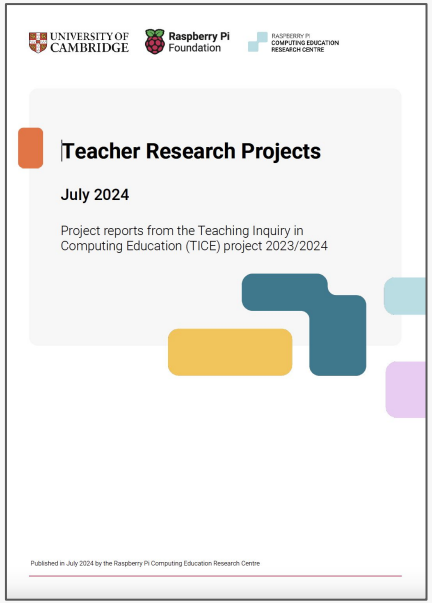
Teacher Research Projects in Computing

Session 3

CAS Conference

13th July 2024

Sue Sentance, Rachael Coultart, Pete Dring, Justin Heath and Jo Hodge



Teacher Research Projects booklet available at http://bit.ly/tice2-booklet

Teacher research in computing

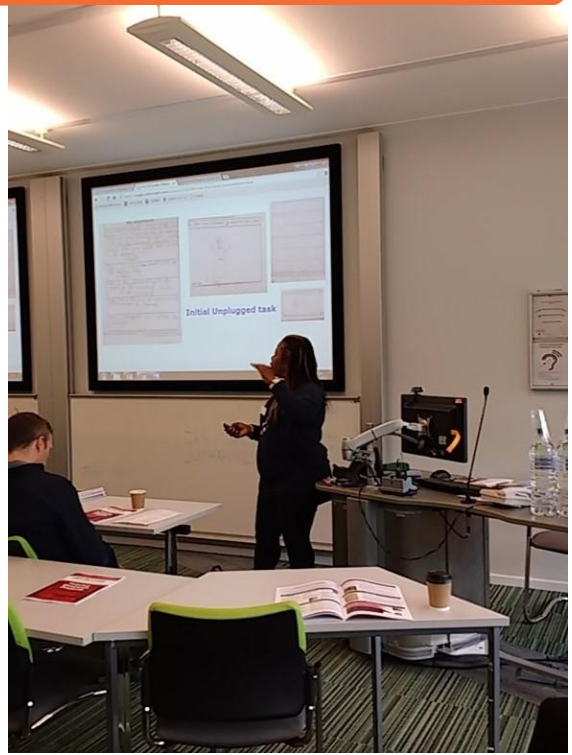
As teachers, it can be transformative to your practice to investigate what might improve your practice.

In computing in school there's even more reason to do this as we've all been learning how to teach it and there isn't a huge amount of research.

However there are barriers: time, confidence, expertise ….

In this project, we wanted to facilitate small-scale computing education inquiry projects, through real partnerships between teachers and academic helpers over a period of months.

The project is called Teacher Inquiry in Computing Education (TICE).



How TICE works

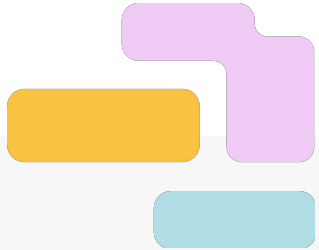
- Teachers volunteer/apply and construct a research question that is relevant to their own context and practice
- Introduced to a ‘helper’ who has research experience to be a buddy and offer support
- Webinars/workshops introduce the various stages of a research project
- Teachers write up project using a template

In this session

- **Rachael Coultart** - Impact of using LitterBox to support debugging skills
- **Pete Dring** - Impact of feedback of students' engagement and progress in KS4 Computer Science. Can AI replace a good teacher?
- **Justin Heath** - FLARE - Deepening understanding of abstraction in block-based languages: A framework for learning about relational elements
- **Jo Hodge** - Which PRIMM activities lend themselves to assessment in two Year 4 classes over the 6-week Spring Term in a primary programming unit

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation



Rachael Coultart

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

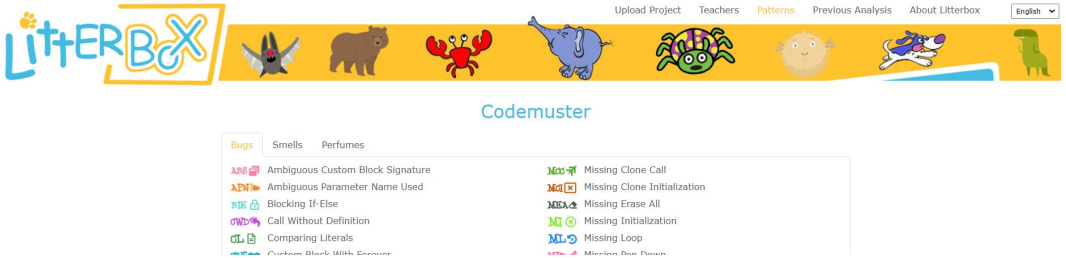
RASPBERRY PI
COMPUTING EDUCATION
RESEARCH CENTRE

The Impact of using Litterbox to improve debugging skills

TICE2 Research Project Spring 2024

Rachael Coultart supported by Dr Bobby Whyte

WiPSCE 2023



In what ways does the use of Litterbox support Year 5 and 6 Code Clubbers to improve their

- perseverance,
- code comprehension and
- debugging skills

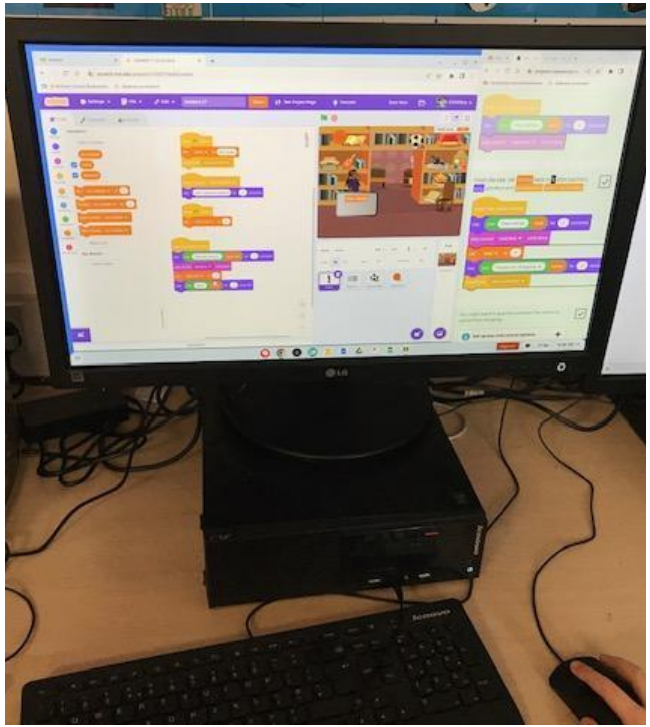
in their Scratch projects over 8 weeks in the Spring term?

