Royal Academy of Engineering

MANCHESTER 1824
The University of Manchester

Improve – Problem Finding

Looking around to spot things that aren't working well or could work better

Download the full report:

Bianchi, L. and Wiskow, J. (2023) Progressing to be an Engineer – The Approach. Royal Academy of Engineering.

Informed by work from project schools:
Archway School, All Saints' Primary School, Beech Hill Primary School, Ince Church of England Primary School, Ribblesdale High School, Salusbury Primary School, St Bartholomew's CofE Primary School, St Charles RC Primary, St Edmund's Primary School, St Wulstan's Primary School

The Progressing to be an Engineer Cycle

Overview

Improve – Problem Finding is the process of asking questions about the way something works and exploring whether there are ways in which it can work better. This happens through cycles of testing, undertaken with a logical approach where key refinements can be prioritised to improve the functionality of the product. This is the precursor to actually making the changes. .

ILOs	Key learning	Suggested activities
What do we want pupils to understand about Improve – Problem Finding?	Improving something happens well when it is based on observing how a product works, and reviewing whether it functions in a way that meets the original design specification or user requirements. Asking questions brings engineers back to the beginning of the design cycle, when they are looking for things that could work better. Taking a logical questioning approach, using note taking and prioritising potential improvements leads to a systematic approach to improving.	**Evaluating:** Testing how something works. **Activity:** **1.** Shoe Showcase
How do we want them to apply their knowledge?	It is important for pupils have time to test their products and to closely observe performance to gain a clear understanding of which materials or components could be improved. This can involve thinking about the range of options in terms of materials, mechanism types, the way the system works etc. The art of question asking is key to problem finding, and is best done by exploring if the design specification has been met in part or in full.	**Designing to a specification:** **Activity:** **2.** Design a shoe

	From	To	Towards
	Suggested 5–7 years	**Suggested 7–11 years**	**Suggested 11–14 years**
Pupils should be taught to:	Check things work by testing.	Test that things work using a logical approach, gathering evidence to make an informed decision.	Test and evaluate products against a specification, reacting to the views of specific user groups.
Success was demonstrated when pupils:	■ decided on how to test if the product worked ■ could explain what worked well and what didn't ■ had some ideas about what needed to change.	■ made a plan for how to test the product, including what criteria they would use to evaluate ■ kept notes about what they saw ■ tested the same thing a number of times.	■ could explain what was working well specifically in relation to how it worked or didn't work for a specific user ■ showed understanding of how different users may require different improvements.

Generic task

Initial learning activity – eliciting and developing understanding

Activity 1: Shoe Showcase

Pupils were given 3 different kinds of shoes. These were real physical objects and not images, so they could handle them. They were encouraged to evaluate the shoes using a set of guiding questions. Similar household or familiar objects are useful alternatives in this task. as long as they are different iterations of the same objects.

Initial learning activity – eliciting and developing understanding using a generic task (continued)

Activity 1: Shoe Showcase

This led to the following types of ideas.

IMPROVE – Problem Finding
EMBEDDED TASK a. Evaluate a product

Name:

