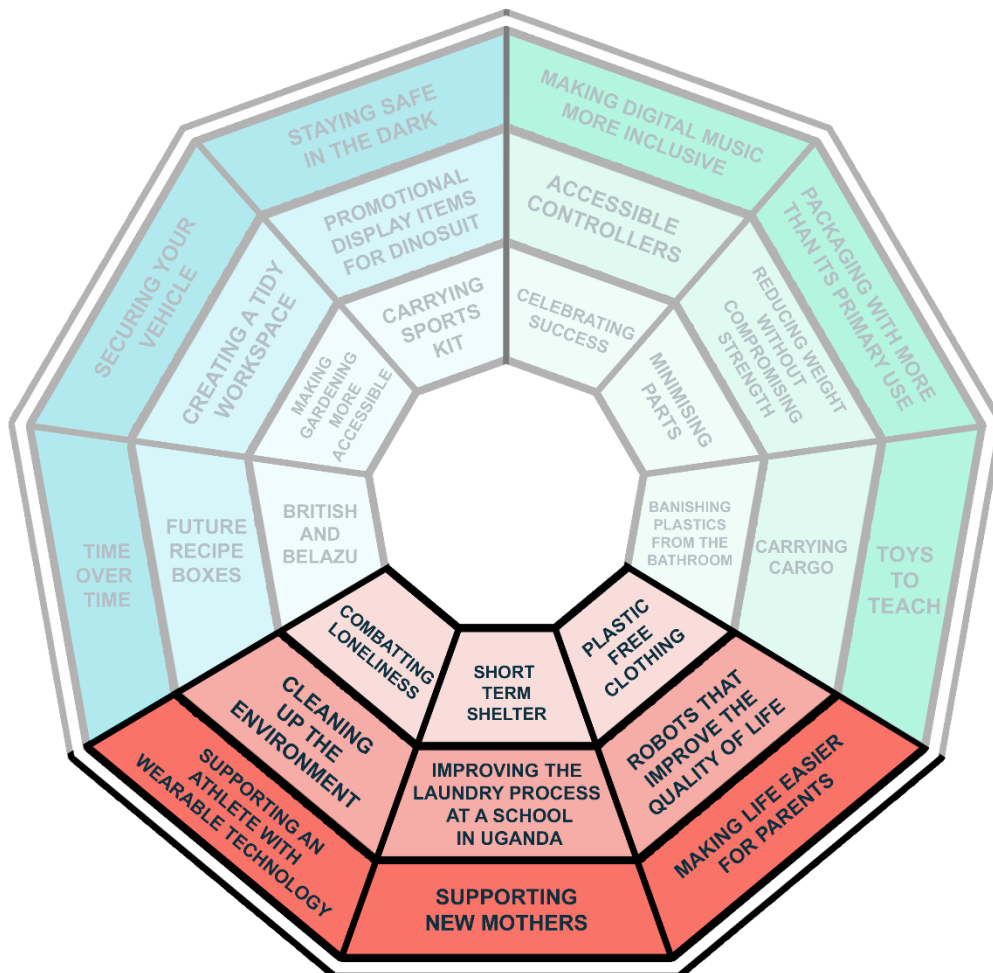


INSPIRED BY INDUSTRY

Improving the laundry process at a school in Uganda

#InspiredbyTheWashingMachineProject



Introduction

This context has been put together with the support of the Washing Machine Project to highlight the plight of many people in the world, predicted to be 60% of the population, who still have to wash laundry by hand, often in streams and rivers or unsanitary conditions. While there is a solution offered by the company (in the form of a manual washing machine), the context asks students to consider how aspects of the process could be improved in some (possibly small) way. The context explores a real client they have worked with, a school based in Uganda. This provides an additional opportunity to realise the far-reaching impact of design and technology and explore needs and values of individuals in other countries.

Materials

Because of this very open context, there is the scope to use a wide range of materials. In some ways, the exploration of a range of materials may be key to meeting the brief. There is the opportunity to look at small-scale trials of components or whole products, for scale models or for teamwork projects. Depending on how confident the group are, it may be advisable to constrain it to potentially one sector – such as the Ugandan school, or possibly give them a smaller range of challenges to work in. There is a good opportunity to explore 3D printing, laser cutting and CAD modelling in this context. Similarly, you may want to explore materials easily accessible in the area such as timber and bamboo.

Potential outcomes

The outcomes are prototypes but will require testing in terms of their function and performance. This context provides a good opportunity for teamwork exercises. It is important that students are given some freedom within this context and so outcomes should vary between students / groups. You may decide to limit your class outcomes areas to make it more manageable.

