walkways. • The display should look modern so that it fits in with the surrounding furnishings. • The display could feature curves, making it look more futuristic and stand out.	**My Feedback:** • The wooden look and clear acrylic will not interfere with the colour scheme present. • It is hard to place the design against a wall as it is quite long/ sticks out far, may obstruct walkways. • Because of the combination of rubber wood and acrylic used, the design will look modern. • It has curves, but it is not a strong-point of the design. This could be improved during model development.	**Client Feedback:** My Client stated that the design would match the colour scheme of the learning centre provided it was made mostly out of wood. He said it "sticks too far out" to be considered a display piece. The curve contrasting the stair design was a nice addition.	**My Feedback:** • The design would be made from acrylic or a type of wood, and so would match both the theme and colour scheme of the learning centre. • is tall and not very deep, so can easily be placed against a wall and won't stick out far. • It looks modern due to its one piece design, which helps it blend into the new learning centre.	**Client Feedback:** Mr. Connell said that if this design was made of some kind of wood, it would suit the common room colour scheme and theme well, but if it was made of plastic it would be "a tad out of place" when compared to the rest of the furniture.	**My Feedback:** • As this is made from Beech or Rubber wood, it would blend in well with the colour scheme present in the learning centre, which heavily features wooden accents. • This display is designed to be placed against a wall, so it does not obstruct any walk ways at all. • The modular design of this product gives it a modern look. • It doesn't feature any curves, the whole design is quite 'pointy'. The magazine holders or the whole wall could be given curves during development.	**Client Feedback:** "If its wall mounted and made from wood, it should blend in well with the doors and room dividers put in place".
Function: • The design must display at least 6 magazines at once. • The design must feature storage of 6 magazines near each magazine on display, which is easy to access. • The design should have a space for storing older magazines. • There could be a space to display books, such as the year book. • The display could be adjustable, so that the arrangement of magazines can be changed.	**My Feedback:** • This design can display 6 magazines at once, but not all are visible from certain viewing angles. • There is no storage for magazines on this design. Can be improved using suggested ideas from design sheets. • There is no adjustability in this design. This design may not need adjustability as magazines are displayed at different heights already.	**Client Feedback:** Mr. Connell was worried that due to the display part being so upright, there was little to prevent the magazines from falling flat, or alternatively falling off the side.	**My Feedback:** • This design can easily display 6 or more magazines in a way that is easy for people to see. • It can only store about 2 magazines behind each one on display. This is short of the specification, and it will be hard to modify design. • There is no adjustable element to this design, although it can display other types of reading material.	**Client Feedback:** "It can display all the magazines well, but it can't store many, if any. That needs to be changed"	**My Feedback:** • This design can display 6 magazines at once, given that enough of the modular displays are placed on the wall. • The storage is easy to access and can be removed when needed as it is also modular. • This display is adjustable, so if the clients needs change slightly it can easily be modified.	**Client Feedback:** He said this was the most practical design as it allowed lots of magazines to be stored. Mr. Connell also liked the adjustability.
User Requirements: • The design must fit in with the surrounding environment, as otherwise it will look badly designed. • The design must be safe for people to use, as it is a school. • The design should feature different materials. This will make it look more interesting. • The design could incorporate some detailing from a CNC machine. • The storage of older magazines could be contained in a detailed box or use some kind of organisation system.	**My Feedback:** • The design does fit in with the environment, as it will be made from rubberwood, and wooden veneer is quite prominent in the learning centre. • It is not completely safe, as the rear of this design is considered unstable and could topple over if pushed too hard. • The design does feature both woods and plastics, so it does have different materials. The base may even be made of metal after further development. • There is no plan to use CNC, but it could be used to engrave a KLASS logo onto the design as pictured above.	**Client Feedback:** While he stated the design matched the colour scheme, he also said that it wouldn't go with the theme. "when placed in the learning centre, it might look shabby".	**My Feedback:** • The design will fit in well if it is made from a type of wood, as there is a lot of veneered wood in the learning centre. • It is quite safe as the base can support such an upright structure easily. However, corners on display need to be sanded down. • There will only be 1 type of material used for this design, which would not meet the specification.	**Client Feedback:** He was worried about the safety and stability of this design, as it is a tall product and has a small base.	**My Feedback:** • It fits in to the 6th form environment well as it matches the colour scheme present, but is not distracting to students. • The design is very safe as it is wall mounted, this means it is very unlikely to fall over. However, there are a number of sharp corners that need to be addressed in development. • CNC will be used during manufacture for the slots in the design, this speeds up manufacture.	
Performance Requirements: • The design must not look worn after a few uses, it should be durable so that it lasts a long time. • It must be stable so that it doesn't fall over when knocked, which could possibly cause damage. • The design should be easily assembled and disassembled. • The design could be "flat-packed" in order to save space when being stored.	**My Feedback:** • There is no reason for this design to start looking worn quickly; it is made from durable materials which are then varnished. • It is not very stable at the back as all the weight rests on a thin part of the frame. This needs to be changed during further development of this idea. • This would be hard to assemble and disassemble as it is a large product made from heavy parts. This would also make it very hard to flat pack. Side displays could be split up into small pieces.	**Client Feedback:** The client said that he wanted something that could be easily repaired by the school maintenance staff. The design looked simple enough for him to be confident that they could repair it.	**My Feedback:** • There are no parts which could easily become worn on this product. Magazines are rested on the display and these do not give much stress on the materials. • The design would be stable, as non of the product is overhanging the base. • As it is a one piece design, it cannot be disassembled. • It cannot be flat packed, but could be laid flat and stacked as it is one piece.	**Client Feedback:** Mr. Connell felt that this design might end up breaking if someone lent on it for too long. "It looks a bit weak". This would be changed by adding support to the back.	**My Feedback:** • The product will be varnished completely in order to protect it and make it more durable. The grooves in the design will be lined with steel for added durability. • As it is wall mounted, it wont fall over. • The modular display and storage units are easy to remove, but the wall mounted part will be heavy and will be hard to move around.	
Material and component Requirements: • The materials must not wear easily, otherwise it may give splinters or break eventually. • The materials used should not look cheap, as this will prevent it from fitting in with the rest of the common room furnishings. • The materials should use a varnish finish for any wood that is used, to increase better durability. • Different types of wood/plastic could be used to provide an interesting overall finish/look.	**My Feedback:** • The materials used are finished/varnished properly to prevent any breaking or splintering. • Thick acrylic will be used which stops the design from being flimsy and looking cheap.		**My Feedback:** • The materials used are finished/varnished properly to prevent any breaking or splintering. • Thick acrylic will be used which stops the design from being flimsy and looking cheap.		**My Feedback:** • All materials will be finished properly to ensure they do not wear away. The grooves will be lined with metal to ensure they do not wear away quickly. • The product should be manufactured and finished properly in order to make sure it looks of a high quality.	**Client Feedback:** The client was worried that the sliding mechanism would wear away and become useless after a few adjustments.
Scale of Production and cost: • The design should be assembled easily with one or two people working together. • The design could use parts brought in from suppliers, for parts that require advanced processes.	**My Feedback:** • There are not many parts to this product, so it should be easy for two people to assemble the products. • No parts are needed from outside suppliers for this product.		**My Feedback:** • The one piece design does not need any assembly, so it would only need two people to carry it. • No parts will need to be brought in from the supplier.		**My Feedback:** • It can be put together by 2 people, and only 1 person is needed to move the modular parts around. • There is no need for parts to be brought in by suppliers.	**Client Feedback:** The weight of this product would be an issue, as he was worried the wall mounting holes would not be strong enough.
Sustainability: • The design should be made out of materials that are good for the environment. Materials that have been recycled are ideal as they do not impact the environment as much. • The manufacture should be planned thoroughly so that as little material is wasted as possible.	**My Feedback:** • Rubber wood is a recycled material and so can be said to be good for the environment. It lowers the environmental impact as no extra trees need to be taken down. • Manufacture would need to be planned during the development.	**Client Feedback:** My client said that "you should try use as little materials as possible, as it's quite a big design". Using less materials would make the design more sustainable.	**My Feedback:** • As one sheet of acrylic is being used, there will be a minimal amount of off cuts produced.	**Client Feedback:** The same comment was made by my client as with the previous model. The less material I use, the better.	**My Feedback:** • Rubber wood is a recycled material that has a low impact on the environment as its already been used, this is good material for the product.	**Client Feedback:** As he could see this design would take up a lot of materials, he suggested I use a recycled material for this product.
User Group Feedback:	**The user group liked the fact that the design resembled steps. They also liked how the logo was incorporated onto the side of the design. They agreed with me that something should be done about the space under the top display parts, either for storage, or for a suggested "bench for people to read" to be put in place. Overall the response was that it was "ok" and "nice" but nothing spectacular.**		My user group commented that this design looked very simple. Other DT students said it looked like a point of sales display for magazines, rather than a magazine rack for a 6th form common room. There was no real interested in this design from my user group, apart from a few that said the one piece design was "cool".		The user group liked the idea of the sliding modular parts. They also liked how it would take up wall space, and not just litter the floor. Some people were sceptical of how well it would slide, or wouldn't slide.	
Conclusion:	This design does not seem to be a very good one for the new learning centre. It does not store any magazines, and the method of displaying them is poor. The divider limits the view of one side of the rack, and people would have to walk from one side to another to see what's on it. Overall there are more disadvantages than advantages to this design, so I feel it won't be suitable.		This design is suitable, it is compact in shape, and can be placed against a wall without extruding far from it. It uses fewer materials than both the other designs, and would require small amounts of redesigning to include storage. I feel this would be the best choice for the new learning centre, as it is compact and sleek.		There is not much that can be changed with this design. The shape of the design is ok as it is, but is very square and ugly. The parts that display the magazines are very limited in the shapes they can be, and as my client said, the sliding mechanism may not be that durable.	

Development

This is the design which I am carrying forward. I will need to model it to determine what is ok with it, what needs to be improved, and what needs to be redesigned.



When comparing this to the new learning centre, it is immediately obvious that it looks out of place.

The design does not fit in with the furniture present in the learning centre. Its angular design contrasts with all the curves present in this environment. This is a large area to improve upon. It also needs more of a presence; it is too small and will not be noticed by passersby if it is the same height as some of the chairs. My client commented on this model saying it was shabby, explaining it looks like it was a "cheap, last minute add in" which is not what he wants. I also looked at the design of the current magazine display, and although it is cheap looking as well, it is somehow better suited due to the number of magazines it can hold.

The contrast between my design and the environment was very obvious. Curves, waves and simple design are everywhere, and so these need to be incorporated into the aesthetics of my design.

Aesthetics

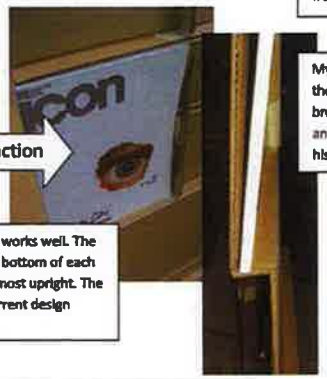
Modeling shows me straight away that the design is too small. It looks good on paper, but a 'to scale model' is a lot lower than expected.

Even though the design does not use much material at all, it still manages to look bulky, particularly from a front on view, where it resembles a rectangular block.

The small dividers in the middle of the displays look like a last minute add-on. They are purely visual, as the magazines sit on the design better than expected. Since they are so small they can be discarded from further designs, unless they are necessary.

