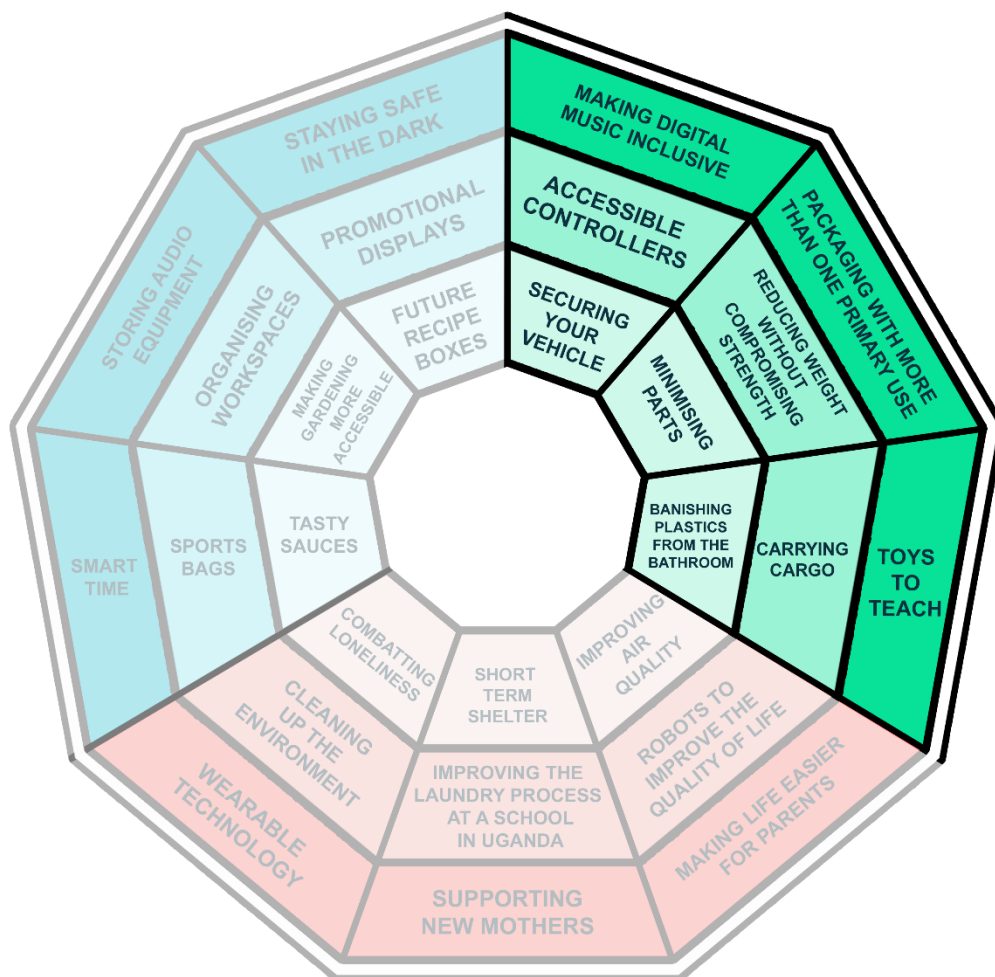


INSPIRED BY INDUSTRY

Accessible controllers

#InspiredbyScalextric



Introduction

This context has been put together to allow for a range of opportunities for students to explore the design and creation of accessible controllers for slot car racing. The context is adaptable to other types or applications of controllers. This may even be non-digital like handles possibly.

Materials

Whilst not exclusive to this context, it provides good opportunities to explore polymers as well as prototyping materials such as card and expanded foam. This context could also encourage the exploration of simple electronics and/or mechanical systems studying inputs, outputs and how they are powered. Exploring wireless and wired controllers can be useful. This may be through the use of micro:bit or Crumble where they can allow for some prototyping of products that react to inputs. Alternatively, it could just make use of existing standard components found in controllers.

Potential outcomes

Some outcomes are likely to be conceptual and may not be fully working. For example, a controller design may focus on accessibility or ergonomics which can often be tested without functioning as an electronic component.