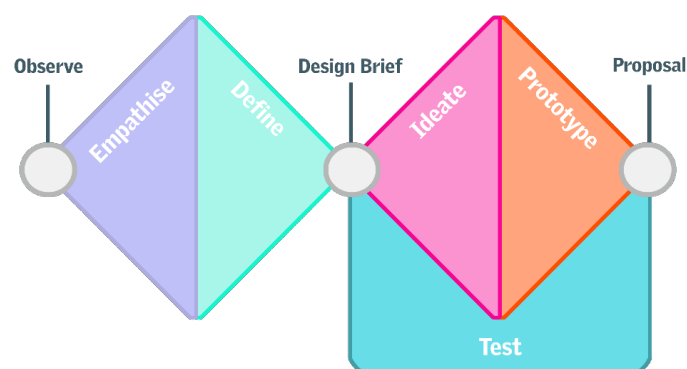
Consider any aspect of the laundry process that could be addressed and where simple low-cost solutions might be introduced to make the process easier. This could be storage, washing, drying, grinding / shredding soap, carrying water or even pressing/ironing laundry items even though the focus of the context is the washing process itself. Frames and other flat components could be hand-made or laser cut and smaller components could be 3D printed (remembering that these can be transported to Uganda). The target market might be limited by access to technologies, but as designers, your students can use any manufacturing or prototyping processes available to them.

Consider sharing work on social media using the hashtag:

#InspiredbyTheWashingMachineProject

Design cycle

The design cycle shown can be worked through in a range of orders. It's advised that the areas are revisited throughout the process depending on your time. We advise that a graphical representation of thinking convergent and then divergent may be shown to your students.



The following are some tips as to the type of activities you could do with your students.

Empathize stage

- Students should be introduced to this term if not already familiar.
- Finding out more about Uganda is important, so assumptions aren't made. This lends itself well to a flipped learning task whereby students use a variety of resources to familiarise themselves with the country and how it differs to the U.K.
- Empathising with the hand-washing of clothes is vital to what the Washing Machine Project does. Get students to do the process themselves. Not only washing clothes in a bucket / tub, but carrying the water great distances too, hanging them out to dry. You could go through the whole process of wearing their clothes after they have washed them (think of a muddy game of football at lunch, then the hand-washing process...!) It would make a great awareness piece for the school / D&T.
- Trying various aspects as a group can also be useful. For example, in one of the videos they show how users grate soap to use as a detergent. In a group, one can do the activity, one ask questions and the other records things observed. Rotate in the tasks so they can all see what it's like.
- For this context, taking part in the [Global Washout Day](#) or trying the experience at any time would be useful, especially during similar weather conditions.
- At the start of the context, students should be thinking wide with their thoughts, exploring the problem and not deciding too soon what they 'want to make', but observing what is happening and identifying problems.
- Whilst clearly not the same company, this [VIDEO](#) from Red Bull shows the process that goes into making a bolt, and the subsequent importance of it. So, even if students are designing something that feels rather trivial, the impact can be significant.
- Collaboration software such as Miro or Google/Microsoft collaboration can be good to use to collate ideas from all.
- Students should get as much information to help them later in the challenge. They may present this in any way they wish.
- When looking at a range of different laundry applications it is an opportunity for students to look at Gantt charts and similar, to identify certain features or attributes as well as planning their time and highlight any possible issues that may arise.
- More information on the Washing Machine Project can be found [here](#).

Define stage

- This is where students try to get the real root of the problem and decide what they are going to do/focus on.
- There may be a whole range of problems identified. Whilst the user is fairly defined, their needs, values as well as constraints or barriers (e.g. making it light and practical) may help.
- Remember that the company uses the washing process as a basis for the examples in the videos, but your students can focus on any area of laundry they think is suitable.
- For this stage, you may possibly constrain it to ensure students are working with materials and processes you wish to cover in the unit of work. There will still be plenty of opportunity for designs, testing, iteration etc.

- Whilst it may not be applicable at this stage initially, defining costs for an existing solution and then comparing it with their proposal could be useful. Students could create a cost spreadsheet showing savings made if 100, 1000, 1 million + were made with a new design based on the cost of a single unit. They could achieve these figures by calculating materials saved or the cost of components no longer needed.
- Are students able to articulate why tackling their defined problem would make an impact?

Ideate stage

- For the ideation stage, you may be drawing on existing ideas (e.g. improving / adapting an existing product) rather than starting from scratch. Having examples / handling collections of some things may be useful. For example, cheese-graters, pegs, washing airers. Get students to use them (don't assume they have ever done laundry!) and how do they think they can be improved (especially thinking about the age of the user and the location intended).
- Consider giving students the initial freedom of how to approach their ideas. For example, it may be CAD, a card model or a sketch. Giving students autonomy in how to approach their designs will prevent them from feeling restricted. Working in groups can help generate creative ideas.
- Consider pre-making and demonstrating/testing a few designs. For example, 3D-print some crank handles to spin a drum or clips to sit in a cradle so a drum can be rotated.
- Encourage students to annotate elements of their drawings – things like WHY it's that big, WHY it's that shape, WHY it has holes where it does (for example), How they are proposing to minimise parts or make the process easier / less complex, easy to self-assemble etc.
- A range of techniques such as 2D, 3D, exploded and cross sections are good. It is likely that for this unit, 3D drawings may not be the most useful viewpoint for the product being designed, and instead, 2D / cross sections are more beneficial.
- Consider using AI to generate more realistic solutions from student sketches and photographs. This will help them to see what their designs 'could' look like when manufactured.
- CAD programs will be of great use here. Many have easy-to-use simulation elements and photorealistic rendering. Some CAD programs also have generative design which can create stronger, lighter versions of your designs.
- For more able students, there is the opportunity to also include computational fluid dynamics if your CAD software supports it. This can be useful to see how water would move in your design before you make a prototype.