I decided to run an intervention...

Model using Litterbox and support learners to interpret the results it produces when they run their projects through it. Encourage them to use the results to improve their projects and talk to them about what they did, how Litterbox helped or hindered.

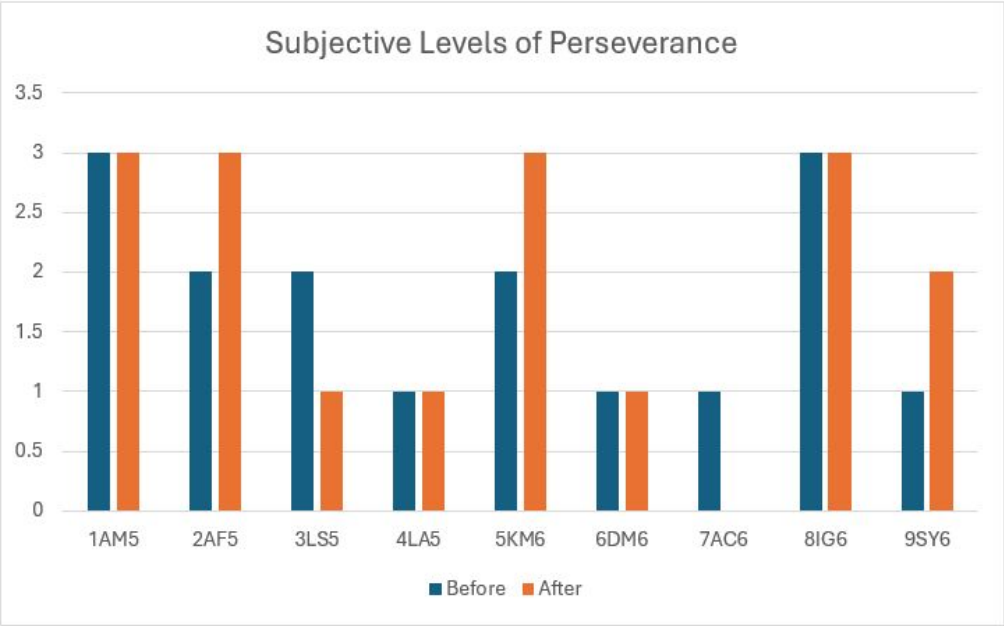
1. Look at their Scratch accounts
2. Code Comprehension quiz based on the 'More Scratch pathway' as baseline
3. Complete projects and use Litterbox to debug and analyse
4. Code Comprehension quiz repeated

Hiccups



- Delayed start
- Clash with football match and then SATs Booster classes
- Using the Code Club More Scratch pathway may not have been the best idea
- Interpreting the hints was an issue for some
- It’s very difficult to measure perseverance

Perseverance Results



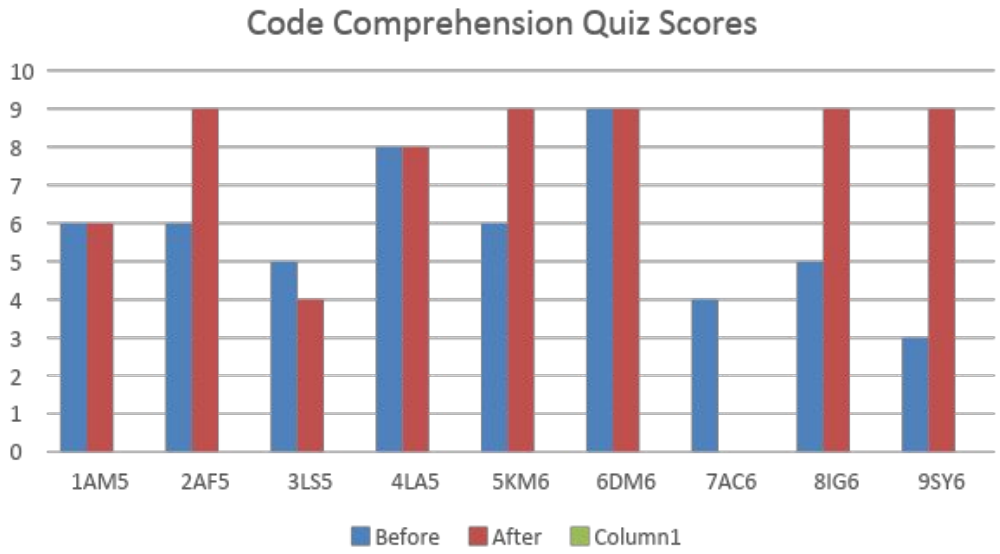
How do you feel when your program doesn't work the way you want it to?

