

Improve – Problem Finding

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



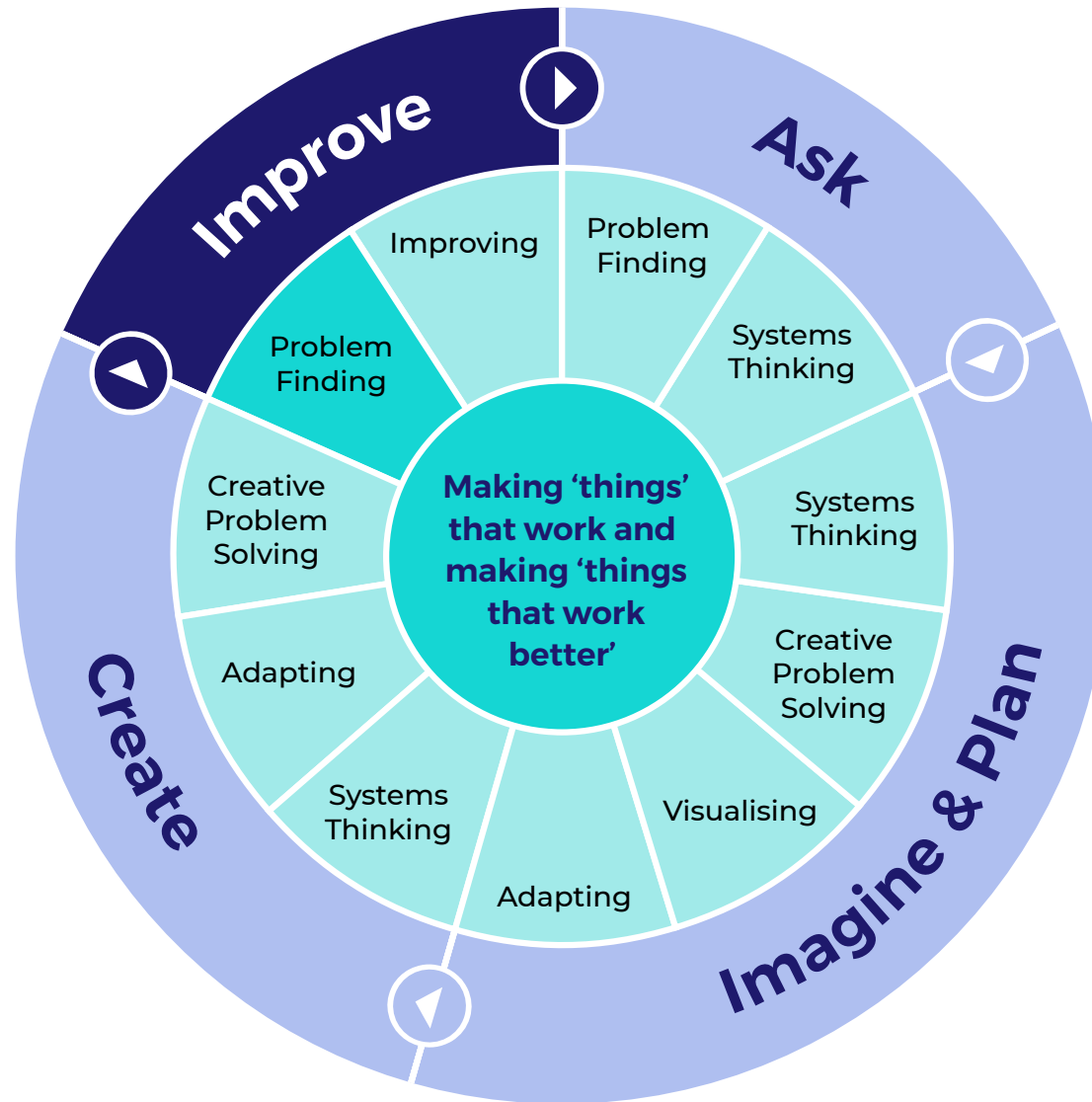
Download the full report:

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,
Salisbury 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?	<p>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.</p> <p>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.</p>	<p>Evaluating:</p> <p>Testing how something works.</p> <p>Activity:</p> <p>1. <u>Shoe Showcase</u></p>
How do we want them to apply their knowledge?	<p>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.</p> <p>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.</p>	<p>Designing to a specification:</p> <p>Activity:</p> <p>2. <u>Design a shoe</u></p>