I'm going to redesign the idea to make it fit in better with the learning centre. It needs to look less bulky, but I want it to keep the overall shape. The way of displaying the magazines on a slanted display with a ledge works very well, so that will be kept in the design as well.

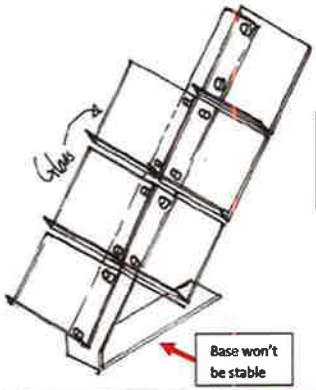
Function



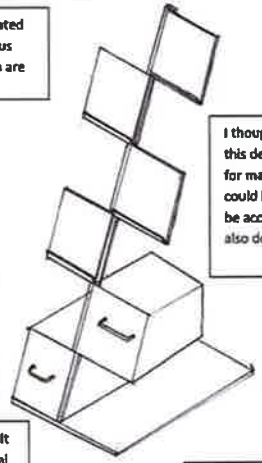
My client had a look and said immediately that there was no storage. This is a point that was brought up during the designing and evaluation, and so a solution will need to be found to fulfill his specification.

The way the magazines are displayed in this design works well. The slight slant of the design and the small ledge at the bottom of each level keep the magazines in place, despite being almost upright. The ledge may need to be made a bit deeper, as the current design could only keep 2 magazines on each level at once.

To make the design look less bulky, I separated the display pieces. Instead of one continuous block, they are now individual pieces which are attached to a centre beam.



The glass/ see through acrylic will make it look less bulky, although the sizes remain mostly the same.



I thought about possible storage solutions for this design. As the bottom levels won't be used for magazines as they are too low to reach, they could instead be used for storage which won't be accessed as often. Being stored in this way also doesn't ruin the aesthetics.

Structure

The one piece design will not be strong enough to support its own weight without bending. The model required support from two beams to keep it upright and straight. Although this was just cardboard, a very thick material will be needed to keep the structure straight as the model wanted to bend due to the slant.

However, a thick material will add weight which will increase the stress on the joint at the base. Again, thicker and stronger materials and joints can be used, but the design will become excessively heavy, and start to look more bulky. It is clear support is needed from the base, to support the upper part of the design.

The flaws in the overall structure of the design became present when trying to build the model.

Base won't be stable

To make the product seem more interesting, I tried rearranging how the displays are laid out. By placing them in a checkered style, the idea looks a lot thinner and more interesting, even though it is slightly higher than the original design.

Weak area – needs work

There is a lot of blank wall space in the learning centre. The design should definitely be kept as something that is placed against a wall, or can be wall mounted if desired.

I modeled the idea to see if it had any improvement over the previous design, or if other problems had been caused.

A lot of bending in the material was noticed, despite the model being propped up by two supports. While stiffer materials like woods and plastics will prevent this, they will also be heavier, and when displaying magazines the weight will be increased. If the design has such a small frame, as shown here by the polystyrene, an effective support will need to be found.

There is more of a presence with this design. It immediately stands out more than the original idea. This is due to it being taller. It also looks a lot less bulky as parts of the display have been removed.

Despite the extra height, a lot of display space has been lost. The top display is low enough to be reached, but the bottom two displays are too low down for anyone to reach, or notice while walking past. 4 displays is less than the client asked for, and so a way of displaying more is needed.

The bottom sections should be used for storage, as they won't be noticed as easily and will only be accessed occasionally.

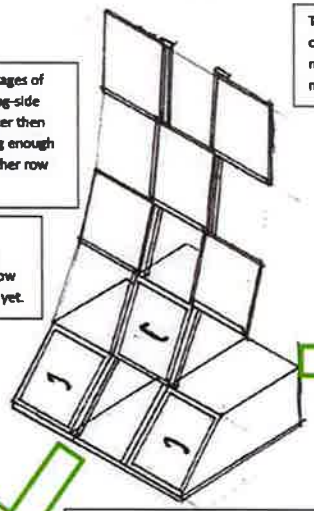
The design is still very straight, and this will contrast with the environment. It needs a more modern and interesting design, to make it look more attractive and so that more people look at/read the magazines on the display.

Structurally, the design is a lot weaker than the original. The narrow frame provides little support to the displays and the magazines it will hold. This will cause many problems regarding support for the upper part.

Development

After reviewing the advantages and disadvantages of the 2nd model, I decided to keep the alternating-side display that made the second model look better then the first. To address the problem of not having enough displays, I made the design wider so that another row of displays can be added.

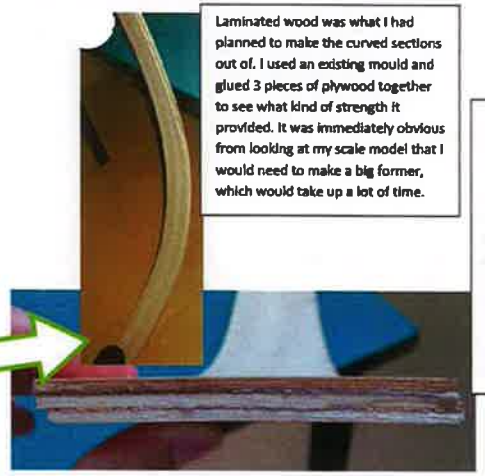
The design keeps the same display pieces, as they function very well. I have also added in the storage units seen on the previous idea, however I don't know how many magazines I will be able to store in them yet.



To better suit th nment of the new learning centre, I have ad a curve to the design. This matches the curvy dividers found in the learning marketplace.

I modeled the whole design, to get an idea of its height and width, and how it looked compared to my previous 2 models. The extra width makes it look sturdier, and the lower height makes it look more stable.

I really like the idea of the curved lower section; it makes the design look more elegant. I will need to model this and see how easy it is to make a curved section of wood similar to the size in the model.



Laminated wood was what I had planned to make the curved sections out of. I used an existing mould and glued 3 pieces of plywood together to see what kind of strength it provided. It was immediately obvious from looking at my scale model that I would need to make a big former, which would take up a lot of time.

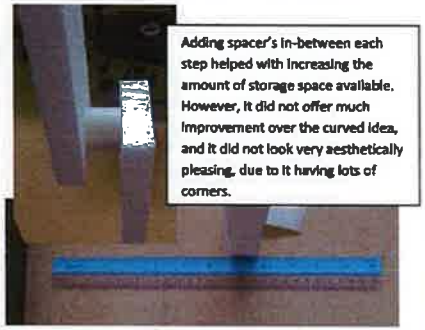
I was pleased with the result as the laminated plywood was reasonably strong given its thickness.

However, I feel creating a former for such a large design would take too much time, the actual process of laminating would be too difficult as it is hard to bend only the bottom half of the design, leaving the top half straight. Even if the frame was done in two sections, this would add more complications to how the sections would be attached together.

I modeled the storage based on distances I had taken between my previous model and the wall, to see if the curve would limit how many magazines I could store.

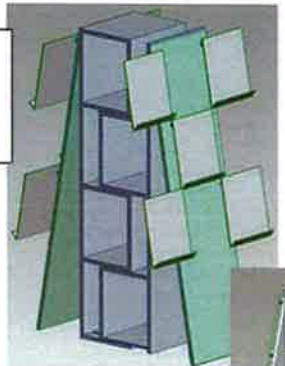
I decided to design the storage in small draws instead of one large container. I checked that the storage would be wide enough to hold magazines, and still be able to slide the draws in and out. Overall, the storage unit would be the same length as the display pieces above.

One very large problem is that the top shelf is not deep enough to store a magazine. This means that only the very bottom section of the display can be used.



Adding spacer's in-between each step helped with increasing the amount of storage space available. However, it did not offer much improvement over the curved idea, and it did not look very aesthetically pleasing, due to it having lots of corners.

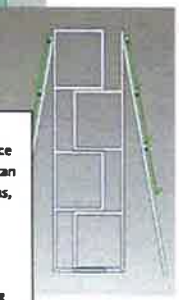
The storage and frame parts of the design are becoming hard to improve on, so I decided to create a new idea that used a similar display layout but had a different way of storing things.



Shaped draws could be placed inside the shelving to give the product a more professional look. The draws will have slanted containers inside them which help to maximize the amount of space available to magazines

The space underneath could be utilized by putting some kind of shelving in.

These storage units are quite complicated to build, and would require lots of planning and accurate cutting to insure they fit properly. It is seen in the CAD model that the draw design doesn't quite fit, and even though space is maximized by the slanted design, it still can't hold that many magazines compared to what is stated in the specification.



This design keeps the same display layout, but has a lot more storage space then the previous design. Magazines can be easily stacked in the middle sections, and the displays face 2 directions.

Also, the design comes apart into 2 separate pieces which may be very useful as the number of displays facing one direction can be doubled, or if you want a display in another location, you can just move one section.

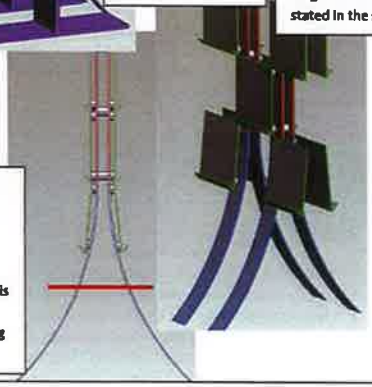
Changing the frame to a step shaped design didn't help increase the storage. It was even closer to the

I then produced a CAD model to accurately check how deep the storage could go at different heights along the curve.

The red line indicates the level where magazines will no longer fit. The depth past the line is less then 320mm (magazine length + 20mm material thickness) and so would not be suitable for storage.

This is a major flaw in my design and will have to consider other ways of storing magazines in such a limited space. This will leave a blank section on the frame that is too low for someone to reach, but is too high for storage to be used.

I decided to stick with the original idea, but increase space placing two of the designs together. The space underneath is doubled, and extra space is gained by placing 50mm spacers in-between, giving extra space.



However, the design starts to look bulky again, which is what I am trying to avoid. The front and side profile is still full of corners and large rectangular pieces. This is not suitable for the common room.

I need to come up with a way of displaying magazines in this "checker board" arrangement, but keep the storage discrete, and make sure its aesthetics blend in with the 6th form learning centre.

Development

After reviewing the previous model, I decided that it was best to stick with a small frame as this is the only way to make such a large structure look less bulky. I wanted to keep the two piece frame design, but allow space for more storage whilst not compromising the aesthetics.

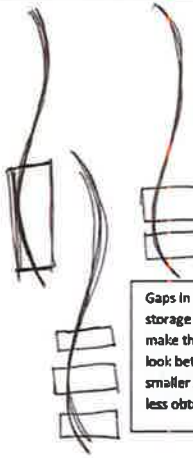
I decided to go with an S shape after studying the shape of the learning centre dividers. They manage to look good without reducing the space.

Functionality

This design allows for more space to be used as storage. As the curve is coming away from the back of the design, storage can be placed higher up.

This leaves a lot of space that can be played with for different designs.

I feel that 2 storage units are better than just one or three. Three make the design look messy, and will be larger as more material thickness will be added to the design. 1 piece looks too bulky, but offers a lot of space. Therefore, a good compromise is 2 pieces as it still has a lot of space, but doesn't look messy or bulky.



Gaps in between the storage units help make the design look better, as smaller sections look less obtrusive.