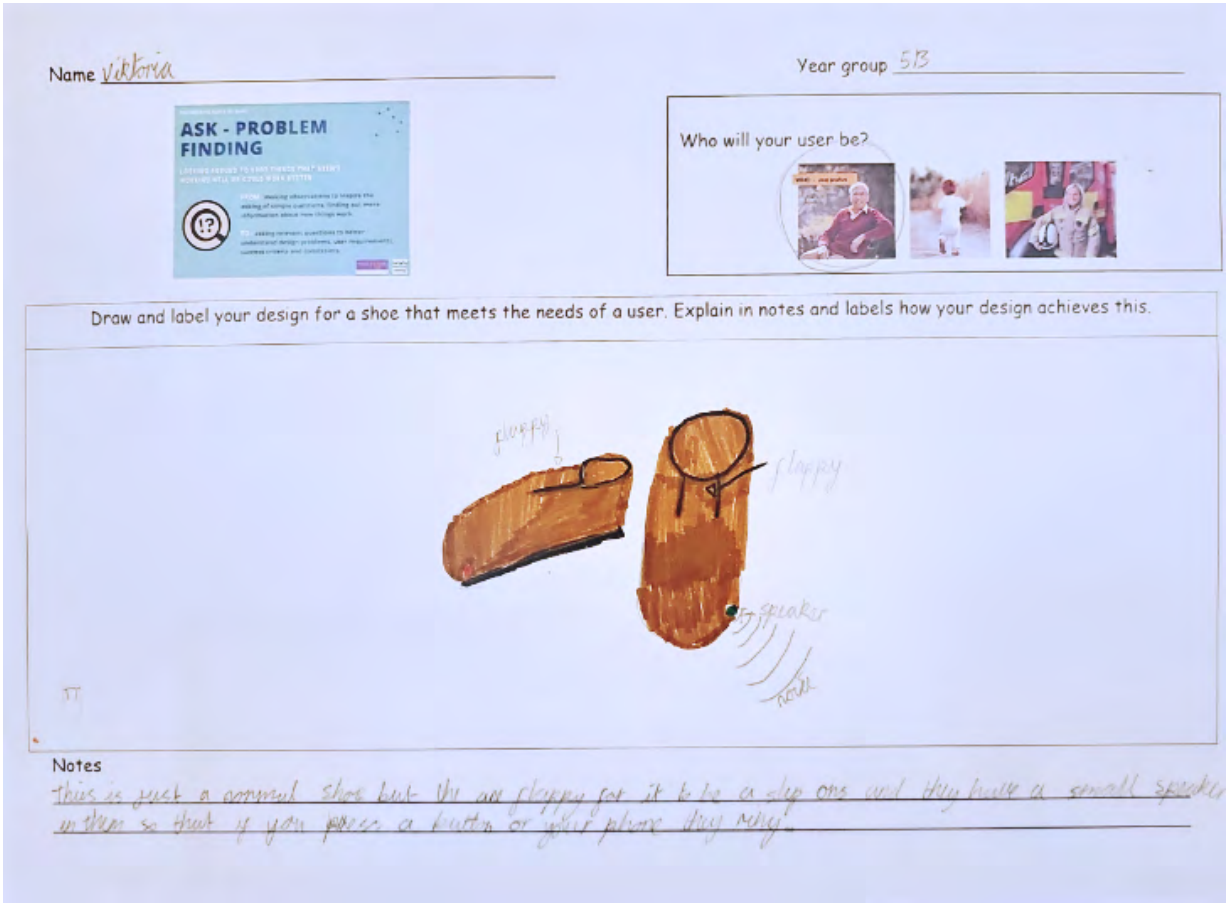
	What is the product for?	What are its different parts? What does each part do? Why is it there - what is its function?	What is each part made of? Why is it made of this specific material?	What properties and features does the product have so it can function well?	Who is the product designed for? How do you know this? How does its design meet this user's needs?	Are there any problems with the product?
						
						
						