Prototype stage

- Getting students to realise when and why to make a prototype is key. What are they looking to prove / disprove? Linking the prototype method with the problem is a good task. In the video they suggest any realisation of a design is a prototype, even small-scale trials.
- Prototypes may be mechanical or structural models, test rigs, mock ups, painted models, or CAD models and/or assemblies.
- The following are all suitable CAD programs:

- [AUTODESK](#) free for schools/students. (Mac & Windows)
- [CREO](#) free for schools/students (PC only)
- [FREECAD](#) free for schools/students
- [ONSHAPE](#) free for schools/students
- [SKETCHUP](#) free for schools/students
- [SOLIDEDGE](#) free for schools/students
- [SOLIDWORKS](#) discounted licensing for schools/students
- There are some good Autodesk Fusion tutorials [HERE](#) and TinkerCad [HERE](#)
- Feedback would usually be gathered from intended users on the prototypes as they are being developed and at the testing stage. Discuss with students how they feel this could be done at the Washing Machine Project (and the associated pros and cons of travel etc) and what they can do at school (likely to be peer evaluated and judged against their insight into the laundry process previously).
- Whilst the CAD models produced may be fairly simplistic in their nature, it is an opportunity to explore different techniques with students such as assemblies, FEA and generative design.
- Investigating properties of materials lends itself well to this context. Students will naturally test items in the next stage, and so learning about a range of properties is useful.
- Bamboo is one material that you could explore with students as an alternative to regular D&T materials. Is there a benefit to using it? What are the disadvantages?
- The assignment of actual materials to models is necessary if both FEA and generative design are to work correctly. You could use this opportunity to introduce theory of materials properties to this context.
- Consider how rapid prototyping can bring the ideas to life, and into a 3D form, more quickly.
- You may want to share this brief [video](#) from Reekon tools that show the variety and quantity of models that a company may produce.

Test stage

- Although this is the final stage of the design cycle, encourage students to evaluate throughout and act on their feedback (and consider the feedback of others too). It is not a final thing, but a step to improve further.
- Test in as many different scenarios as possible to ensure you get realistic feedback.
- Ask young and old, inside and outside in different weather and environments to ensure you are getting a good overview of how it might be used.
- Observe how users are interacting with the product and use these observations to add more detail to your questions for feedback.
- Consider whether you need to test with static or dynamic tests, and show students the difference between these. This [short video](#) helps to explain, using a can to illustrate it.
- Be sure to record the testing results, either in data form, written test or use digital audio and video to record. You may wish to get students to do lab-testing (testing in the classroom) and also field testing (testing with a user).
- With destructive testing it is important to ensure safety at all times as products may react in unexpected ways. Suggest that the students write a risk assessment for the test. This will be similar to what is done in science, and ensure they adhere to all relevant PPE and safety procedures when carrying out supervised tests.

- Draw on approaches from science here. It may be worth speaking with a science colleague to replicate how students predict and record experiments. Doing this using similar methods will help to reinforce the learning.

Focused Tasks

'Fold up airer'	'Making pegs'	'Automating the process'	'Working with alternative materials'
For washing to dry naturally, it needs air to move around it to reduce the moisture. The easiest way to do this is to hang the washed items separately, but this can take up a lot of space. Consider designing a folding airer that can extend to hang washing while taking up a small space on the floor!	When hanging washing outside, it is likely to blow away unless secured to a line or airer. The easiest way to do this is to use a clip or peg. Consider how a peg works by looking at existing solutions then design your own simple to make peg. You could even create a 3D printed solution.	While the washing machine project looks to alleviate the hard work of hand washing, the machine itself is still hand operated. Consider ways that the process might be automated in a future iteration using a system powered by nature such as wind, sun or moving water.	Working with materials and components that are readily accessible in the field (the area you are working) is key. This allows things to be replaced and repaired if needed. Shipping parts from across the world with take time and money. Bamboo is one such material that is easy to access in Uganda. Experiment cutting and joining the material to learn its advantages and disadvantages as an alternative material to use.

Investigative and Evaluative Activities

'Reverse engineer'	'Life-cycle analysis (LCA)'	'Washing performance'
Look at how an existing machine works and how it has evolved over the centuries. How did we used to wash clothes before electricity and the development of the modern washing machine? Can you breakdown how these early devices worked to inspire new ideas for your own washing machine?	No product simply exists, it needs to be designed, made, used and then disposed of. Any type of washing machine has a 'life' and some impact on the environment. This is from raw materials to manufacture, how it is used and what happens to it at the end of its useful life. Consider doing a LCA of a domestic washing machine and compare it to your own solutions. Could you create a design that has the minimum impact on the environment?	Experimenting with a range of small fabric samples, try staining them with coffee, juice, ketchup, oils, mud etc. then wash at different temperatures with or without soaps or detergents. Make a log of the results to see which combinations are the most effective. Then consider how these conditions could be created in your designs.