1 = low ie frustrated with no suggestion of strategies for debugging

2 = medium ie some suggestion that they might be able to debug and get project working

3 = high ie expressed confidence at being able To debug and had range of strategies

Code Comprehension Results



Key concepts made clearer through discussions

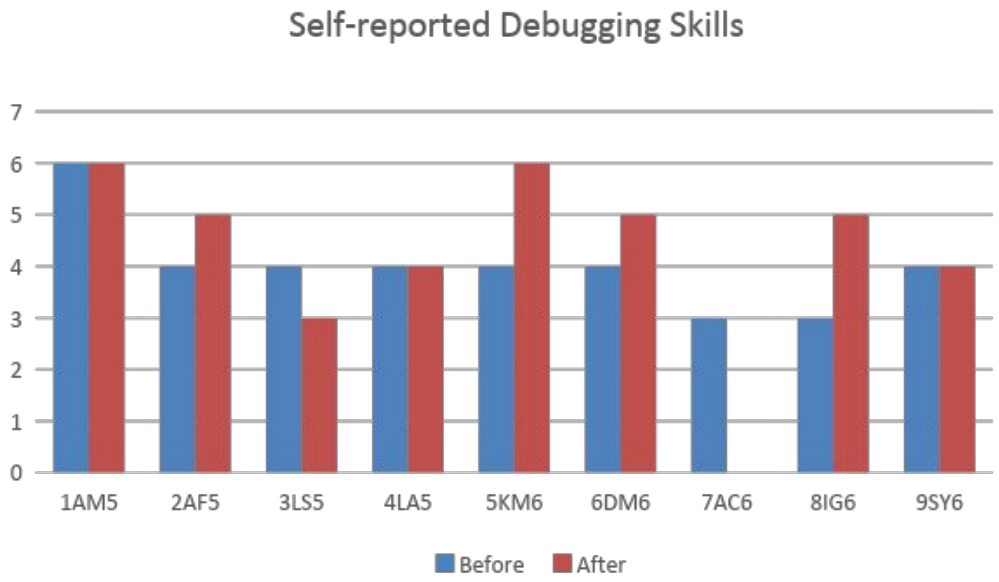
Conversations were meaningful and productive

“Litterbox helped me with a useless block.”

Significant improvement in students 8 and 9

https://docs.google.com/forms/d/e/1FAIpQLSeTJT4D_f_30rOWlQbVOANJUhGm-UX5Gx-yHRQp-8-6SlotXQ/viewform

Self-Reported Debugging Skills Results



How do you rate your debugging skills on a scale of 1 to 6?

Litterbox was initially very motivating, but this wasn't sustained for all

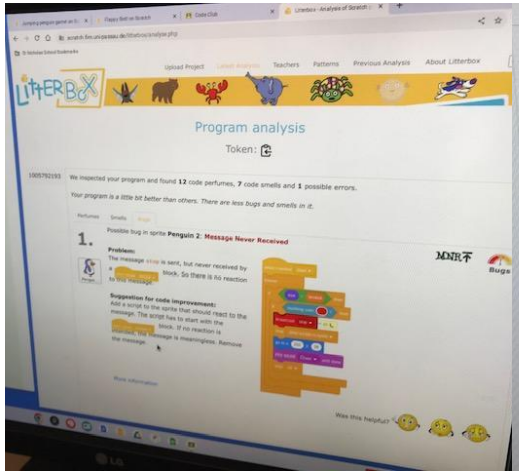
Hints needed unpicking

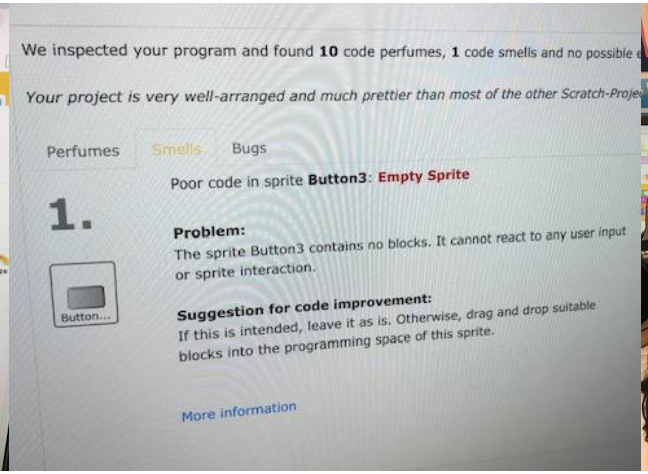
Second analysis was the same!

Highlights

- Sprites were named appropriately and initialisation improved dramatically
- Conversations about projects were more meaningful and demonstrated improved understanding
- Empowered students to improve own projects
- My improved confidence in supporting debugging
- Didn’t want to stop and go home!

Conclusions





- Fantastic tool for teachers to help analyse projects and provide constructive fee
- Needs careful introduction to students to ensure remains motivational
- Could potentially be improved with the addition of video tutorials

Give it a go!

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

RASPBERRY PI

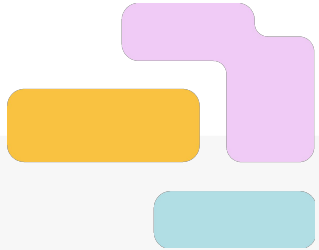
COMPUTING EDUCATION RESEARCH CENTRE

Thank you

To talk more about this, feel free to email me: rachael@coultart.com

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation



Pete Dring

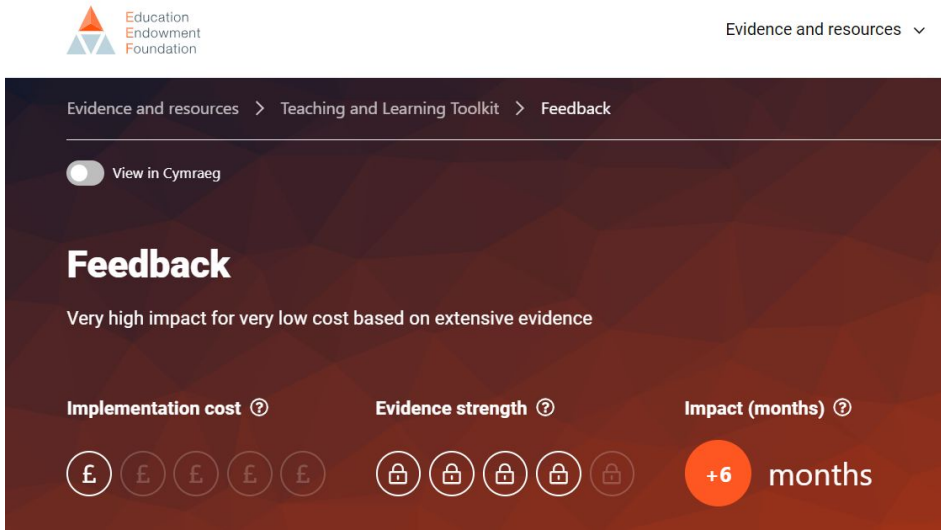
Impact of feedback on students' engagement and progress in KS4 Computer Science

Can AI replace a good programming teacher?