Embedded task

Exploring Improve – Problem finding

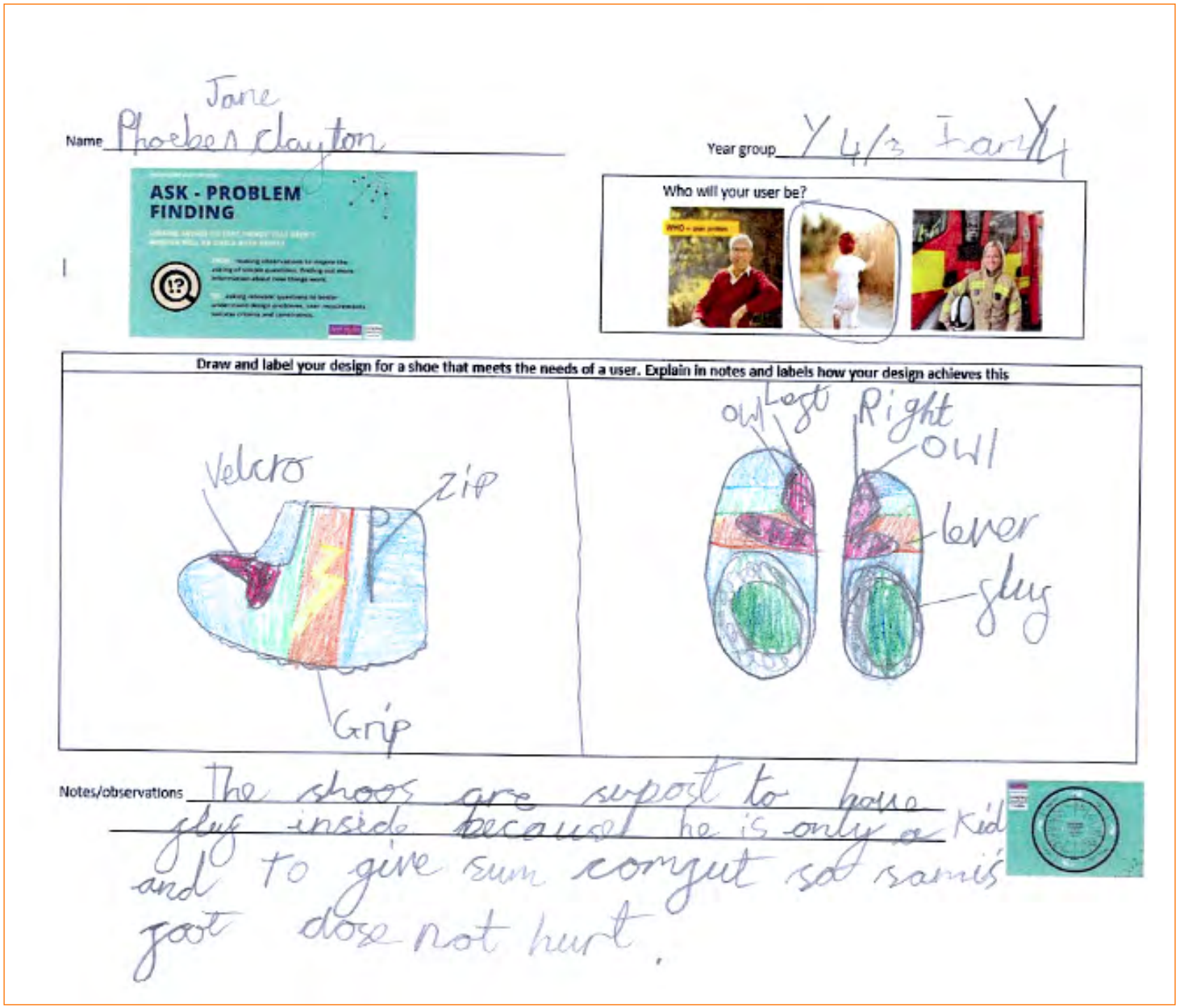
Activity 2: Design a shoe for a specific user

This activity inspired the pupils to take the observations they had made when evaluating the shoes, and to design a new shoe which would be an improvement from the last. This further developed their understanding of a design brief and user needs.



This is a shoe suitable for another child in the class. The design has a flap on the front of each shoe to make it easy to slide the shoe on and off without having to bend down.

A small speaker is incorporated in the front of the shoe which would connect to an app on a mobile device. You can then track the shoes from the device and they would make a noise to help you locate them.



Y4 Pupil with special educational needs

This design is very simple, the most important feature she considered was getting the shoes on the right feet.

Rather than have an R and L written on the shoe they thought making a picture of an owl when the shoes were on the right feet would make more sense to the wearer (who may not be able to read yet).