	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:	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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: <i>Chloe</i>						
	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?
	Non-slip and a mudguard or to protect from heavy slush or puddle	Rubber is main shoe sole and it is made of a different material or has a different pattern for extra grip	Holder for grip and support of the foot Sole to help Coating of waterproofing to help prevent water getting in	Help grip and is waterproof to catch through muddy field so you don't get wet feet	Everyone that plays on grass in the winter that has to have wet feet for so long and just feet are dirty in the mud	That cause blisters, heavy mud on shoes, and it's not very comfortable. They are covering up the holes in the shoes so it's damaging the material.
	To play football, prevent sliding, maintain grip, the foot, the sole.	Plastic for grip, the sole is made of rubber to hold the foot together, sole to help grip.	Rubber to hold the foot together, plastic to help the foot together, sole to help grip and support.	To help the player to feel the ball and have grip or control on the ball, the sole is made of rubber to help grip.	Everyone that plays football, that needs football boots for better grip on the field or be able to score goals, the sole is made of rubber to help grip.	That they are heavy and slow, that they are not very comfortable, that they are not very durable.
	To provide support when carrying heavy loads.	Buffer between the foot and the sole, sole to help grip, sole to help grip.	Soft leather, synthetic material, sole to help grip, sole to help grip.	Stiffer soles for extra support.	Everyone that plays football, that needs football boots for better grip on the field or be able to score goals, the sole is made of rubber to help grip.	Have heavy parts if you get blisters on the sole, sole to help grip, sole to help grip.

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.

Name Victoria Year group 5B


ASK - PROBLEM FINDING

LISTENING AHEAD TO WHAT THINGS THAT DON'T WORK WELL WE CAN DO BETTER


IT'S... finding observations to help the asking of simple questions. Finding out more information about how things work.

IT'S... asking questions according to their context and design problems, user requirements, current reality and constraints.

Who will your user be?



Draw and label your design for a shoe that meets the needs of a user. Explain in notes and labels how your design achieves this.



Notes

this is just a normal shoe but the are floppy for it to be a slip on one and they built a small speaker in there so that if you press a button or your phone they ring.

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).

Name Jane Phoebe Clayton Year group Y4/3 Jane

ASK - PROBLEM FINDING

CHALLENGE: DESIGNING A SHOE THAT MEETS THE NEEDS OF A USER. WHO WILL YOUR USER BE?

1. Making observations to explore the existing situation, finding out more information about how things work.

2. Asking relevant questions to better understand design problems, user requirements, success criteria and constraints.

Who will your user be?

Draw and label your design for a shoe that meets the needs of a user. Explain in notes and labels how your design achieves this

Velcro Zip Grip

Left Right owl lever plug

Notes/observations: The shoes are supost to have plug inside because he is only a kid and to give sum comfort so samis foot dose not hurt.