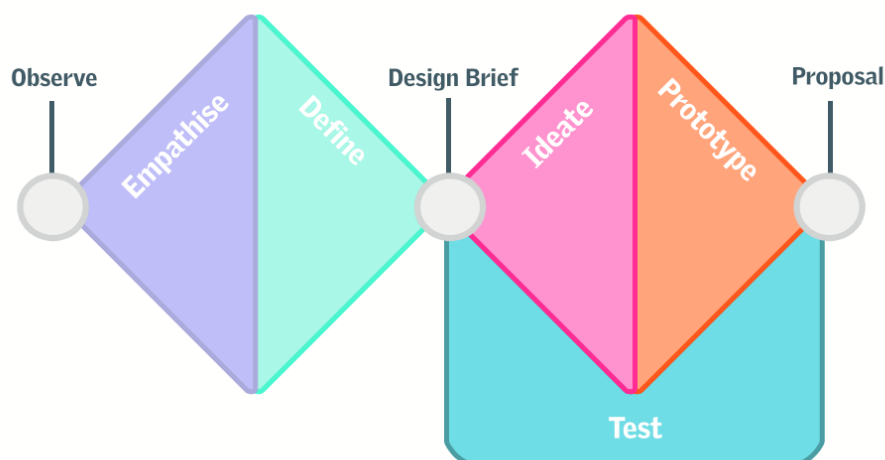
It is important that students are given some freedom within this context and so outcomes should vary between students / groups. You may decide to limit your class to a range of outcomes or applications or the components they need to incorporate.

There is an opportunity to look at rapid prototyping here as well as more traditional methods of product development. Smaller handheld devices could be realised relatively quickly especially in shell or case form. While incorporating the electronics is advisable, again, this should be viewed as a prototype to test a concept. You may wish to explore making a 'what it looks like' prototype with students – or may be an opportunity for introducing or developing 3D CAD work.

Consider sharing work on social media using the hashtag #InspiredbyScalextric

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 convergently and then divergently may be shown to your students, such as this example:



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.
- 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.
- Observations (may be a video, producing a journal for someone to fill in, a phone call interview, email etc) should allow them to 'spot common problems' or identify opportunities for improvements over existing solutions.
- The following videos from Ford are good examples of empathetic design in industry [VIDEO 1](#) [VIDEO 2](#)
- The Big Life Fix [HERE](#) is fantastic for showing empathetic designing. Throughout the process the designers try to immerse themselves in the problem and regularly get feedback from the clients. Observing others is really important rather than just asking people what they want as they may not know!
- If gaining access to research is hard, you may want to observe slot car racing online or, if you have a Scalextric activity, arrange to observe it. If you decide not to look at Scalextric, it could be something like gaming, or even user interfaces for things like a microwave, chip and pin machine, car parking etc. Note: There are interesting adaptive controllers such as [X-Box](#) and [Project Leonardo](#) that you may wish to explore as another product solution. As a group, note down all the potential issues you see – don't think at all about solutions yet, or even if they are able to be solved using technology – this is just a stage to highlight issues and concerns. It may be things like, grip, comfort, ease of use, effectiveness, handling etc.
- Whilst it may not be suitable for students, there may be aspects of [The Tommy Edison experience](#) on YouTube that is useful to show how visually impaired people interact with products.
- Students should get as much information to help them later on in the challenge, but also be aware the research can be done at any relevant point in the design process. They may present their findings in any way they feel appropriate or effective.

Define stage

- This is where students try to get the real root of the problem and decide what they are going to do. What aspect of designing or improvement will be their focus?
- There may be a whole range of 'applications' identified other than slot car racing. Are there similar applications for a controller to make it more accessible to users?
- The '5 why's' may be a good resource to run through with students. You could even pair them up to do this with each other at the define / empathy stage [VIDEO HERE](#)
- This is a good opportunity to introduce contextual challenges to students and get them to consider all aspects of the problem. It will undoubtedly need some support from you as a teacher. Please get students to share their thinking as clearly as they are able.
- Get students to create a specification. Whilst templates / writing frames are fine at KS3, you will want to avoid this at KS4. Consider using columns such as 'Essential', 'Desirable' and 'Definitely not'.