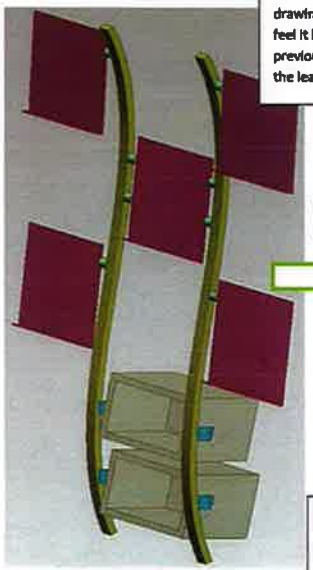
A small support piece can be used to hold the storage units in place.

Slanted boxes will be easier to access. As the storage is located at the bottom of the design, a slant will mean people will not have to bend over as far to look at and pick up a magazine.

I am going to keep the "checker board" layout of displays, as this is the best compromise of display area and aesthetics.

The displays would need to be angled differently to insure that the students can see all the displays well.

Structure



After looking at functionality of the design, this is a basic CAD drawing I have come up with. I feel it looks better than the previous designs, fitting in with the learning centre very well.

Frame

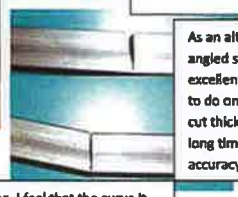
Wood would not be suitable for this design, as the laminating process needed will be too complex and it is likely it will take many times to get a perfect shape.

An alternative to the wood is square steel tube. This provides lots of strength and can be shaped more easily compared to wood. A way of shaping this in a curve is to cut small sections out of it and then bend it over.

Bending the bar inwards (top square tube) was a method I feel is better. Every bend is the same angle, as the amount cut out is always consistent. It also leaves a very small gap which can easily be welded shut and made to look like there is no gap at all.

I modelled my idea out of thin square steel tube. I cut a section out every three inches and then bent the tubes. I first bent it outwards. The shape I got was very smooth and was exactly what I wanted. However, each bend was different and it left an ugly gap (bottom square tube) that would be hard to fill.

I tried filling the gaps with wood, but it was apparent there was no way of keeping the wood in place. It didn't add much to the aesthetics, and my user group said it looked worse than the gap.



As an alternative method, I tried cutting an angled section out of the steel bar. This gave an excellent finish, but took too long and was hard to do on the metal bandsaw. It would be hard to cut thick steel bar in this way, and would take a long time, as well as encountering various accuracy problems.

I welded up a full scale bend from the CAD drawing. I feel that the curve it produces looks really nice, and that this is a good shape for the final design. The amount of curve the design produces can be changed based on the number of cuts, as every cut is the same. After welding, the bar appeared to be very strong, it was impossible to bend it straight afterwards. This should be enough strength for my magazine display.

I tested this on a full scale piece of steel square tubing and found that the gaps had to be cut a lot closer together in order to get the same amount of curve. While this is not a problem, it does mean that the process will take more time. Another problem is that lots of cutting means less strength. Welding the gaps up will replace some lost strength, but the steel will not be as strong as before. A thicker square tube may solve this problem.

I really like the look of this design, and have decided to carry it forward. I will need to look into other problems in more detail later, in order to make sure this design will work well and fulfil as many specification points as possible

I measured the proposed storage solution with the curved bars to get an idea of what they looked like. While they weren't to scale, the side profile looked very promising, as the boxes did not extend further back then the top curve. This is very good as it means the product can be placed against a wall.

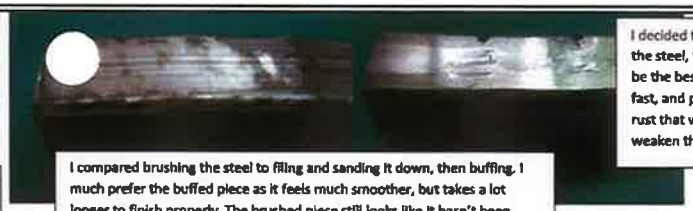
Development

After deciding on using a curvy frame for my design, I now have to think of a way to keep the display upright, as well as how the magazines will be held in place and how my design should be finished.

Finishes

After welding, it was obvious that I need to grind the excess metal off. This was done us ngle grinder

After grinding the metal down, I noticed that there was lots of gaps in the welding. This is something I need to work on during the production, it is better to have too much excess metal, than not enough.

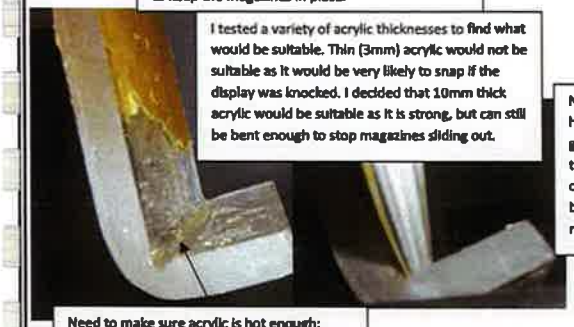


I compared brushing the steel to filing and sanding it down, then buffing. I much prefer the buffed piece as it feels much smoother, but takes a lot longer to finish properly. The brushed piece still looks like it hasn't been finished properly. I need a manufacturing process that will provide the best finish, but take the least amount of time.

I decided that filing and sanding the steel, then chroming it would be the best finish. It is quick and fast, and protects the steel from rust that would otherwise weaken the structure.

Displaying magazines

The magazines will be displayed using sheets of acrylic which are bent at the bottom end in order to keep the magazines in place.



I tested a variety of acrylic thicknesses to find what would be suitable. Thin (3mm) acrylic would not be suitable as it would be very likely to snap if the display was knocked. I decided that 10mm thick acrylic would be suitable as it is strong, but can still be bent enough to stop magazines sliding out.

Need to make sure acrylic is hot enough; otherwise ridges form on the front and back.

Next, I thought about how this acrylic was going to be attached to the frame. A simple clamping method will be the easiest to make.

However, the clamp wasn't strong enough for this small piece of acrylic, as you can see the acrylic is slanted due to its weight.

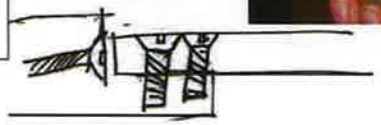
To solve this I screwed the acrylic directly in the display holder, making it a lot sturdier.

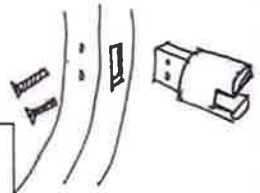
I modelled this again out of aluminium, and used a more realistic size of acrylic to make sure the holder could stand the weight.

The holder seemed strong enough, but I will have to test it properly once I have found a way to hold all the acrylic displays.

There are 3 ways in which the magazines can be attached to the main frame. Each has its own benefits and flaws.

A benefit that comes from this method is that more display space is available, because none of the display holder is overlapping the acrylic. By counter-sinking the screw heads, the surface of the display remains flush.

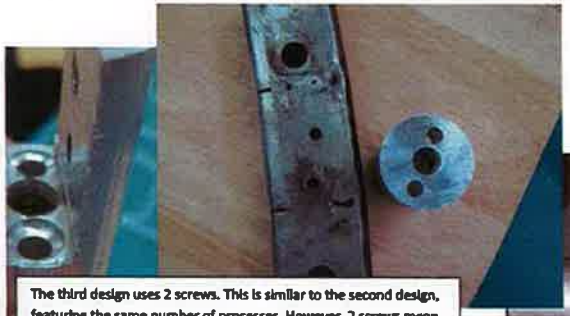




The first method consists of a slot type design. The aluminium bar has a rectangular shape cut into it; while the square steel tube has a slot cut out that the bar fits into. Holes will then be drilled and threaded through the tube to hold the bar in place.
Advantages: The aluminium bar will not rotate while it is holding weight.
Disadvantages: Many more processes are required then other ideas. Drilling a rectangular shape into steel will take a long time. The surface of the steel will be interrupted by screws.

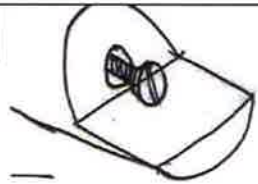
I will be using the third option as it provides a strong join to the steel tube, while requiring a small number of processes. This comes at the expense of adjustability, but otherwise the displays would move over time.

Now that all the small parts have been designed, I will draw them and model them as a full scale product, and make changes to the design as a whole.

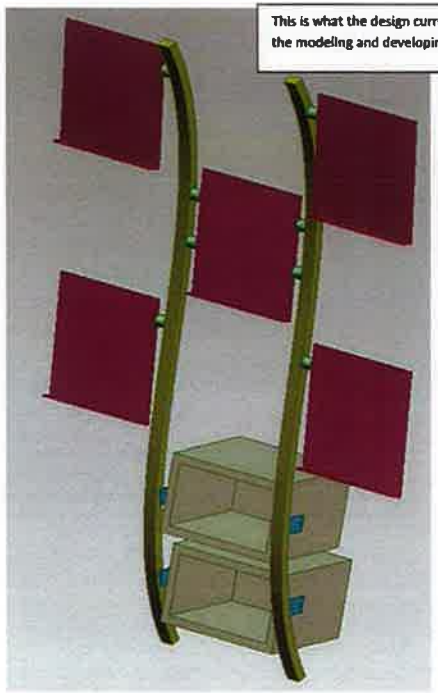


The third design uses 2 screws. This is similar to the second design, featuring the same number of processes. However, 2 screws mean that the displays are in a fixed location and will not move regardless of the weight applied to them.
Advantages: Are in a fixed position, so they will not move no matter how much weight is put on the displays. Requires a small number of processes, and only takes slightly more time than the second method.
Disadvantages: Displays are not adjustable. Requires twice the number of holes drilled.

The second method uses a thin threaded bar which screws into to aluminium bars at each end. Only two holes need to be drilled into the square steel tube, requiring a low number of processes.
Advantages: Not many processes needed, only drilling and tapping required. Display angle is adjustable.
Disadvantages: Display moves when two or more magazines are placed on it, due to the weight. There is no way of tightening it as the thread moves in both aluminium bars.



Development



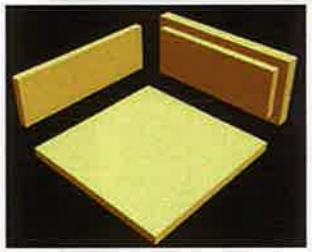
This is what the design currently looks like, after all the modeling and developing on separate parts.

I increased the number of magazine displays from 5 to 6. I feel this makes the design look less bare, as there is less open space. However, it won't make the design look crowded as the displays will still be made out of acrylic.

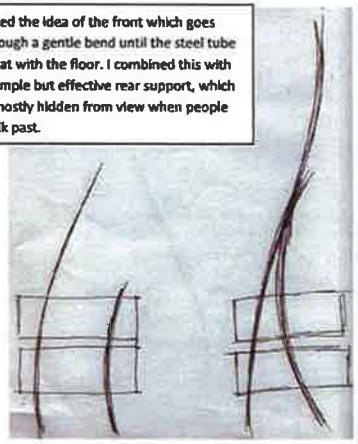
I asked my client what he thought of this design; Mr. Connell replied by saying "This is great, it would look good in the common room. I certainly wouldn't be pushing it into some dark corner that no one could see" and "I'm a bit concerned about the stability, but if its placed against a wall then it should be stable, as its unlikely to be knocked from behind"

My user group also responded positively, stating that it looked very modern, and that it was not something that came to their mind when thinking of a magazine rack.