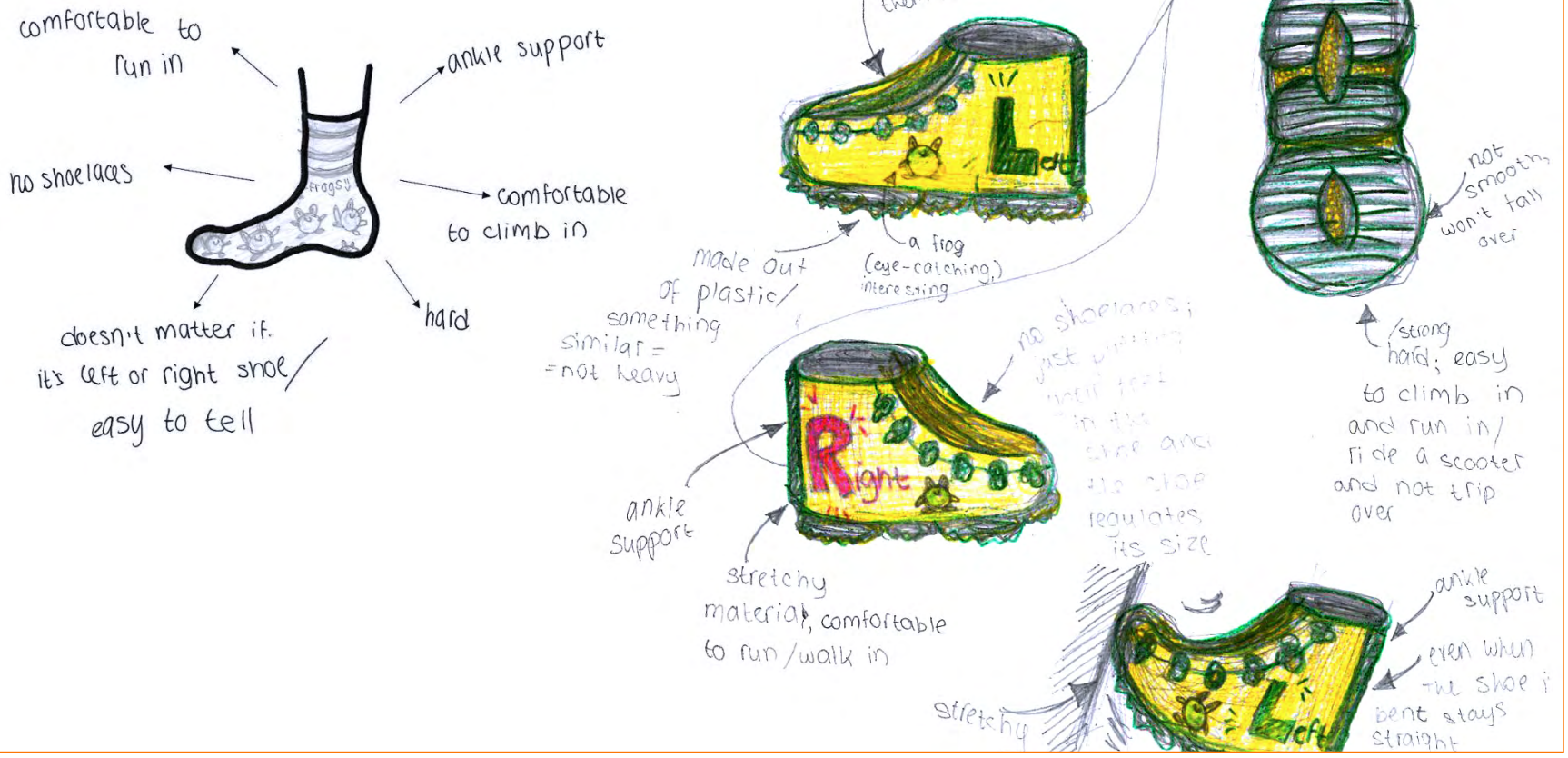
Ksenija 9R

Design a shoe that meets a specific user's needs.

Q. Which user profile have you selected?

A. Sami

- What does this specific user need from a shoe? No shoelaces, comfortable to run around, ankle support
- What problems might they have with regular shoes? How can you solve these problems with your new design?
- What features can you include in your shoe design to ensure they meet your user's needs?