Ideate stage

- Ideas for the controller may initially be through words. You may want to consider listing the key part available for your system and do a matching activity. For example, trigger, switches, rotary dials, lights etc.
- Encourage students to think wide initially. No ideas are too silly, or too big.
- Ideas can also be produced through making or modelling. Get students experimenting with modelling or rapid prototyping early in the design development phase.
- The outcome can also be modelled using 3D CAD to help visualise colours and materials in a more realistic way and without the use of materials.
- There are a range of videos on YouTube to help students with sketching techniques. [HERE](#)
- Product design sketching tutorials can be found [HERE](#)
- The Design Museum have some nice, short, case-study videos [HERE](#)
- Students should be encouraged to sketch on anything to hand – envelopes, packaging etc. This may be a good method to stop students potentially being daunted by blank paper.
- Encourage zoomed-in parts of the product to focus on details and annotation.
- Annotation may be things they like, things they are not happy with and explanation of parts that are not clear from the picture.
- A range of techniques such as 2D, 3D, Exploded and cross sections are good.
- Further research may be needed at this stage. Consider a handling collection such as old and current controllers. Can they think of other products that perform a similar function?
- Ideas don't have to be revolutionary and completely new. They can be a development of an existing product, but you may well see an opportunity for something totally new!
- Maybe they can start with an existing product and improve it. This [VIDEO](#) is a good introduction to this for older students / teachers.
- You could introduce modern / smart materials such as QTC, or voice activated sensors which may generate alternative approaches or ideas for students.

Prototype stage

- A nice video from BBC Bitesize is [HERE](#)
- This short video from The Design Museum looks at the journey a designer had to design and make a collapsible bottle. [HERE](#).
- There are a number of videos by Jude Pullen from Big Life Fix [HERE](#) on how to create shapes in card. However, many may not have access to materials / tools and so C.A.D. may be more suitable.
- 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](#)

- It is worth discussing with students why they create a model or prototype. What are you wanting to test or evaluate; function, comfort, aesthetics etc? Choosing the correct model or prototype for the correct test is important.
- Throughout the process, ensure students follow procedures for health and safety and understand the process of risk assessment.

Test stage

- Although this is the final stage of the design cycle, encourage students to evaluate throughout the process and act on their feedback (and consider the feedback of others too). Testing is not a final thing, but a step to improve your designs further.
- Consider **AR** (Augmented Reality). If you use windows, PAINT 3D allows you to open .obj (CAD) files and students can then view their design in a hand, or near a slot car track to see how it may appear in use.
- To help students that are **reluctant to improve their idea**, consider prompts such as “What if I could use any technology available?”, “What if it had to be made in 1 day?”, “What if you needed to make 100,000?”, “What if it had to be made cheaper?”, “What if it had to be made lighter?”.
- This could be a good opportunity to explore mathematical content by getting students to calculate amount of material used, costs etc. Some programs such as Autodesk Fusion allow you to calculate the amount of material you have used [HERE](#).
- How can students get feedback from users? Could they use technology to get a wide range of feedback – e.g. a Google Form? A poll on twitter (X)?
- Get students to think about the main problem they identified earlier – does it actually do that? How successful is the outcome compared to the intention?
- Prompts for younger students e.g. ACCESS FM are suitable approaches. For older students they need to consider a wider range of aspects such as scalability, manufacturing techniques and limitations, ergonomics etc.

Focused tasks

<u>'Sketch modelling'</u>	<u>'CAD'</u>	<u>'CAM'</u>
For this and many other contexts, you could encourage sketch modelling. Get scrap materials such as foam or card and introduce modelling while students are still generating ideas.	Use CAD to create shell like structures that can be edited to make a range of controllers. Consider giving students a range of component parts that they can rearrange into their designs to save time.	Investigate how CAD models can be converted to shapes that can be printed or cut out using a laser or vinyl cutter.
<u>'Freehand sketching'</u>	<u>'Digital sketching'</u>	<u>'Organic shapes'</u>
A controller can be a good opportunity to develop 3D sketching and rendering skills as it is not too complex a shape to sketch. Consider sketching over a photograph of a posed hand to ensure it will fit the users' grip.	If you have tablets or digital software, encourage development of ideas by sketching over existing photos, models or sketches.	Sketching organic shapes can be tricky. Consider practicing how to tackle these using a 'potato-shape' approach.

Investigative and Evaluative Activities

<u>'Reverse engineer'</u>	<u>'Success criteria'</u>	<u>'Ergonomics'</u>	<u>'Adapt'</u>
Scalextric encourage reworking existing ideas by sketching over them. You could take this further by disassembling an existing controller to see how they have been engineered.	Investigate controllers that work well and have proven to be popular. What features do they have that make them successful?	This considers how humans interact with their environment and objects. Get a range of different controllers and discuss how effective they are in terms of accessibility, comfort, design or how intuitive they are to use. These could be controllers from different applications other than slot car racing.	When there is limited time for a full design and make task, consider adapting or improving an existing controller to make it more accessible to a wider range of users. You could use existing parts from the controller or use CAD modelling to design the improved version.