Pete Dring, Fulford School, York

Context and starting point

- Edexcel GCSE Computer Science
- Practical programming paper 2



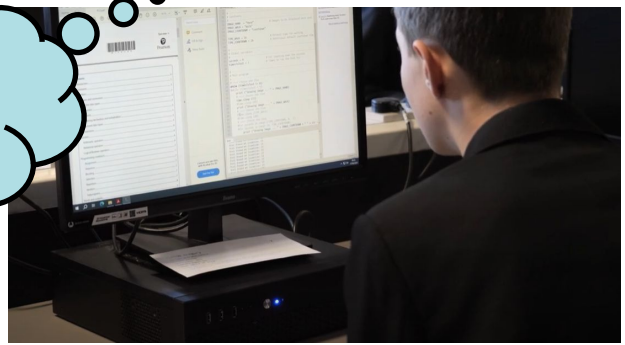
Source: educationendowmentfoundation.org.uk

Research questions

What type of feedback has the most positive impact on students'…

2 … ability to improve …

I know what to do



1 … engagement …

I'm going to do it

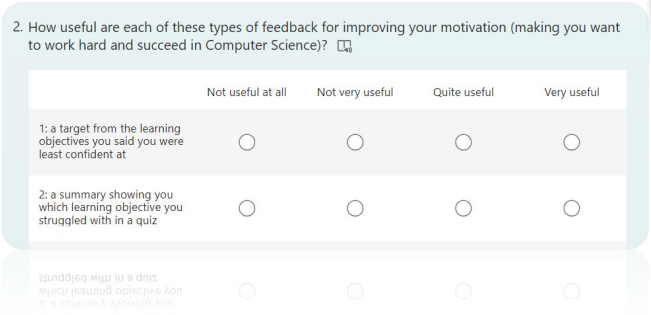
…in the programming aspect of GCSE Computer Science?

The process

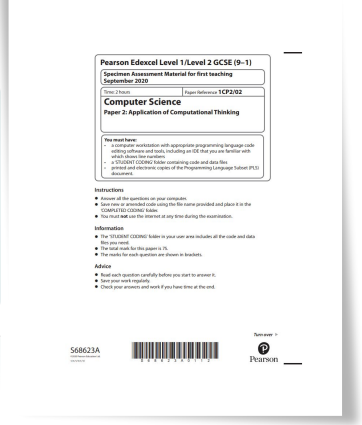
Initial survey
- Jan 24
- n = 43

Intervention
- Feb 24
- n = 36

Final survey
- Mar 24
- n = 15


2. How useful are each of these types of feedback for improving your motivation (making you want to work hard and succeed in Computer Science)?

	Not useful at all	Not very useful	Quite useful	Very useful
1: a target from the learning objectives you said you were least confident at	○	○	○	○
2: a summary showing you which learning objective you struggled with in a quiz	○	○	○	○


Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Specimen Assessment Material for first teaching September 2020

Time: 2 hours | Paper Reference: 1CP2/02

Computer Science

Paper 2: Application of Computational Thinking

You must have:
- a computer, workstation with appropriate programming language code writing software and tools, including an IDE that you are familiar with which shows line numbers
- a STUDENT CODING folder containing code and data files
- printed and electronic copies of the Programming Language Subset (PLS) document

Instructions
- Answer all the questions on your computer.
- Save new or amended code using the file name provided and place it in the COMPLETED CODING folder.
- You must **not** use the internet at any time during the examination.

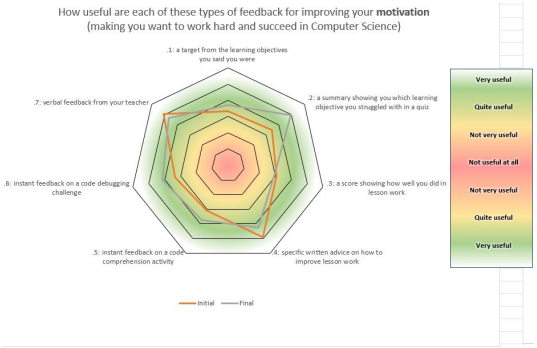
Information
- The 'STUDENT CODING' folder in your user area includes all the code and data files you need.
- The total mark for this paper is 75.
- The marks for each question are shown in brackets.

Advice
- Read each question carefully before you start to answer it.
- Save your work regularly.
- Check your answers and work if you have time at the end.

S68623A

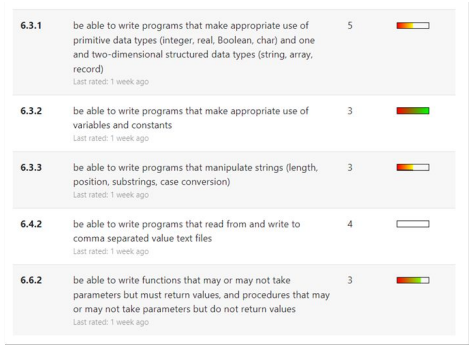
Turn over

Pearson



Types of feedback

1: a target from the learning objectives you said you were least confident at



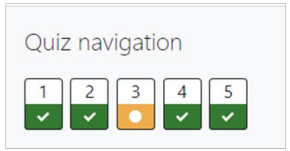
6.3.1	be able to write programs that make appropriate use of primitive data types (integer, real, Boolean, char) and one and two-dimensional structured data types (string, array, record) Last rated: 1 week ago	5	
6.3.2	be able to write programs that make appropriate use of variables and constants Last rated: 1 week ago	3	
6.3.3	be able to write programs that manipulate strings (length, position, substrings, case conversion) Last rated: 1 week ago	3	
6.4.2	be able to write programs that read from and write to comma separated value text files Last rated: 1 week ago	4	
6.6.2	be able to write functions that may or may not take parameters but must return values, and procedures that may or may not take parameters but do not return values Last rated: 1 week ago	3	