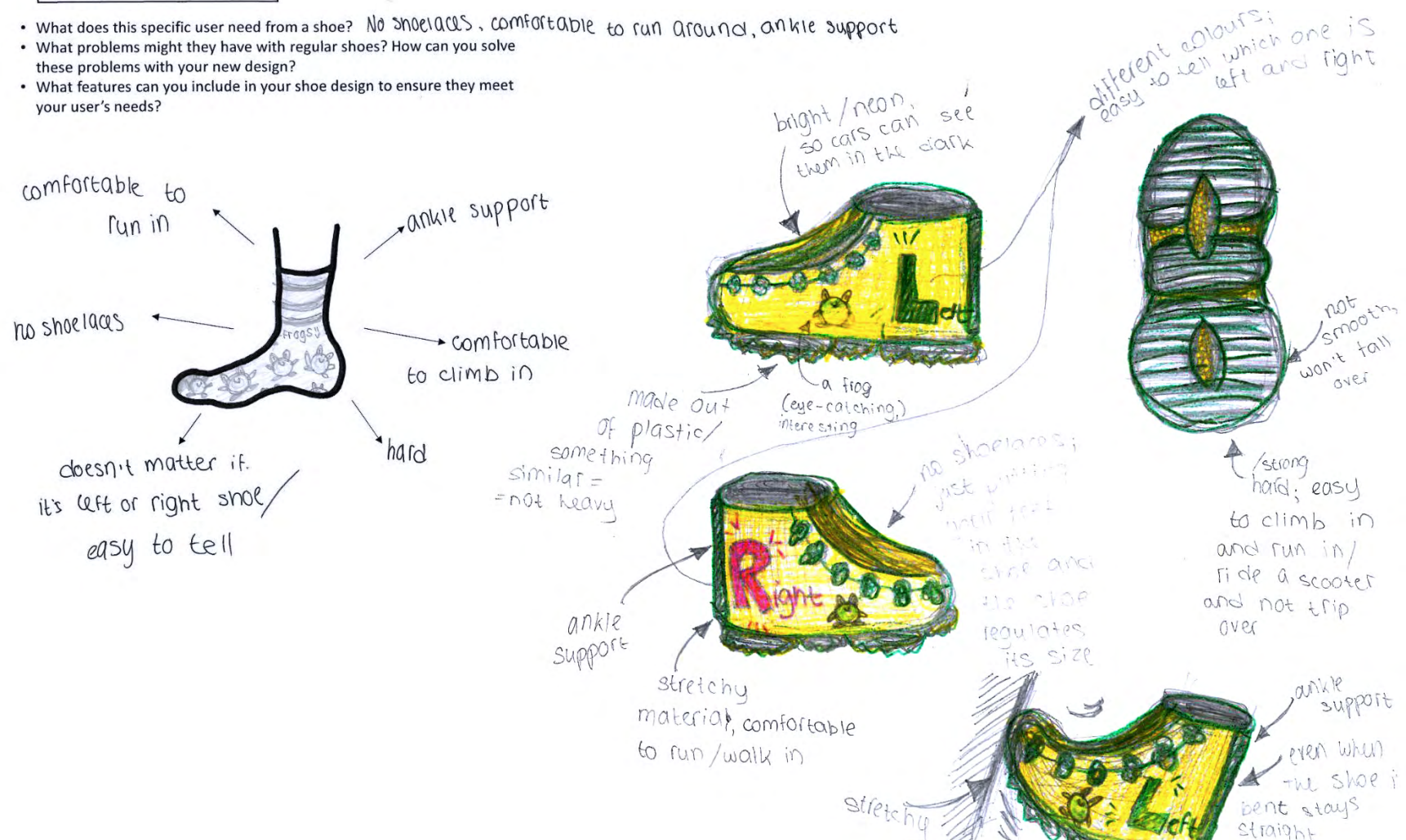
Kseniia GR

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.

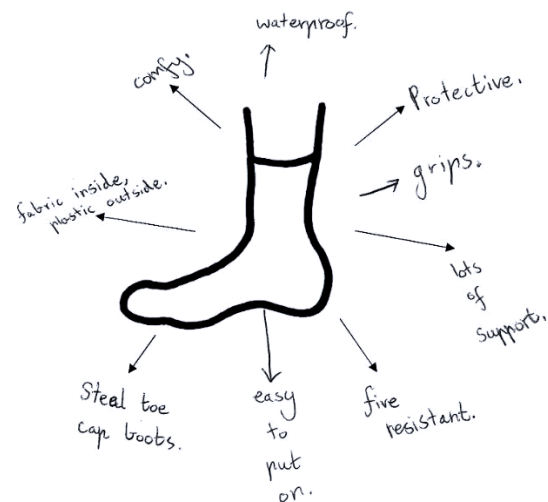
21/05/24.

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?



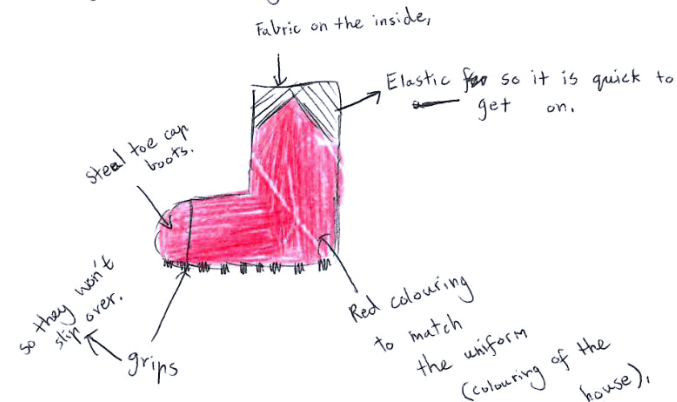
fabric inside, plastic outside = comfy and water resistant.

Steel 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 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 shoe for a specific user's 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 a 5 year old.