After drawing out the design in full size, I found a problem that was not noticeable during the CAD modeling. From the drawing I could tell that there would be too much weight hanging over the front of the supports for the design. The supports are very near the center of mass, meaning that a small nudge from behind could send the product crashing forward.



I liked the idea of the front which goes through a gentle bend until the steel tube is flat with the floor. I combined this with a simple but effective rear support, which is mostly hidden from view when people walk past.



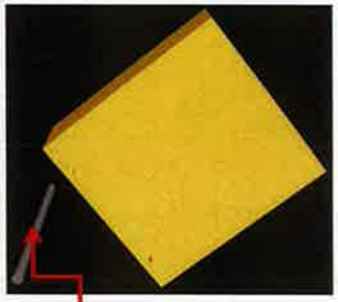
By having the rear supports as far back as possible, and having the front parts of the steel tube as far forward as possible, the design has the most stable base given its dimensions.

I decided to change how the box would be made, as it is now supporting a lot of weight. Thick side panels would be used as these will take the main strain from the above design. The back piece is also very thick so that the aluminium bars at the back will be held in place securely, and so that there is no chance of cracking.

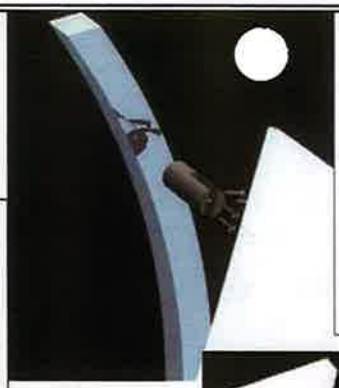
Exploded View

This sheet shows my design in an exploded view. It shows how everything will fit together and will highlight manufacturing methods.

The metal frame is made by cutting slots out of a square steel tube, then bending the tube into shape. Welding the small gaps afterwards helps it retain its strength.

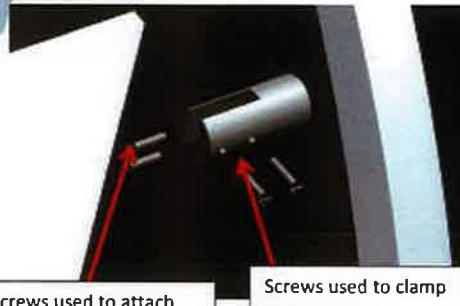


The aluminum poles at the back of the design act as supports. These stop the display falling backwards due to the weight above. They also give the display a small profile, so that it can be easily placed against a wall. The poles are held in place by screws.



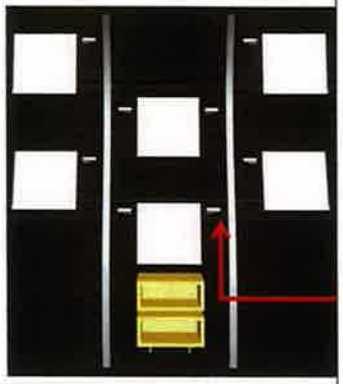
The magazine displays are made from 8 mm thick acrylic. These are bent at the bottom using a hot wire bender and a hot air gun.

They are attached to the frame using aluminum display holders which are produced on CNC lathes. These are screwed into the main frame of the design, but also clamp the displays in place.

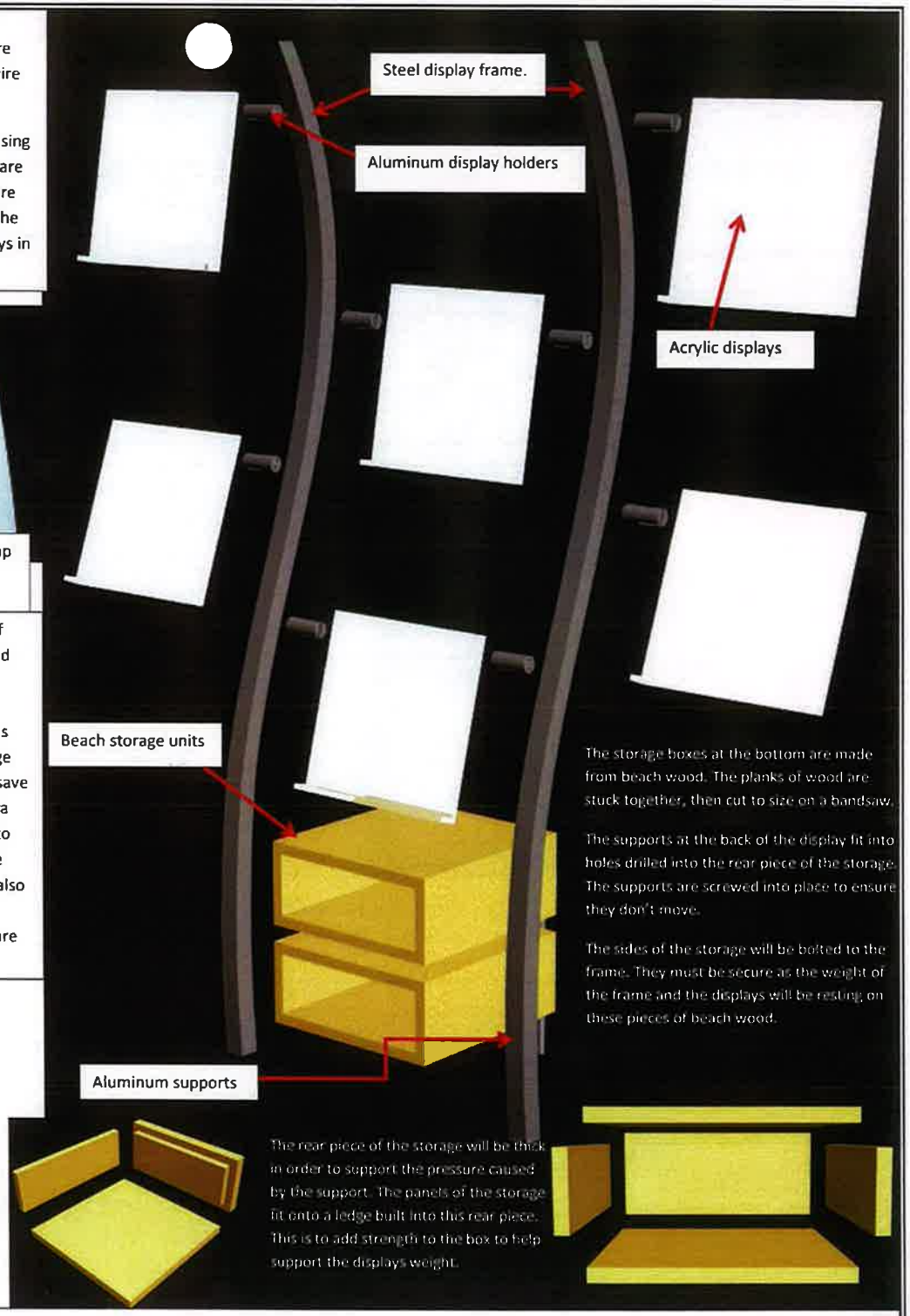


Screws used to attach display holders to frame

Screws used to clamp acrylic in place.

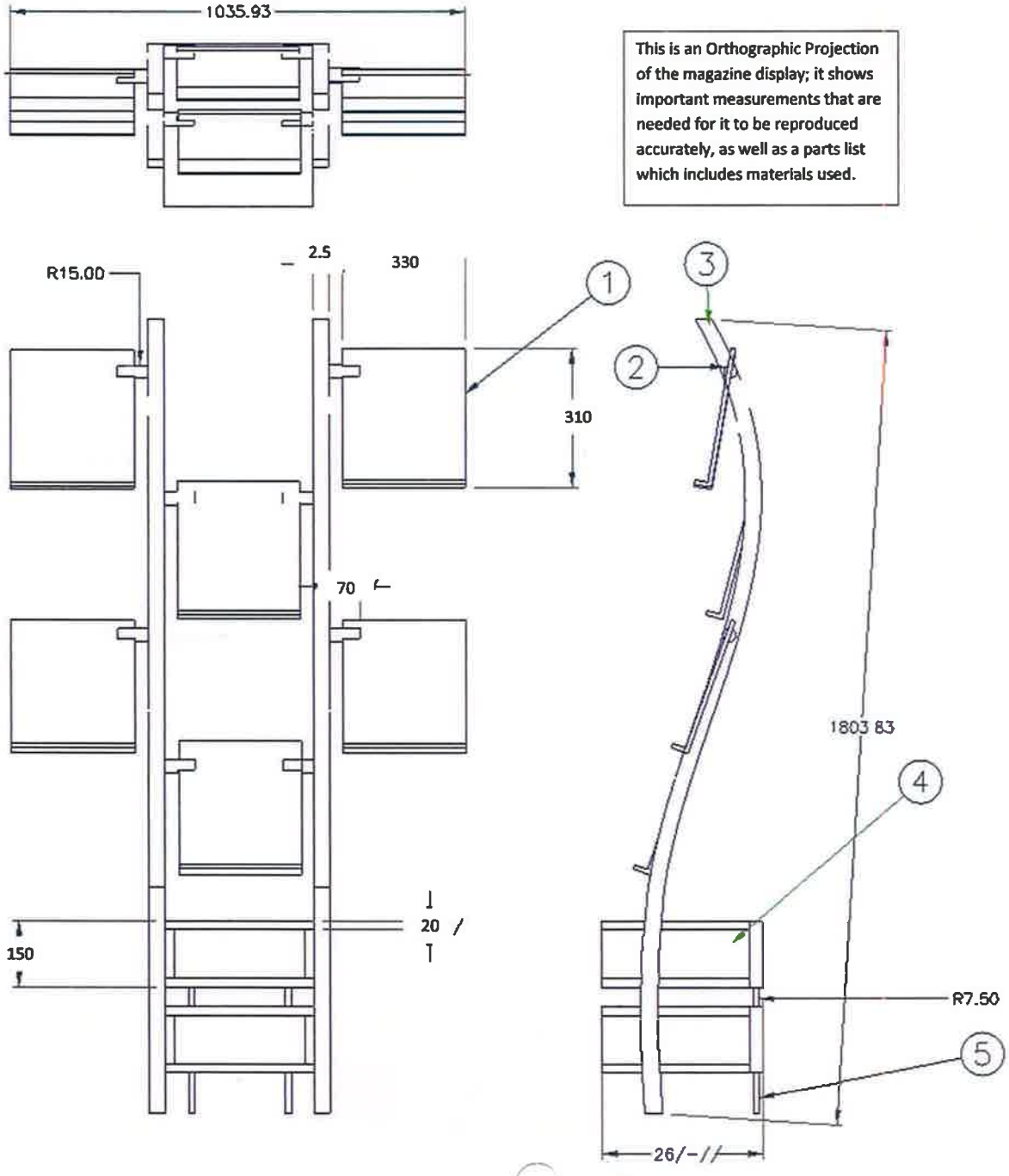


The two pieces of the frame are held together by the display and the display holders, as well as the storage units. This helps save weight as no extra metal is needed to hold to the frame parts in place. It also reduces cost as fewer materials are used.