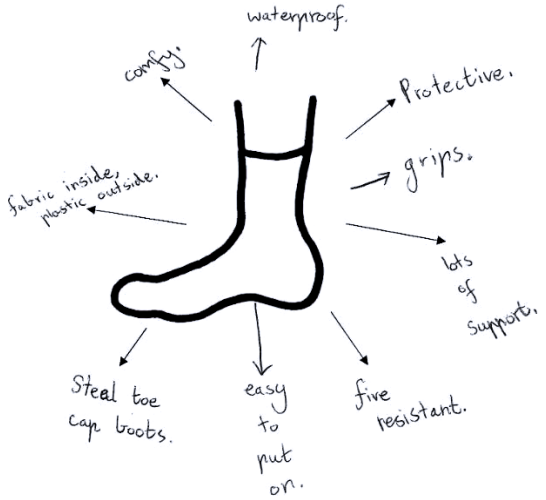
Aurelia Oliver, 8S. 21/05/24.

Design a shoe that meets a specific user's needs.

Q. Which user profile have you selected?

A. Firefighter (Sarah).

- What does this specific user need from a shoe? needs to be able to protect them.
- What problems might they have with regular shoes? How can you solve these problems with your new design?
- What features can you include in your shoe design to ensure they meet your user's needs?



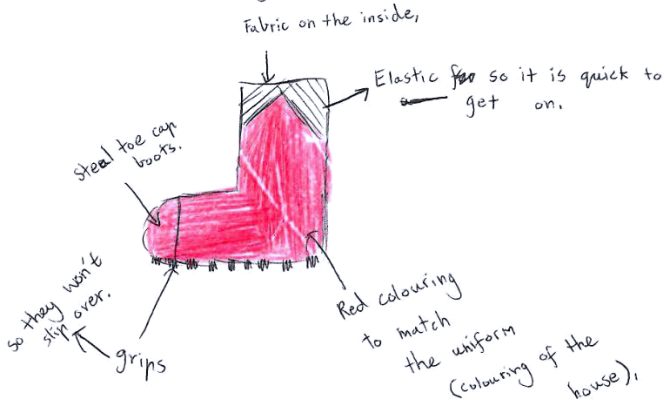
fabric inside, plastic outside = comfy and water resistant.

Steal toe cap boots = if wood falls onto their foot when there is a fire they won't hurt their foot.

Fire resistant = won't set on fire when saving people from a fire.

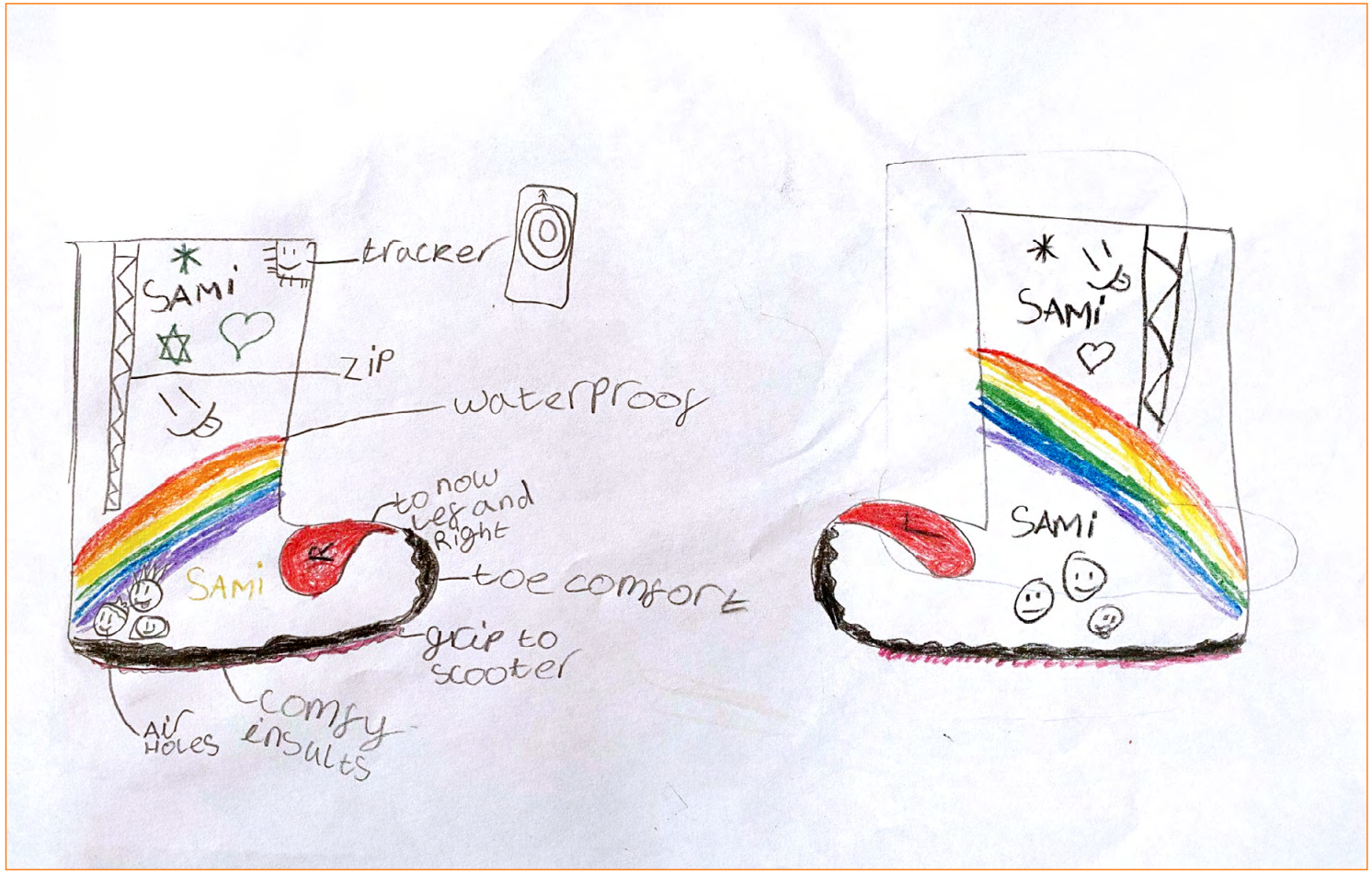
easy to put on = so when they are rushing, they can put it on quickly.