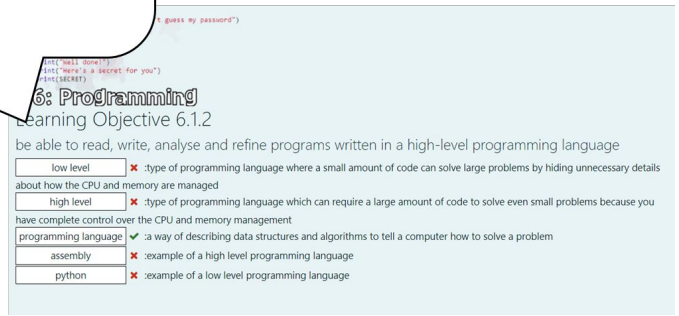
2 … ability to improve …

1 … engagement …

Types of feedback

2: a summary showing you which learning objective you struggled with in a quiz





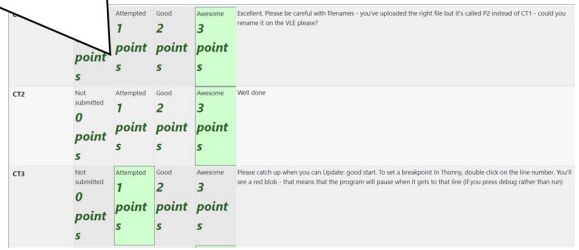
2 … ability to improve …

1 … engagement …

Types of feedback

3: a score showing how well you did in lesson work

Y10-01-CT1_Activities.docx
Y11_01_CT2_Activities.docx
Y11_01_CT3_Activities.docx



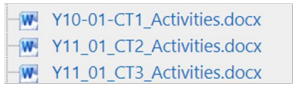
	points	Attempted 1 points	Good 2 points	Awesome 3 points	Excellent. Please be careful with filenames - you've uploaded the right file but it's called P2 instead of CT1 - could you rename it on the VLE please?
CT2	Not submitted 0 points	Attempted 1 points	Good 2 points	Awesome 3 points	Well done
CT3	Not submitted 0 points	Attempted 1 points	Good 2 points	Awesome 3 points	Please catch up when you can Update: good start. To set a breakpoint in Thonny, double click on the line number. You'll see a red blob - that means that the program will pause when it gets to that line (if you press debug rather than run)