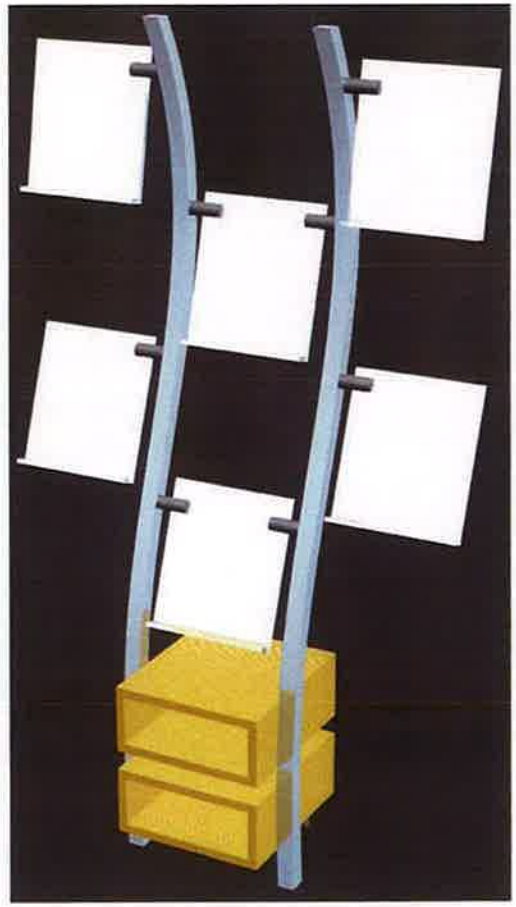
Part	Material	Size (mm)	Number of:
Display	Clear acrylic	330 x 380 x 8	6
Storage box	Beach wood	190x390 x 60 330x190x30 330x330x22	2
Frame	Steel	180x40(dist. Across) x3(thickness)	2
Display holders	Aluminium	80x 25(diameter)	

Orthographic Projection



This is an Orthographic Projection of the magazine display; it shows important measurements that are needed for it to be reproduced accurately, as well as a parts list which includes materials used.

Part Number	Description	Quantity
1.	Acrylic Magazine Display	6
2.	Aluminum Display Holder	8
3.	Steel Display Frame	2
4.	Beach Storage Unit	2
5.	Aluminum Support Pole	2



Specification heading	Specification points	Evaluation – Does it meet the specification set	Clients Evaluation	User Group Comments
Form	• The magazine display and storage unit must match the colour scheme/theme of the new learning centre so it does not look out of place and ruin the overall look of the centre. • The display should be easily placed against a wall, while not sticking out too far so that it doesn't obstruct walkways. • The display should look modern so that it fits in with the surrounding furnishings. • The display could feature curves, making it look more futuristic and stand out.	The wood and chromed metal goes with the new furniture in the learning centre. The clear acrylic doesn't block the colour of the wall behind, so it does not conflict with any colour scheme. The frame and supports are designed to be level with the wall, so it does not stick out far into walkways. The design will be considered modern by many people as it has a curvy minimalist design. The curves present in the design make it stand out a lot more than a standard magazine rack present in most libraries. Overall my design fulfils the form section of the specification very well.	My client said that the design fit right in with the 6th form learning centre. It was very modern and used wood that matched the wood in the common room. He was very pleased, saying that he "wouldn't want to put it in a dark corner". "I like how the curves match the dividers in the common room" was another comment. Mr. Connell said that all these points look to be covered.	My user group thought the design fit right in with the styling and theme of the new learning centre.
Function	• The design must display at least 6 magazines at once. • The design must feature storage of 6 magazines near each magazine on display, which is easy to access. • The design should have a space for storing older magazines. • There could be a space to display books, such as the year book. • The display could be adjustable, so that the arrangement of magazines can be changed.	This design displays 6 magazines well, without any obstruction. They are displayed close to eye level so that as many people notice them as possible. This design also has space for storing about 20 magazines without much problem. It can't display any books as I do not think it will be strong or stable enough/ particularly when displayed on the higher units. The display is not adjustable, due to choosing durability over adjustability. Overall my design fulfils half of this specification point, but it fulfils all of the "must" points highlighted in green.	The number of magazines that are stored was Mr. Connells idea. He was happy to see that this number had been met. However, there is little storage for any extra magazines, meaning the second and third points were not met. The 4th point was met, but at the expense of only displaying 5 magazines.	They said this should have no problems holding the magazines currently available in the common room.
User Requirements	• The design must fit in with the surrounding environment, as otherwise it will look badly designed. • The design must be safe for people to use, as it is a school. • The design should feature different materials. This will make it look more interesting. • The design could incorporate some detailing from a CNC machine. • The storage of older magazines could be contained in a detailed box or use some kind of organisation system.	My design fits in very well with the surrounding environment. The curves present match that of the common room dividers. I feel the design is stable and safe during normal use, due to having the largest possible base. However, if knocked it may topple due to a high centre of gravity. The design features many different materials, including: Acrylic, Beach, Steel and Aluminium. There is no CNC present in manufacturing, due to no complex cutting designs. The storage units have no organisational or styling features. All the "must" sections of this spec. point are fulfilled, as well as one "should". This is good as it meets important criteria.	As stated earlier, Mr. Connell feels the design fits in very well with the 6th form common room. He did have concern about the stability of the design, due to the small base. The rest of the points were not met, making this section of the specification incomplete.	They already said that the design should fit right in.
Performance Requirements	• The design must not look worn after a few uses, it should be durable so that it lasts a long time. • It must be stable so that it doesn't fall over when knocked, which could possibly cause damage. • The design should be easily assembled and disassembled. • The design could be "flat-packed" in order to save space when being stored.	The thick acrylic should not crack or scratch easily, making it look new for a long time. The design is fairly stable, but may topple if knocked or ran into, due to a narrow base surface area. It is also hard to disassemble and assemble due to lots of small parts. It can be flat packed as the individual parts have small dimensions. My design does not fulfil many of these specification points. However I feel that the product still performs well without meeting these.	Mr. Connell already stated he was concerned about stablility. He had no other comments for this section of the specification.	They had no comments as they won't know until testing.
Material & Component Requirements	• The materials must not wear easily; otherwise it may give splinters or break eventually. • The materials used should not look cheap, as this will prevent it from fitting in with the rest of the common room furnishings. • The materials should use a varnish finish for any wood that is used, to provide better durability. • Different types of wood/plastic could be used to provide an interesting overall finish/look.	The materials used are thick and therefore durable, so will resist cracking. The wood will be varnished well, so that bare wood/splinters should not appear for a long time. The chrome finish and varnished wood will look well finished, whereas the acrylic does not need to be finished, it looks well done left alone. The mix of materials used with give the final product a very unique look that is not found among common furnishings.	My client had no comments for this section, but had already stated that he thinks the product looks unique due to the material choices.	They had no comments as they won't know until testing.
Scale of production and cost	• The design should be assembled easily with one or two people working together. • The design could use parts brought in from suppliers, for parts that require advanced processes	The design comes in lots of small and easy to assemble pieces, making it easy for just one person to assemble. Various parts of the design are brought in from external suppliers, such as screws, bolts and the materials. These are small parts that would take a long time to manufacture without appropriate equipment. This section of the spec. is met, although external suppliers could be used more.	My client liked that the design could be put together by one person, as it is made of lots of small manageable parts.	They had no comments.
Sustainability	• The design should be made out of materials that are good for the environment. Materials that have been recycled are ideal as they do not impact the environment as much. • The manufacture should be planned thoroughly so that as little material is wasted as possible	The materials I am using are not recycled, nor are they good for the environment. The wood may come from a tree farm, where trees are planted once they are dug up, but that is not certain. The use of CAD and CNC allow materials to be cut with precision, leaving little waste behind. The metal an acrylic are cut as needed. My design barely fulfils this specification point, something which could be improved upon.	My client had no comment on this	They had no comments.

Flow Chart

Cutting and curving the square steel tubes

The tubes must be measured using a tape measure, and the correct distance marked out, compensating for the 1-2mm lost when cutting.

Once cut to length using a grinding disk, marking for the cuts along the tubes must be made at the distances specified during development. | Tools: Scriber, Ruler, Set square.

Batch Production: The square tubes would be cut using computer aided machinery in some kind of band saw/grinding disk arrangement. This would speed up the process and make it more accurate

No

Check that the marking out on both pieces matches up, so that the curve will be equal. | QC 1

Yes

HS 1 | These are then cut on the grinding disk. The cut is not through the whole piece, as the side of the tube opposite to the marking out is left intact. | Tools: Grinding Disk

HS 2 | The tubes are bent into shape along the cuts. The gaps are welded using an arc welder to provide | Tools: Electric Arc Welder

Batch Production: In order to make the welds accurate, effective and fast, a computer controlled welding gun could be used. A MIG welder would be used as it provides a continuous supply of steel to weld with, unlike the arc welder which requires its rods to be changed fairly regularly.

No

One bar is welded completely first, then the second is clamped to it and welded, to give the same curve | QC 2

Yes

HS 1 | The excess metal is grinded off using a hand grinder, leaving a rough but flat surface behind. Any extra gaps that are left in the joins must be welded and grinded again | Tools: Hand Grinder

The tube must then be filed and sanded, to leave a smooth surface. A hand file is run across each face of the tube, and sanded with emery cloth and wet/dry paper. Once this is done, the steel can then be chromed which will give it a good finish and also protect it from rusting | Tools: Hand File, Sand paper

Milling and drilling Aluminium Bar

Batch Production: The Aluminium bar would be milled on a CNC router and a CNC lathe. This would speed up the process dramatically.

A 30mm thick aluminium bar is cut into eight 70mm long pieces on a metal band saw. | Tools: Ruler, scriber, band saw

HS 3 | The aluminium bars must be milled 40mm down the middle using an 8mm drill bit. | Tools: Milling Machine

A jig is made to help mark out the Location of the holes for screws connecting the aluminium to the steel frame | QC 3

Batch Production: A jig will help make sure all the holes are drilled in the correct place, and will save time, as each bit of tube doesn't have to be measured and marked out on individually.

Yes

The holes are drilled down through the bar, which will be used to connect the aluminium to the frame. They are drilled slightly bigger than the screws, so the screws can move freely. | Tools: Pillar drill

Holes are then drilled towards the middle of the bar, which will be used to hold the acrylic display in place. These must be drilled smaller than the screws, so that a thread can be applied to keep the screws in place. | Tools: Pillar drill, tapping wrench

HS 4 | The bars are given a small 45 degree draft angle on the lathe, to make them look neater, and to remove the sharp edge. The aluminium is then sanded with emery cloth, and given a brushed finish with an air-powered rotating metal brush | Tools: Lathe, emery cloth, metal brush

Batch Production: The draft angle can also be done on a CNC lathe

Key

Process:

Quality Control Check:

Information point: HS 1 QC 1

Acrylic

The correct sizes of acrylic are marked out on the large acrylic sheet. They are then cut on a band saw | Tools: Ruler, Band saw

HS 5 | An oxy-acetylene torch is used to give the sides of the acrylic a clear finish, making the acrylic look much nicer. | Tools: oxy acetylene torch.

QC 4

The jig used to mark out the holes for the aluminium bar is used again to mark out where to drill the holes for the screws which hold the acrylic in place

Yes

The holes for the acrylic are drilled using a drill bit which is smaller than the screws. This is so that the holes can then be tapped, which will apply a thread and will secure the acrylic in place. | Tools: Pillar drill, drill bit, tapping wrench

Batch Production: The acrylic can be cut out on a CNC router, or using some kind of machine operated band saw

Batch Production: A jig will help make sure all the holes are drilled in the correct place, and will save time, as each bit of tube doesn't have to be measured and marked out on individually.