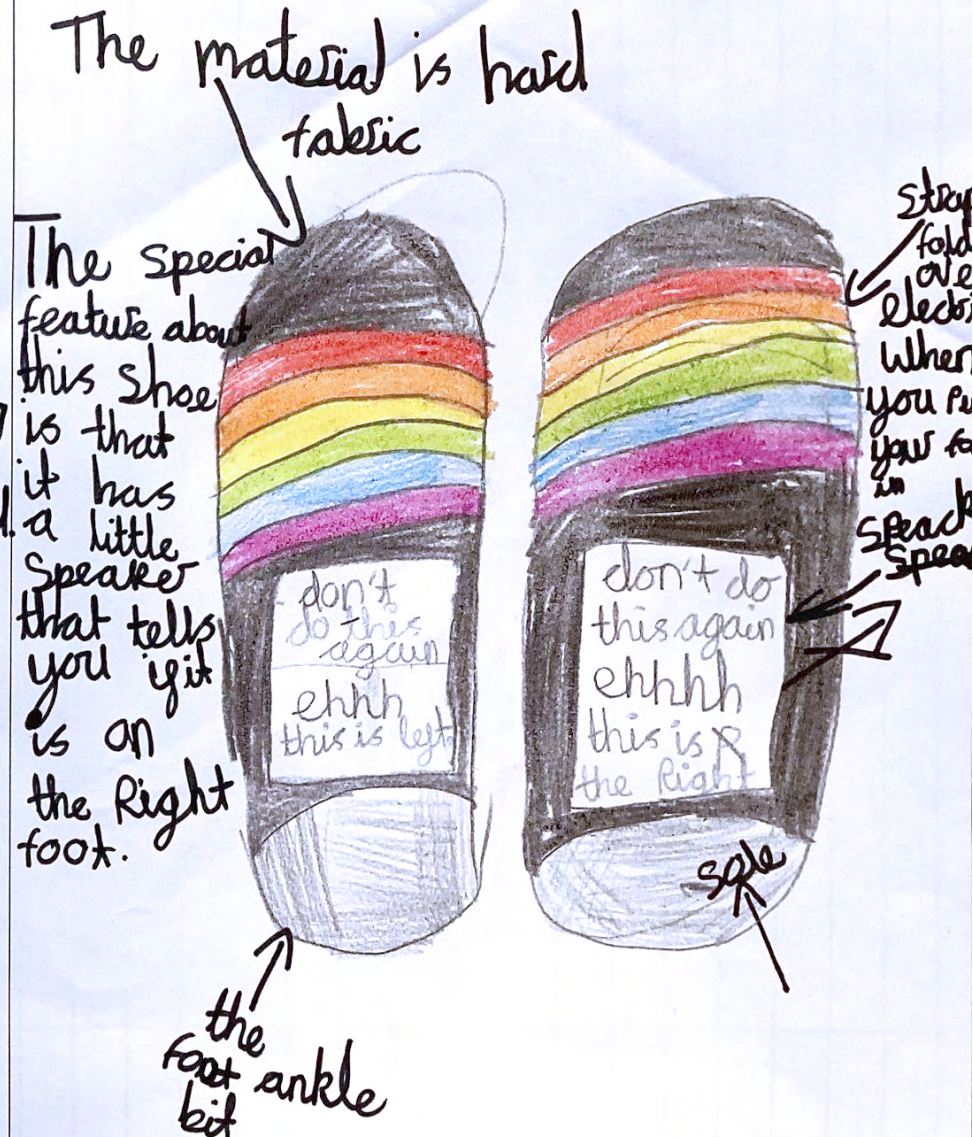
What does this specific user need from a shoe?

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

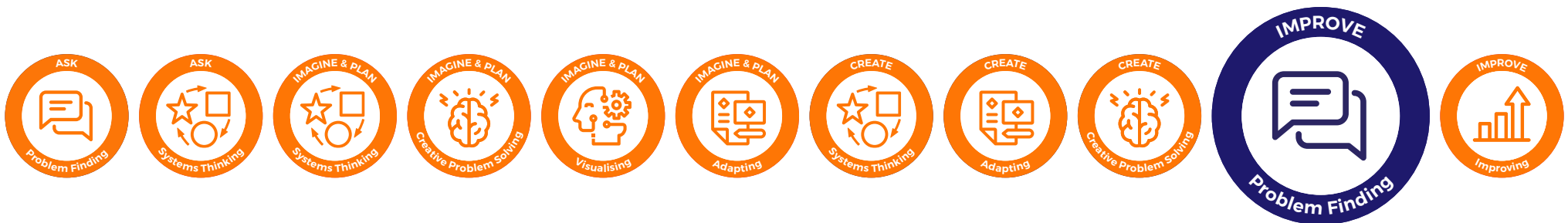
user need from a shoe?' might result in a pupil saying 'No laces'. However, this is not a 'need', rather, it is this pupil's 'solution' to the user's need. The 'need' is a shoe a toddler can independently put on and take off easily. This differentiation is really important to make and clarify, as it 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 to 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.