waterproof = when using water she won't get her ~~feet~~ feet wet.



Embedded task

Exploring Improve – Problem Finding (continued)



'This pupil designed a colourful shoe with good grip so the child doesn't slip. No laces, a zip.

Each shoe is waterproof as small children go through water and puddles without thinking they are going to get their feet wet! So their feet will stay dry inside. Again both shoes have a R or L on so the child knows which foot they go on.'

'The children could really relate to this activity and it opened up some interesting conversations as the children discussed each user and debated about which designs and materials would be best suited. The children were considering their own feelings, wants and needs for their own shoes and were applying this to their problem solving.'

Evolving to be an Engineer
Improve –
Creative Problem Solving

Task: Design a show for a specific users needs.

User: * Sami is a 2.5 year old toddler he loves running around and playing on his scooter he doesn't know what the left and Right is yet.

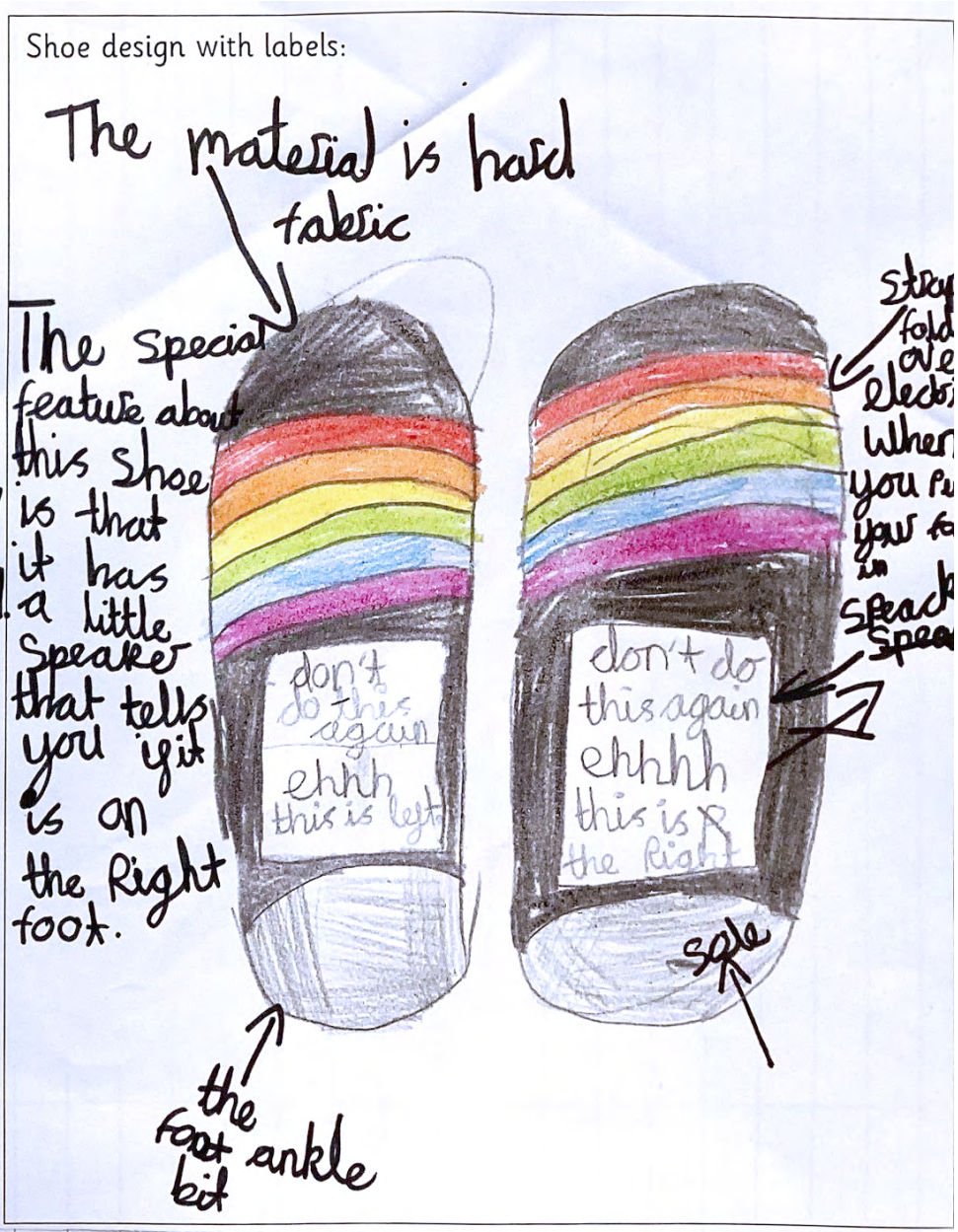
What does this specific user need from a shoe?

What problems might they have with regular shoes? How can you solve these problems with your new design?

What features can you include in your shoe design to ensure they meet your user's needs?

Check your design - can you improve the shoe so it works even better for your user? What does this specific user need from a shoe?

Shoe design with labels:



Teachers' ideas to extend and support thinking

Extending

Enable pupils to identify products they're keen to evaluate from their own experience, class, school or home. Practising the process of question asking and supporting them with linking questions to user needs will enable them to develop the habit of close observation and problem finding. Help pupils understand the difference between a 'user's need' and a 'design solution'. For example, a response to the prompt 'What does this specific user need from a shoe?' might result in a pupil saying 'No laces'. However, this is not a 'need', rather, it is this pupil's 'solution' to the user's need. The 'need' is a shoe a toddler can independently put on and take off easily. This differentiation is really important to make and clarify, as it encourages open thinking leading to more creative solutions. Open ended briefs (i.e. briefs that clearly specify the need, but do not give the solution) yield better solutions!

Further support

Pupils may struggle tto ask well formed questions. Sentence starters or key questions linked to a design specification can help them experience the improving process in a logical way.

E.g.

- Does the material of the shoe mean it is comfortable for the user?
- Does the way the shoe close mean that it is suitable for all types of people?
- Is the shoe fully waterproof?

Improve – Problem Finding

Looking around to spot things that aren't working well or could work better

FROM – checking things work by testing.

TO – testing that things work using a logical approach, gathering evidence to make an informed decision.

TOWARDS – testing and evaluating products against a specification, reacting to the views of specific user groups.