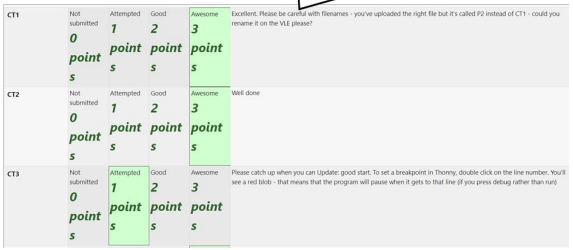
2 … ability to improve …

1 … engagement …

Types of feedback

4: specific written advice on how to improve lesson work



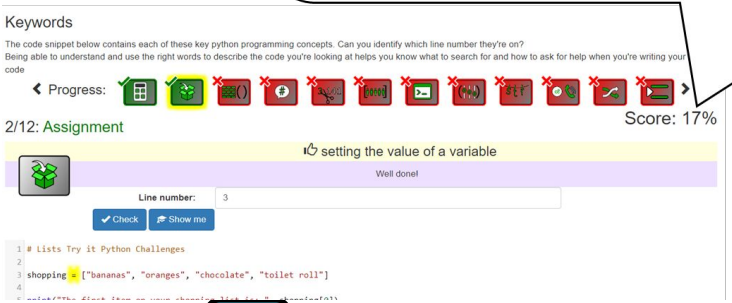


2 … ability to improve …

1 … engagement …

Types of feedback

5: instant feedback on a code comprehension activity

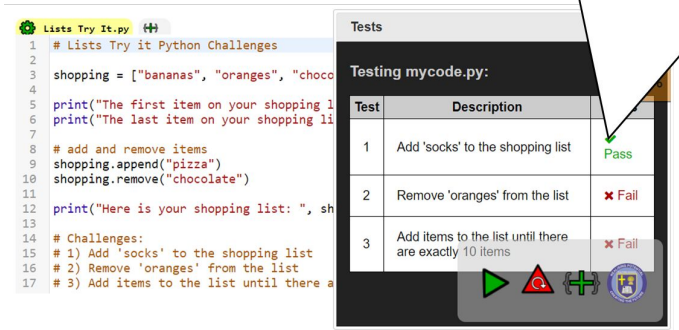


2 … ability to improve …

1 … engagement …

Types of feedback

6: instant feedback on a code debugging challenge

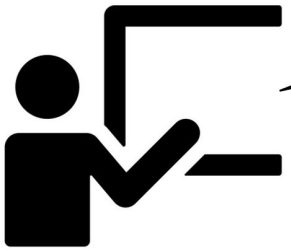


2 … ability to improve …

1 … engagement …

Types of feedback

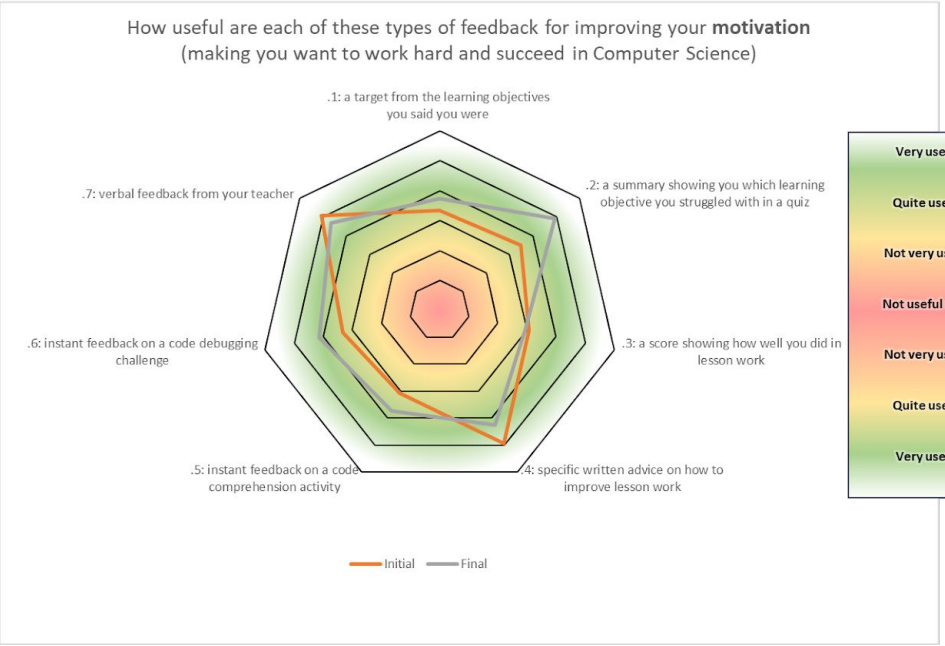
7: verbal feedback from your teacher

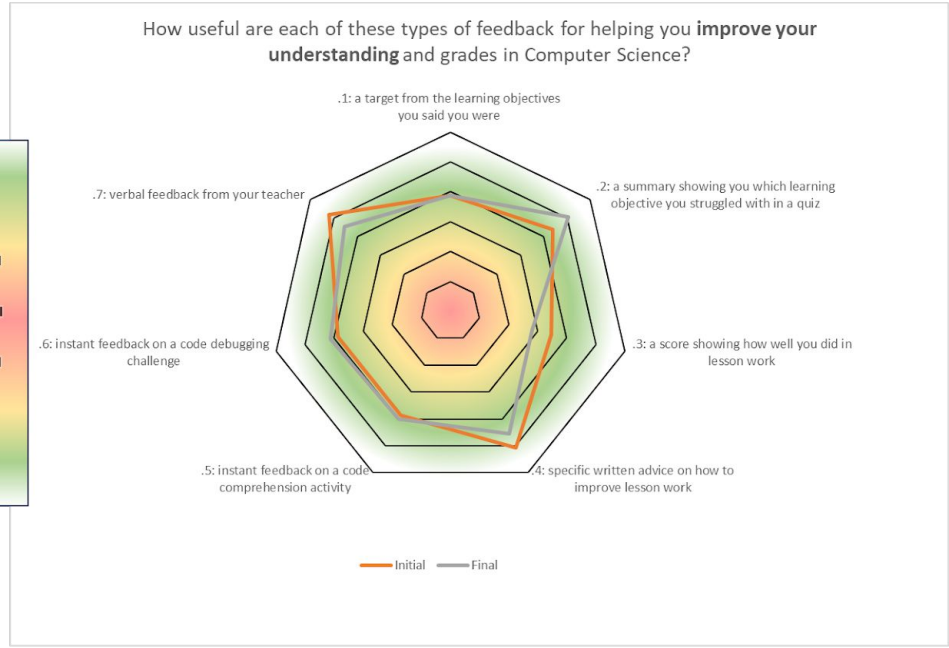


2 … ability to improve …

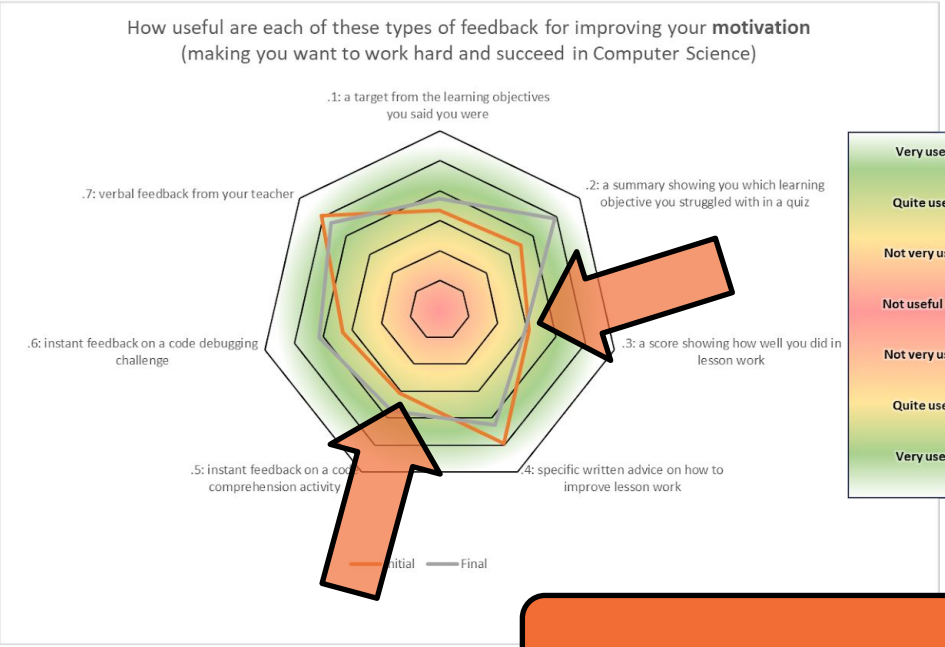
1 … engagement …

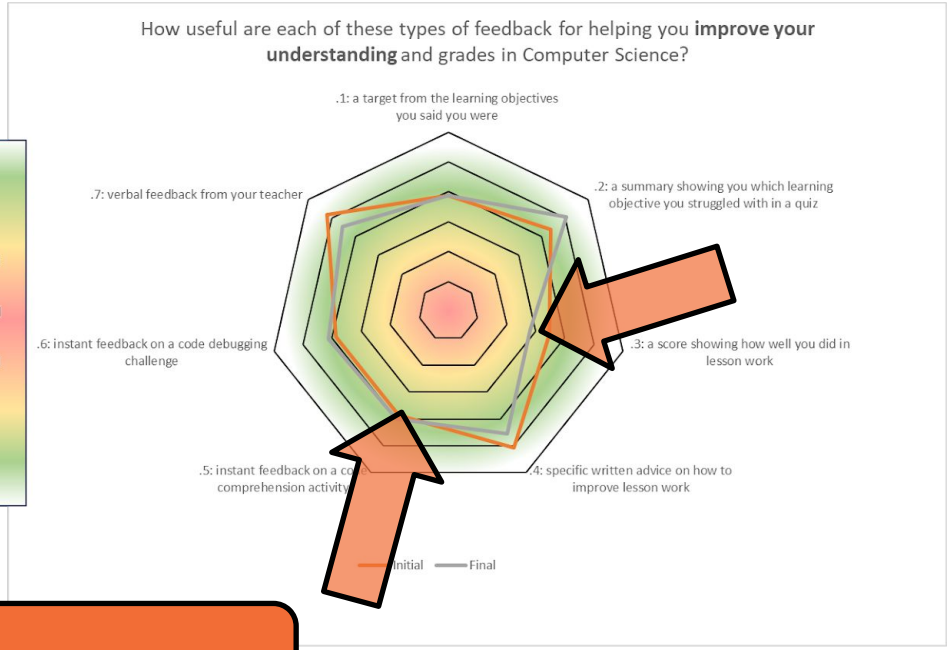
Findings


How useful are each of these types of feedback for improving your **motivation** (making you want to work hard and succeed in Computer Science)
.1: a target from the learning objectives you said you were
.2: a summary showing you which learning objective you struggled with in a quiz
.3: a score showing how well you did in lesson work
.4: specific written advice on how to improve lesson work
.5: instant feedback on a code comprehension activity
.6: instant feedback on a code debugging challenge
.7: verbal feedback from your teacher
Very useful
Quite useful
Not very useful
Not useful at all
Not very useful
Quite useful
Very useful
Initial
Final


How useful are each of these types of feedback for helping you **improve your understanding** and grades in Computer Science?
.1: a target from the learning objectives you said you were
.2: a summary showing you which learning objective you struggled with in a quiz
.3: a score showing how well you did in lesson work
.4: specific written advice on how to improve lesson work
.5: instant feedback on a code comprehension activity
.6: instant feedback on a code debugging challenge
.7: verbal feedback from your teacher
Initial
Final