Batch Production: As an alternative to the jig, a CNC router could be used to drill the holes, this will reduce human error.

Key

Process: ▭

Quality Control Check: ◇

Information point: HS 1 | QC 1

Batch Production: The wooden pieces can be cut out on a CNC machine to ensure accuracy and increase the speed they are produced

Wooden storage Box

Cut wood to size on band saw after marking out. | Tools: ruler, set square, band saw, PVA glue

Glue pieces of wood together to create the thick rear "plug" part at back of storage box

The locations for biscuit joints are marked out, spaced equal distances along the beach. A biscuit jointer is then used to cut the grooves into the material. Glue and biscuit joints are then placed in the grooves, and the box is clamped and the glue is left to set. | Tools: Biscuit jointer, Biscuit joints, glue, clamps.

Holes need to be drilled for the bolts which will hold the box to the frame. There needs to be space for the nut to be counter sunk, so that it does not tear the magazines. | Tools: Pillar drill, drill bit.

HS 6 | The box then needs to be sanded. The edges of the box are planed down to give a nice draft angle. The rest of the box is sanded using the electric hand sander, as well as sand paper. | Tools: Sand Paper, electric hand sander

The box is then varnished. Varnish is applied in even coats, until the desired colour/thickness is reached. It is left to dry.

Quality Control

Quality Control Code	Identify Reason for check	How the check has been achieved
QC1	To ensure that the parts of the product will fit together properly once assembled.	Once everything has been marked out, it must be checked using a ruler to make sure it all fits properly.
QC2	To make sure the parts are identical to each other, so that assembly does not become complicated/problematic.	By welding up one bar first, then clamping the second to it and welding it, the bars will have identical curves.
QC3	Eight pieces of aluminum all need to be identical, and so a jig will ensure all marking out and drilling is done in the same place	Cutting a piece of material and marking out exact locations of holes, then using this as a guide for every cut.
QC4	This jig is to ensure the holes in the acrylic will match up exactly with the holes in the aluminum bar.	Cutting a piece of material and marking out exact locations of holes, and then using this as a guide for every cut.

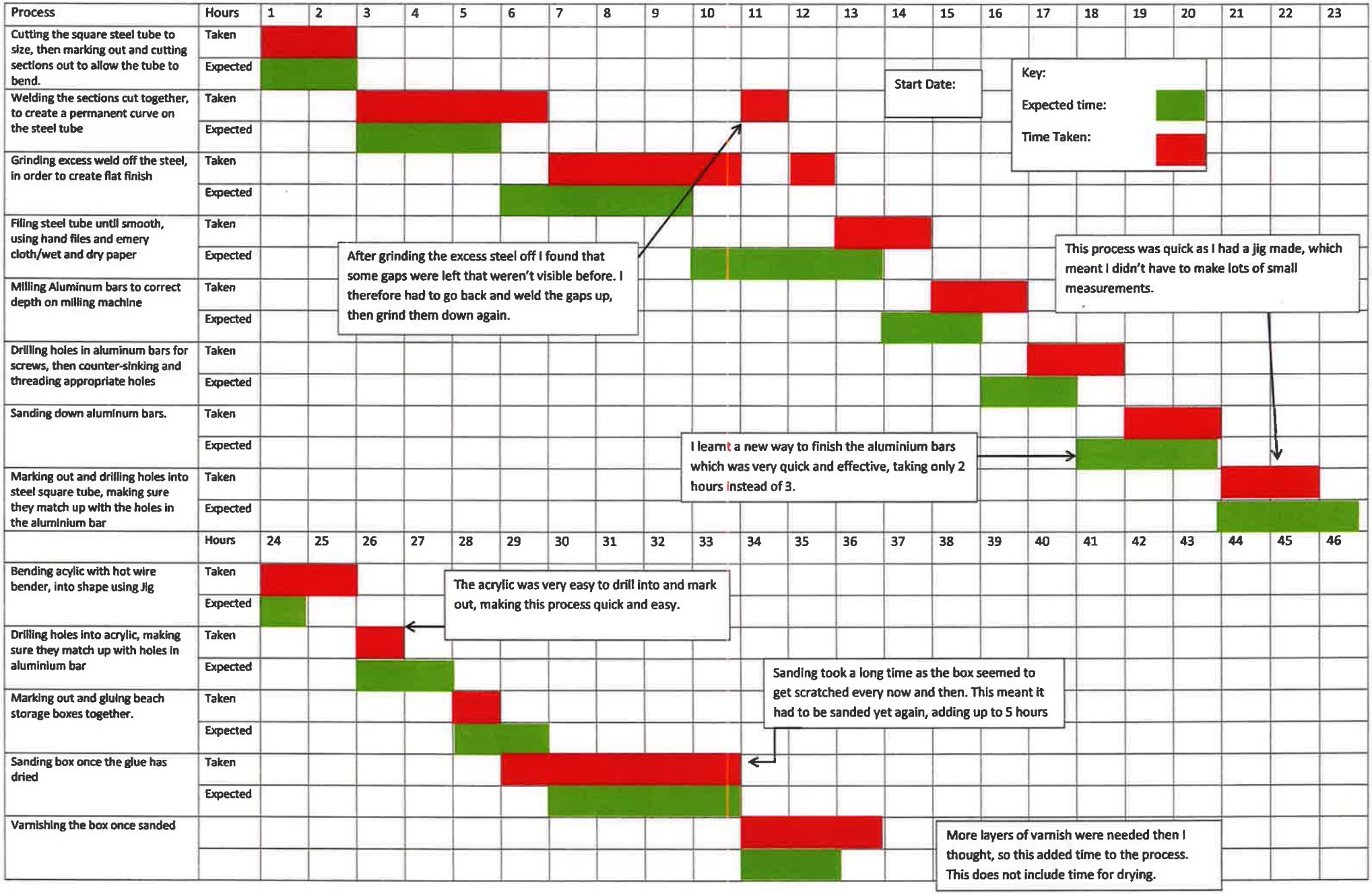
Scales of Production

The scale of production for this product would most likely be batch production, as large quantities need to be made but only if enough resources (mainly wood) are available. The difference between this batch production and a one off production in a school work shop are that the machines are automated and controlled by CAD programs. This automated machinery would require the planning and design of the product to be different. It would be made in ways more suited to CNC machines, than to workshop tools. The order of what part is made first would change so that the product can be made more efficiently, taking up less time. Overall, this type of production would be much more accurate when compared to a school workshop, as the machines are controlled by computers, compared with a person's eye sight when using workshop tools

Health and Safety

Health and Safety Point	Process	Health and Safety Procedures
HS 1	Using the Grinding Disk to cut lengths of metal and to cut small sections out.	An apron and goggles must be worn. Ear protection is recommended. This process should be carried out outside due to the sparks and dust given off, which could pose as a fire hazard. Material should be handled with gloves afterwards as it will be hot.
HS 2	Electric Arc Welding	Sufficient eye, face, hands and foot protection is required due to high temperatures and bright UV light. The room must be well ventilated to prevent toxic gas build up. Materials should be left to cool or quenched before handling.
HS 3	Milling Aluminum	Eye protection must be worn in case of offcuts that fly out during milling. The milling bit must be moved at a realistic pace, and given time to cool down.
HS 4	Lathe work	All loose clothing must be pinned back to avoid being tangled in the lathe. Goggles must be worn to prevent any damage to the eyes from sharp offcuts
HS 5	Heat treating Plastic	The area must be well ventilated to remove toxic gases. The acrylic must be left to cool before being handled. The torch should be used sensibly to avoid burns.
HS 6	Sanding	Appropriate dust extraction is required for sanding. The sanding power tools should be used with goggles to prevent damage from offcuts.

Gantt Chart


Process
Hours
Cutting the square steel tube to size, then marking out and cutting sections out to allow the tube to bend.
Welding the sections cut together, to create a permanent curve on the steel tube
Grinding excess weld off the steel, in order to create flat finish
Filing steel tube until smooth, using hand files and emery cloth/wet and dry paper
Milling Aluminum bars to correct depth on milling machine
Drilling holes in aluminum bars for screws, then counter-sinking and threading appropriate holes
Sanding down aluminum bars.
Marking out and drilling holes into steel square tube, making sure they match up with the holes in the aluminium bar
Taken
Expected
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Start Date:
Key:
Expected time:
Time Taken:
After grinding the excess steel off I found that some gaps were left that weren't visible before. I therefore had to go back and weld the gaps up, then grind them down again.
This process was quick as I had a jig made, which meant I didn't have to make lots of small measurements.
I learnt a new way to finish the aluminium bars which was very quick and effective, taking only 2 hours instead of 3.
24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46
Bending acylic with hot wire bender, into shape using jig
Drilling holes into acrylic, making sure they match up with holes in aluminium bar
Marking out and gluing beach storage boxes together.
Sanding box once the glue has dried
Varnishing the box once sanded
The acrylic was very easy to drill into and mark out, making this process quick and easy.
Sanding took a long time as the box seemed to get scratched every now and then. This meant it had to be sanded yet again, adding up to 5 hours
More layers of varnish were needed then I thought, so this added time to the process. This does not include time for drying.

Reasons for Material and Process Choices

Material /Process	Properties	Working Characteristics	Reason for Choosing Material/Process
Beach– For Storage	Rubber wood is a type of manufactured board. It is made from small planks of timber that have been stuck together. This makes it cheap and available in large sheets. Although it is manufactured, it looks quite aesthetically pleasing due to the different grains which are exposed on the surface of the wood. It also varnishes well.	As it is manufactured, there are a very low number of knots in the wood. This makes the hardness and strength of the wood very predictable. However, as the board is made from strips of wood glued together, where they meet can be harder to saw through due to the glue used. Overall it is very easy to saw through and drill into.	The reason I am using this material instead of other woods is due to a few reasons. Firstly, it comes in large boards, where as many woods come in planks that would require gluing together. Secondly, as it is made from strips of wood, it has a nice aesthetic finish which other manufactured boards don't, due to the exposed grain. It is also easy to work with and finally is cheap in comparison to other woods.
Aluminium – Display holders	Aluminium is a lightweight metal; it has a low melting point and is soft in comparison to metals like iron and steel. It is readily available in a variety of shapes and sizes from bars to sheet metal. As it is quite common and light weight, it is a cheap metal. However, it is not the strongest of metals.	Aluminium is easy to work with due to being less dense then other metals. It can be cut easily and lathe work is fast and efficient as it does not blunt any tools as quickly unlike iron or steel.	Aluminium is great for use on the lathe and on the milling machine, as it is easily shaped and will not blunt the tools. As all these parts will need to be milled, aluminium seems like a sensible choice as it will save time. It is also used for the catch, this is because it is easy to file away and drill into, speeding up the time taken to make those parts.
Steel – Main frame	Steel is a very strong material that can hold a large amount of weight for its size, compared to aluminium or iron. It has a high melting point and is very tough. If finished properly, it can have a very nice smooth look; however this will not last long due to rust and corrosion of the iron within it.	Steel is hard to work with due to its properties. It is very hard to finish with hand tools, requiring power tools for all but the last stages of finishing it off. Drill bits and saws blunt after long usage on steel due to its strength.	I chose this material because of its high strength. As it is the frame of which all the other parts are attached, it needs to be strong and resistant to dents/scratches. It is also able to bend slightly without losing its shape, this is particularly important if it is knocked or falls over.
Acrylic – Magazine holders	Acrylic is a type of thermoplastic. It comes in a wide variety of colours, both opaque and transparent. It has a low melting point and can be reheated numerous times to get a required shape. It is reasonably strong, although not as strong as metals. It is also brittle.	Acrylic is easy to work with. It is easy to cut on a band saw and is very simple to heat treat. It does scratch easily though, which can be a problem when storing and moving pieces around. Finishing the material off is quite quick, as the main sides are already smooth from when they were manufactured. The edges can be sanded and then heat treated.	I chose this material because it comes as a transparent material. This is perfect for adding lots of materials to the design for functionality, without ruining the overall aesthetics. It is also strong enough to hold the two parts of the frame together, meaning that no ugly support bars are needed to keep things in place.
Welding	This process involves using an electric current to melt pieces of metal to one another. The result is two pieces of metal that are joined by a bond that is equally as strong as the metal itself. Excess metal can be easily removed.	This is a process which produces a large amount of heat and light, and so precautions must be taken to ensure it is safe. The resulting bond from welding is very strong and relatively easy to finish off nicely.	I chose this process because it allows me to shape my square steel tube using various cuts, then weld these cuts in place, and have them be as strong as the steel tube was originally. It also lets me finish the square tube so that it is very hard to see any welding was done.
Lathe Turning	The lathe is a way of working on cylindrical objects very accurately. It takes a variety of diameters, and can also be modified to work on square or other symmetrical shapes. There are a variety of tools that can be used with the lathe, this makes it very versatile.	The wide arrays of tools that can be used with this machine mean that a large number of processes can be carried out on it. It is possible to work with hard materials on the lathe, such as steel, due to the hardened tools that are used. Changing tools is very fast and efficient, resulting in the job being done a lot quicker. The lathe is also very precise, as measurements can be taken by 0.1mm.	As I am making eight display supports that need to be identical, the lathe is an ideal machine to use due to its ability to make such fine adjustments to the cutting diameter/depth. The automatic feed tool gives a very consistent finish that does not require any further touching up. As I will be working with aluminium, the process will be very efficient given the strength of the tools used. The ability to knurl components means that the overall product will appear to have a greater quality finish.
Milling	The milling machine is a very useful tool, as it is able to cut, face off and drill into almost any material, for any depth or angle. These unique abilities are perfect for cutting material in ways that would take a long time with hand tools, or for finishing off a material with a flat surface.	Materials are milled in sweeps, similar to a CNC router. You take off layers one by one until the correct depth is reached. It is important not to drill too deeply at once as the material can get too hot and clog up the drilling tool, or breaking it. The machine can be moved with millimetre precision, and can also be run automatically.	I chose this process because it had the ability to cut materials exactly how I wanted. The rectangular slots in the aluminium would have taken a very long time to complete with a saw and file. This process allows me to cut 4 at once, ensuring quality control as they are all cut the same. It is also very fast, which helps speed up production times, and gives me more time for other parts of the design.

Risk Assessment and COSHH

Risk assessment is based on a 5 by 5 table, likelihood on one side and severity on the other. The dangers of different processes vary and are given a ranking out of 5, from 1 being unlikely or small scratches, to 5 being bound to happen or death possible.

Process	Potential Hazards	Safety Precautions	Likelihood (out of 5)	Severity (out of 5)	Rating (out of 25)
Electric Arc Welding	• Burns on skin from molten metal/sparks • Damage to retina in eyes from very bright light produced by the electric arc • Electric shock from equipment if not handled properly, or if the wires are damaged. • Burns on skin from metal which has been left to cool	Welding visor/goggles will be needed to protect the eyes from the bright UV light produced. Equipment must be checked first for damage or holes in wires. Any hot work that is being left to cool must be marked with a warning.	2	3-4	8
Disk Grinder/Hand grinder	• Small burns from sparks that are given off • Grinder gets caught in clothing • Cuts from grinder • Burns from hot grinding disk and metal • Clothes set on fire from sparks	Face protection must be worn as sparks can be very damaging to the eyes if the land there. Large metal off cuts may also fly out. Make sure an apron is worn to prevent any lose clothing being caught in grinder or burnt.	1	4	4
Milling	• Burns from hot metal off cuts and parts that have been worked on. • Drill bit cracking and shattering	Make sure that work is milled at a reasonable pace and depth, as work will heat up considerably otherwise. Eye protection must be worn.	1	2	2
Cutting on wood band saw	• Cutting fingers on lathe is possible if fingers slip off the side of wood that is being cut. • Inhaling wood dust can cause coughing; more serious problems arise after prolonged exposure. • Bodily ache from prolonged exposure	Use a "push stick" when dealing with small pieces so that hands are kept away from the blade. Make sure the blade cover is only as high as it needs to be. Wear eye protection.	3	4	12
Drilling holes	• Drill can snap if too much force is applied. • Metal can start to spin round and fly off drill if not properly secured. • Sharp off cuts can fly out.	Clamp work down using G-clamps. Wear safety goggles and drill into work at realistic speeds.	4	2	8

There are certain precautions that must be obeyed in order to ensure a safe work space regardless of the process being carried out. All these precautions are filed under COSHH regulations. They cover a wide range of processes and materials, with recommended safety precautions that should be followed.

1.058 COSHH REG wood working: Dust

- Eye protection should be worn at all times and exhaust ventilation must be provided to control and regulate dust at its source.
- Dust masks at standard FFP1 should be worn with high exposure to dust. Duration of longer than 15 minutes require a higher regulation mask, particularly if working with manufactured board.

1.032 COSHH REG Metal Working Machines

- Long hair should be tied up and any dangling objects should be removed. An apron or overall must be worn at all times especially when loose clothing/ attire is worn. Proper footwear should be worn to reduce accidents.
- Adequate amount of space should be given around the machines. Guards over moving equipment will minimise the risk of trapping as well preventing objects from flying off which will ensure the safety of others as well as yourself.

1.021 COSHH REG Heat Treatment: Electric Arc Welding

- Good general ventilation must be maintained at all times for removal of toxic and irritant hazards.
- A face shield for user and observers suitable for electric arc welding is needed.
- Clothing worn must provide adequate protection from heat and hot objects. Including substantial footware, apron and eye protection
- Hot metals should be handled with tools or thick gloves
- Open-circuit voltage should be limited to 50V AC or 120V DC, the workplace should be earthed.

Along with these are basic rules that should be followed. Most of these practices are based on common sense and are carried out normally in the workshop, however they are still important:

- An apron should be worn whilst in the workshop in order to keep lose clothes away from machinery, as well as to keep clothes clean.
- Goggles should be worn with all machinery that produce debris, or that require the user to look closely at the material being worked on.
- Long hair should be tied back.
- Any processes involving heat treatment should be done with tinted goggles due to the bright light produced from the equipment.
- Proper footwear covering the whole foot should be worn to minimise damage in case tools/materials are dropped.
- Make sure there is good ventilation around processes that produce dust.

Production Log

Steel Frame

The steel frame is the first part to be made. The grinding disk is used to cut sections out of the square tube; these are the points at which the tube will be bent.

The cutting lines are first marked out using a ruler, set-square and a scriber. The two parts of the frame are compared to make sure the markings are equal; this is part of the quality control.

tube is then bent into the desired shape. s done by clamping it and then using your weight to make sure all the gaps close up as much as possible.
Once this is done, the gaps are then welded together. The steel tube is placed in a vice with the negative clamp attached to it. The gaps are welded quickly, to avoid melting a hole into the metal.

Holes are drilled into the material which will be us ie display holders and the storage boxes. The holes for the display holders must be threaded so that they can be attached securely. This is done by using a tap wrench and tapping bit.

To finish off the steel, the bar is grinded down using a hand grinder. This removes the excess steel left from welding, as well as any small imperfections on the metal. Any deep scratches are hidden, and the finish looks nice, without any further sanding needed

Aluminum Display holders

These parts are used to hold the acrylic displays to the steel frame.

The pieces are milled to the correct depth on the milling machine. Tape is used to mark out how far down the aluminum should be milled

Once milled, a jig is then made to help mark out the holes for drilling. A center punch is used to mark out the drill location. The mark left by the center punch is also used to guide the drill bit into position. This is particularly useful when drilling on a curved surface.

The holes on the back are then drilled with a countersink bit so that the screws sit flush with the aluminum.

The holes which hold the aluminum display in place are threaded.

The aluminum is finished off with fine emery cloth to give it a nice smooth look and feel.

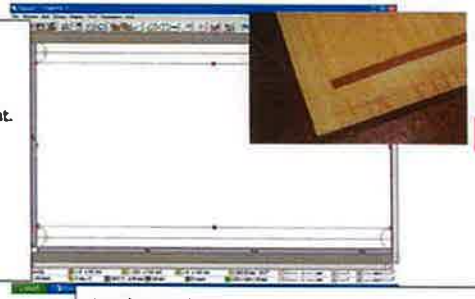
Screws

The screws used on the display holder's required slight modification. The ones attaching them to the steel tube required the head to be filed down. While the ones holding the acrylic display in place had to be cut to 1/3rd the length.

Storage box

The storage box was made out of beach. The beach panels were cut to size on a band saw first, then sanded on a belt sander to insure all the edges are flat.

As the panels required a ledge to be cut out, a CAD drawing was needed in order to make sure these ledges were cut out accurately. The CAD drawings were then uploaded to the CNC router, where they were then cut.



The pieces are then glued together using PVA glue and sash clamps. This is to ensure all the pieces sit firmly together, squeezing out any excess glue

Holes are then drilled into the box so they can be attached to the steel frame. The location for drilling is marked out by using the holes drilled in the steel tube.

The box is then sanded and varnished, so that they have a nice smooth feel and aesthetic finish, as well as being protected from humidity, liquids and insects. The varnish is applied in thin coats using cloth so that it dries quickly.

Acrylic Displays

The acrylic was cut from a large sheet using a band saw with a plastics saw on. The edges of the acrylic were finished first, using a ruler to scrape rough plastic off first, then using the acetylene torch to heat up the edges and give them a nice transparent finish.

Holes are drilled into the acrylic using the same jig for the aluminum display holders. This ensures they are drilled into the correct location each time. The holes are then threaded so they can be attached securely to the supports

The acrylic pieces are then bent into shape. This is done by using a hot wire bender. A hot air gun is used to aid the heating of the acrylic, as it is quite thick and takes a while to heat up.

Testing

Specification heading	Specification points	Does the final product meet the specification	Comments	User Group Feedback	Success rating
Form	• The magazine display and storage unit must match the colour scheme/theme of the new learning centre so it does not look out of place and ruin the overall look of the centre. • The display should be easily placed against a wall, while not sticking out too far so that it doesn't obstruct walkways. • The display should look modern so that it fits in with the surrounding furnishings.	The magazine display has aesthetics that very closely match that of the 6th form learning centre. The wood and chromed metal goes with the wooden doors and veneered dividers present in the learning centre. The chromed metal is the same as the supports for the tables and chairs present in the learning centre. The clear acrylic displays let the colour of the walls show through, so that there is no contrast in paint schemes no matter where it is placed. The design can be placed against a wall without extending too far out into the walkways. The bottom of the design has quite a flat profile, making it very unlikely for anyone to trip up over the storage boxes. However, the metal frame may damage the wall behind it, taking of paint and leaving marks/scratches on it. The mix of materials used makes the design look modern. The curved steel also adds to the modern and futuristic effect, as most metal designs only feature straight sections. The clear acrylic and polished aluminium also add to the overall modern aesthetic.	The design almost fulfils this specification point, being let down by the fact that it can't be placed against a wall properly without looking like it wasn't designed to be next to a wall, or possibly damaging the wall behind.	My user group thought that this product was very modern; a few guessed that I had made it for the new 6th form common room. It was said that it would fit in well there. I asked what people thought about it being placed against a wall, and the majority said "it looks fine against a wall". Non of them commented on the storage boxes not touching the wall. I asked one of the users if they saw it as a problem, and he replied by saying "I thought it was meant to be like that, I can't see anything wrong with it".	8/10
Function	• The design must display at least 6 magazines at once. • The design must feature storage of 6 magazines near each magazine on display, which is easy to access. • The design should have a space for storing older magazines. • The display could be adjustable, so that the arrangement of magazines can be changed.	The 6 acrylic magazine displays can successfully display magazines without obstruction. They stay upright when magazines are placed on them, allowing everyone to see them clearly. Each magazine display can hold between 3-4 magazines, depending on their thickness. This is less than the 6 magazines specified by my client in his specification. This is due to the acrylic displays not having a long enough ledge to support the magazines. There is sufficient space for magazines to be stored at the bottom of the frame; with a maximum of 30 magazines being stored at one time (assuming each magazine is one centimetre thick). Due to the way the magazine displays are attached, the angle they display magazines at is not adjustable. This is because adjustable methods of attaching the displays were either not strong enough or required a large number of processes.	The design was changed to hold the 6 different magazines the client wanted, and it displays them very well. However, it fails to hold the specified number by not having thick enough ledges.	The majority of my user group said that the magazines were displayed at a very convenient height, as they didn't have to bend down or stretch to reach them. One person over 6 foot had to lean over a little to reach the lowest display, but said it wasn't a problem. They tried putting magazines on the displays, and said that they struggled to fit more then 3 magazines on and in some cases could only fit 2. This would be an issue if there are 5 or 6 copies of a magazine available, but only 3 can be displayed for people to use. None of the user group mentioned that it should have been adjustable	5/10
User Requirements	• The design must be safe for people to use, as it is a school. • The design should feature different materials. This will make it look more interesting. • The storage of older magazines could be contained in a detailed box or use some kind of organisation system.	The design has been made safe with a few simple processes during manufacture. All the edges of the acrylic have been lightly sanded and finished to make sure they are no longer sharp. The corners have also been sanded to ensure that no sharp points are left. The same has been done for the beach storage boxes at the bottom of the frame. The frame itself has curved edges and all sharp bits have been grinded down. Four materials are featured on this design. The acrylic, chromed steel and polished aluminium go together very nicely, giving it a very modern look. The beach wood storage boxes add to the aesthetic of the design, adding a subtle contrast to all the artificial materials present in the design. There is no styling present on the storage boxes. This is mainly because the boxes will be hard to see and so any detail would be hidden from view. Also because it adds extra processes to the manufacture. There is no organisational system, as it was decided that one wouldn't be needed for only 30 magazines.	The most important point which is safety, is met successfully. The magazine storage is very basic, and can only hold 25 - 30 magazines, due to size constraints.	My user group tested the stability by nudging the display. It wobbled a bit and the magazines moved, but overall the design stayed stable. One of my users commented that there were too many materials, that there were so many different textures it was a bit overwhelming and "slightly excessive". Some users agreed while others disagreed and said it looked good. It appeared to be a matter of opinion, as you can't cater to everyone's tastes.	6/10
Performance Requirements	• The design must not look worn after a few uses, it should be durable so that it lasts a long time. • It must be stable so that it doesn't fall over when knocked, which could possibly cause damage. • The design should be easily assembled and disassembled.	The materials have been finished so that they will not wear quickly. The steel has been chromed so that it does not rust and lose its strength or aesthetic qualities. The wooden storage boxes have been varnished with 3 layers of varnish; this will ensure that the box has a watertight finish which is humidity and bug proof. All these finishes will allow the design to look new for longer. The design has proven to be stable, despite the small area of the base. This is mainly due to the low centre of gravity created by the wooden storage boxes. The design should stay upright if knocked. It is easy to assemble and disassemble due to all the small parts that simply screw into each other. It only takes one person to disassemble it, but will take two people to assemble it.	The Performance requirements are met very well, as these were kept in mind during the production process.	I asked if the users would be alright with putting something this size together, then taking it apart again. Some seemed overwhelmed, saying it looked too complicated. Others said that they didn't think it would be too hard with 3 or 4 friends helping.	10/10
Material & Component Requirements	• The materials must not wear easily; otherwise it may give splinters or break eventually. • The materials used should not look cheap, as this will prevent it from fitting in with the rest of the common room furnishings.	The above point has been mentioned earlier. The varnish will prevent the wood from splintering and hurting people while they take magazines in and out of the storage. The materials were chosen because of their aesthetic qualities, the thick acrylic gives a very nice effect to the overall aesthetics of the design. While the beach gives an authentic wood look, better than that of recycled or veneered wood.	Materials and components were manufactured to a high quality, and so will not wear and tear, or start to look cheap, by losing its finish quickly.	A few users spotted various imperfections in the metal chroming, due to the welding not being perfect. However, overall they said it seemed to be done to a high standard.	9/10
Scale of production and cost	• Waste could be minimised during manufacture.	The design makes use of computer numerical control, this is a highly efficient way of cutting material whilst minimising waste. Large sheets can be cut to exact measurements, allowing as many pieces as possible to come from just one sheet.	There are only so many ways the waste could be minimised for this product, but not all the components can benefit from it.	My users asked about how the quality would change if this design was mass produced. I replied by saying the quality would improve as it would mostly be done by machines which would make sure everything was accurate, with built in quality control checks.	5/10
Sustainability	• The design should be made out of materials that are good for the environment. Materials that have been recycled are ideal as they do not impact the environment as much.	The aluminium that has been used can be made from recycled aluminium, and can be recycled again once the product is no longer needed. The wood can also be recycled once it has been finished with, although it originally has to come from a tree in order to get the nice wood grain.	Only 2 of the materials used can be fully recycled, which is why this section has half the success rating.	My user group asked about where the different materials came from. Particularly the wood, asking if it was from a farmed location or recycled. They also said that a lot of plastic had been used, and that a smaller frame type magazine display may have used less materials.	5/10

Testing

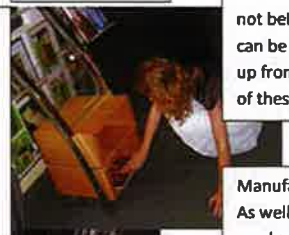
Improvements

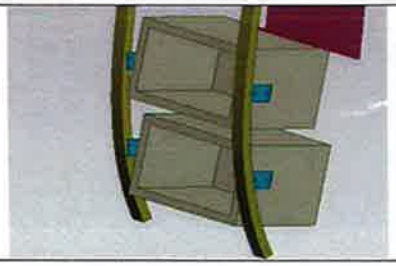
The first improvement that would need to be made is the size of the acrylic displays. They are both tall enough and wide enough to support the tallest of magazines. However, they are not deep enough to support more than 4 magazines at once. This was part of the specification and it has failed to meet it. In order to improve this, I could have bent the plastic at a higher up location, making the ledge which magazines sit on longer. In order to do this I would need to make the plastic thicker, as over time the acrylic may break at the join if there is always 6 magazines on it.

Possible ledge size

The location of the storage boxes is also something that needs to be improved. While the top box is quite reachable, the second one is a lot harder to get to, requiring people to crouch in order to read the spines of the magazines the boxes contain. To solve this the lowest magazine display could be raised up, allowing the box locations to be moved upwards as well. A few inches would be the difference between someone having to bend over to reach a magazine, instead of crouching on the floor.

Alternatively, the boxes could be placed at an angle, similar to how they were designed during the development. This would mean that people could see what magazines they were looking at from a distance, instead of having to crouch down to see what magazines were available.





An improvement to quality control during the manufacture is also needed. The main steel frames were not identical, which is a problem that should either have been picked up during manufacture, or during a quality control check. A quality control check should take place after every major process in order to make sure everything lines up and fits together properly.

Another check needed would be on the aluminium bars, a more accurate jig should be used when drilling holes into them.

Life cycle assessment

Life cycle assessment involves looking at the resources a product uses from a "cradel to grave" point of view, and the impact it has on the environment during its life.

Production:

My product requires metals, plastics and wood for its production. Of the materials used, only aluminium and acrylic can be taken from older products and recycled into something new. The wood must come from trees in order to get the desired grain on the pieces.

To reduce the impact to the environment the trees can be taken from a location where they are planted as soon as they are dug up, so that forests are not being cleared. Alternatively , a recycled wood such as MDF or rubber wood can be used to help reduce the environmental impact. The steel has to be dug up from the ground as iron, then mixed with carbon to make steel. Creating all of these materials takes a lot of energy.

Manufacture:

As well as all the materials, a lot of energy has to be put into creating the product, mainly in the form of electricity. This is required in almost every process, for cutting, bending and drilling material. The waste products include dust and offcuts from the materials used. These can be minimized by planning manufacturing efficiently, but waste products will always be present for this stage.

Transport and Use:

This product can be disassembled and almost entirely flat packed for transport, making it easy and efficient to move around.

While in use the product will use no energy at all, it will be cleaned occasionally but that is all.

Re-use and recycling:

Once the product has finished being used, it will be time to disassemble it. The wooden parts can be recycled by either using the boxes for another design, or by using them for MDF board. The MDF board could then be used again and again as long as it is recycled properly. The aluminium can be recycled by melting it down into aluminium bars or any other shape, allowing it to be used in a variety of situations. An alternative way of recycling it is by donating it to charity, similar to that of the aluminium cans ring-pull collections, where aluminium is melted and turned into prosthetic limbs.

The steel would be very hard to recycle, as it cannot be done in the work shop. The straight parts of the frame could be used again in a different product, but the rest of it would have to be disposed of in landfill. The acrylic pieces are thermoplastics, so they can be heated again and again to the desired shape. This is perfect for re-use in a different product later on.

Magazine display Test 1:

Magazines were left on the displays for 48 hours, to see if they would remain there during that time, or if they would start to fall off. The majority of magazines stayed like the one to the left, exactly as it had been 48 hours ago. However, the heaviest magazine which had been placed on the display with the shallowest angle showed that it was starting to slip off at one of the corners. The test was repeated with this magazine on a display with a greater angle, and this did not happen.

Magazine display Test 2:

3 magazines were left on the acrylic display to see if the aluminium holder would give way or let the acrylic start to sag. This did not happen, and showed that the acrylic was attached firmly. However, it did show up that only 3 -4 magazines could fit on one display, instead of the proposed 6 magazines in the specification.

Magazine display Test 3:

One of the displays would not sit securely in the aluminium display holder. It moved backwards and forwards slightly when magazines were placed on it, this is shown by the red line in the pictures to the left. This may be due to holes being drilled too big in the aluminium holder, or the screws have been put in and out of the acrylic too many times, making the hole larger or thread not as precise.

Storage box test:

Magazines can easily fit into the storage box located at the bottom of the frame. There is space for about 30 magazines, and they are easy to remove from the box due to the additional space at the sides.

Stability test:

The magazine display was pushed to one side as far as it could go before falling over. Due to the heavy storage boxes at the bottom providing a low center of gravity, the design could be pushed quite far to one side before it felt like it would fall over. This is good as it will be less likely to fall over when knocked. When the storage boxes are full with magazines, it will be even more stable.