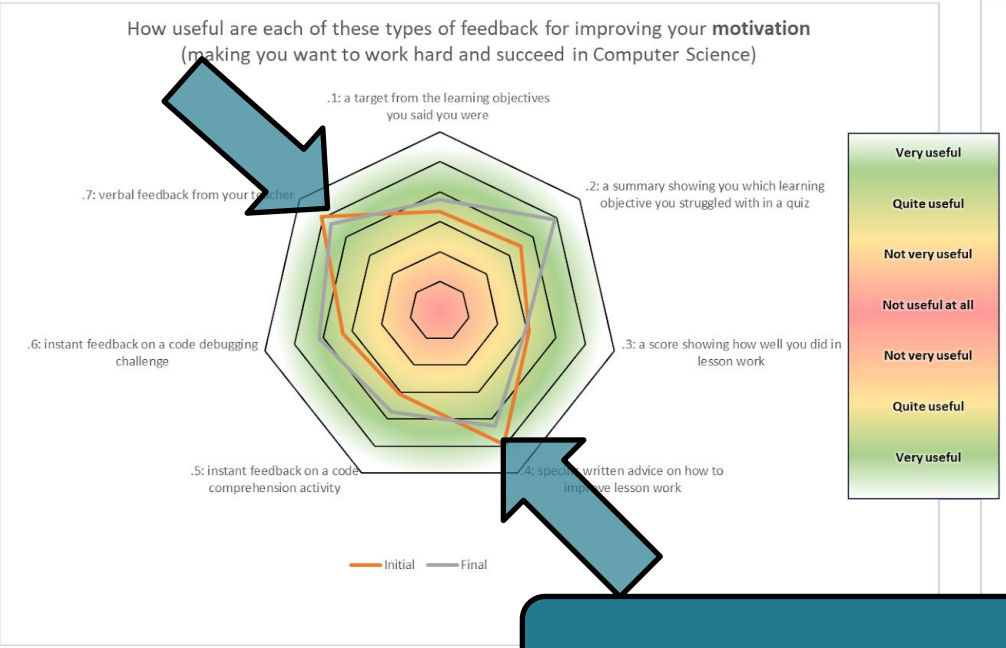
Findings: least useful

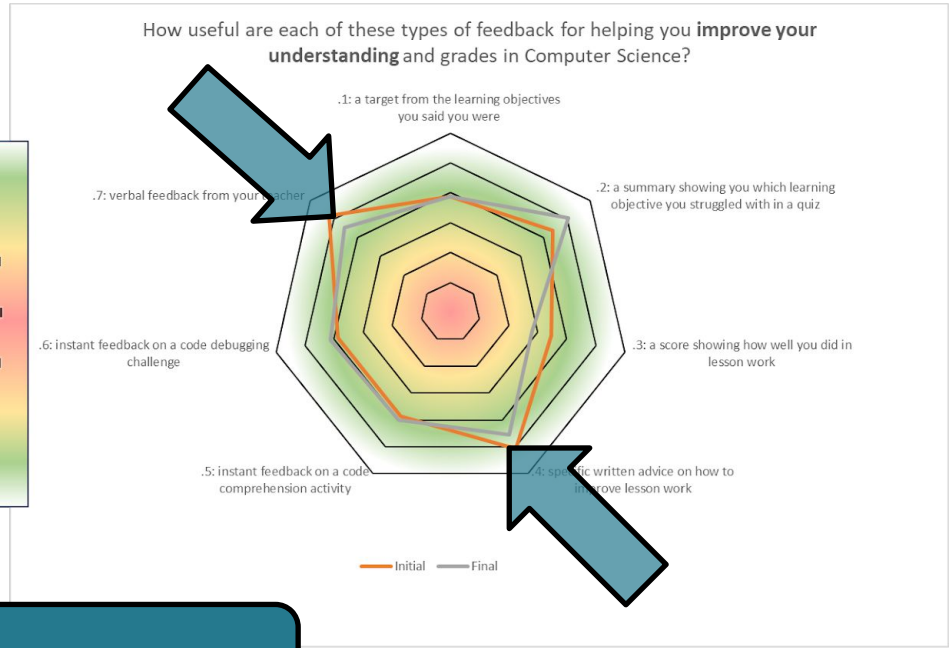




Instant feedback with score

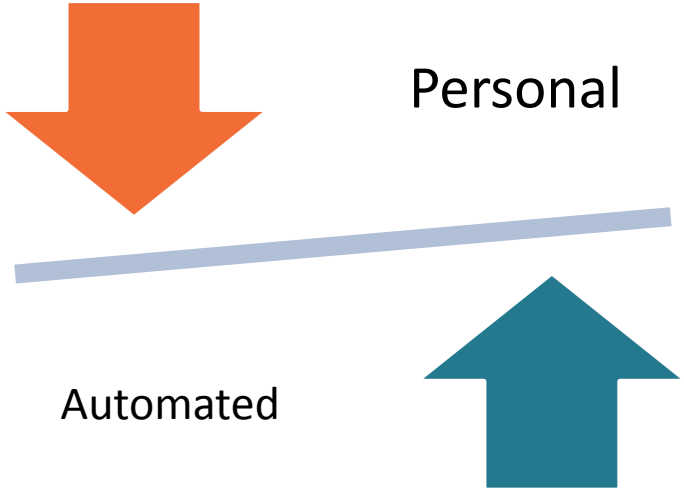
Findings: most useful





Specific written or verbal feedback

Conclusion and next steps



2 … ability to improve …

1 … engagement …

Y11 Computer Science Paper 2 Mock Feedback and DIRT

[STUDENT NAME] 10A/Co1 Mr Dring

FFT: 5= **Y10 Paper 2 mock grade:** 7- 11 marks above FFT

Q	Marks		Notes & Feedback	
Q1	9 / 10	1.1	• Complete creation using '[]' and any 9 integers between 0 and 100 (1)	0
		1.2	• Provide text and missing double quotes (1)	1
		1.3	• Indent original line to be inside subprogram (1)	1
		1.4	• Add function call len() around 'mySentence'	1
		1.5	• Add colon on end of while loop (1)	1
		1.6	• Add keyword 'if' to front of line (1)	1
		1.7	• Add missing brackets around variable 'location' (1)	1
		1.8	• Amend call to subprogram to fix NameError (1)	1
		1.9	• Add type conversion to fix TypeError (1)	1
		1.10	• Change – operator to a + operator to fix infinite loop (1)	1
Q2	8 / 10	2.1	• import time (1)	1
		2.2	• while (timesToTest != 0): (1)	1
		2.3	• time.sleep (15) for 15 seconds (1)	1
		2.4	• time.sleep (TIME_WALK) use of constant over hard-coded, which will not meet requirement of 10 seconds (1)	1
		2.5	• for seconds in range (TIME_COUNTDOWN, 0, -1): to count backwards (1)	1
		2.6	• time.sleep (1) for counting down 1 second (1)	1
		2.7	• timesToTest = timesToTest – 1 to count down tests for three times (1)	0
		2.8	• Functionality (3)	2
Q3	6 / 10	3.1	• Variable 'name' set to "" (1)	1
		3.2	• Get value of 'name' from user using 'input' (1)	1
		3.3	• At least one 'if' statement used (1)	1
		3.4	• Presence check using "" / len (name) == 0 (1)	1
		3.5	• Length check using '< 3' (1)	0
		3.6	• Length check using '> 20' (1)	0
		3.7	• Use of 'if…elif…elif…else' rather than separate 'if' (1)	1
		3.8	Presence check identified in comments and at least one length check identified in comments (1)	0
		3.9	• Both value of 'name' and 'All checks passed' printed on same line (1)	1
		3.10	Functions correctly for normal and erroneous test data, i.e. empty string, name of 2 characters, name of 21 characters, name of 10 characters. (1)	0

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

Justin Heath

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

FLARE: A Framework for Learning About Relational Elements

Justin Heath, Arunside School

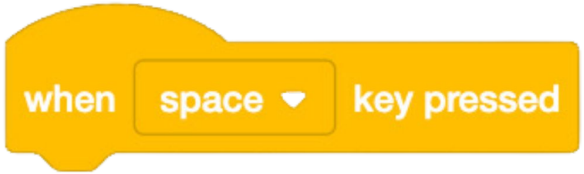
Research Questions

How do teachers respond?

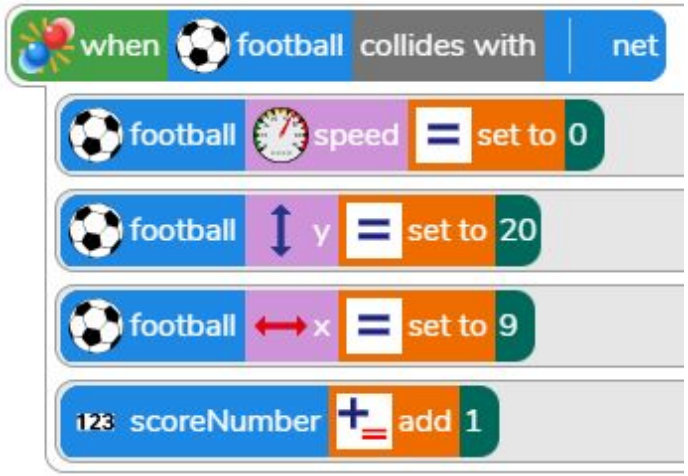
How do children respond?

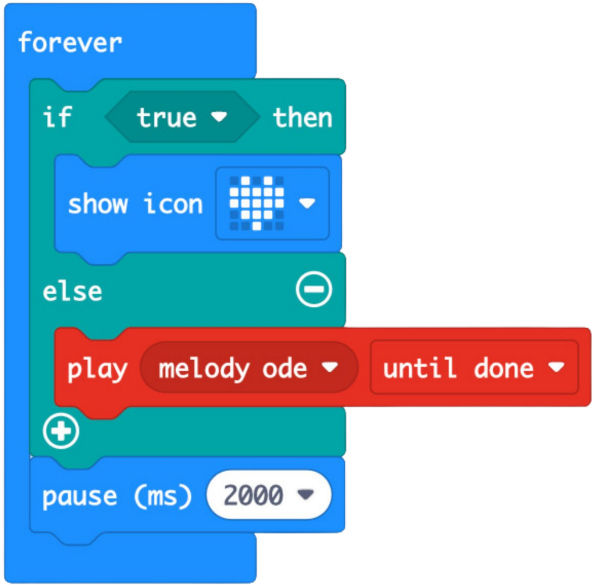
Can it fit in with existing curriculum plans?

BLOCKS - Self Contained Actions

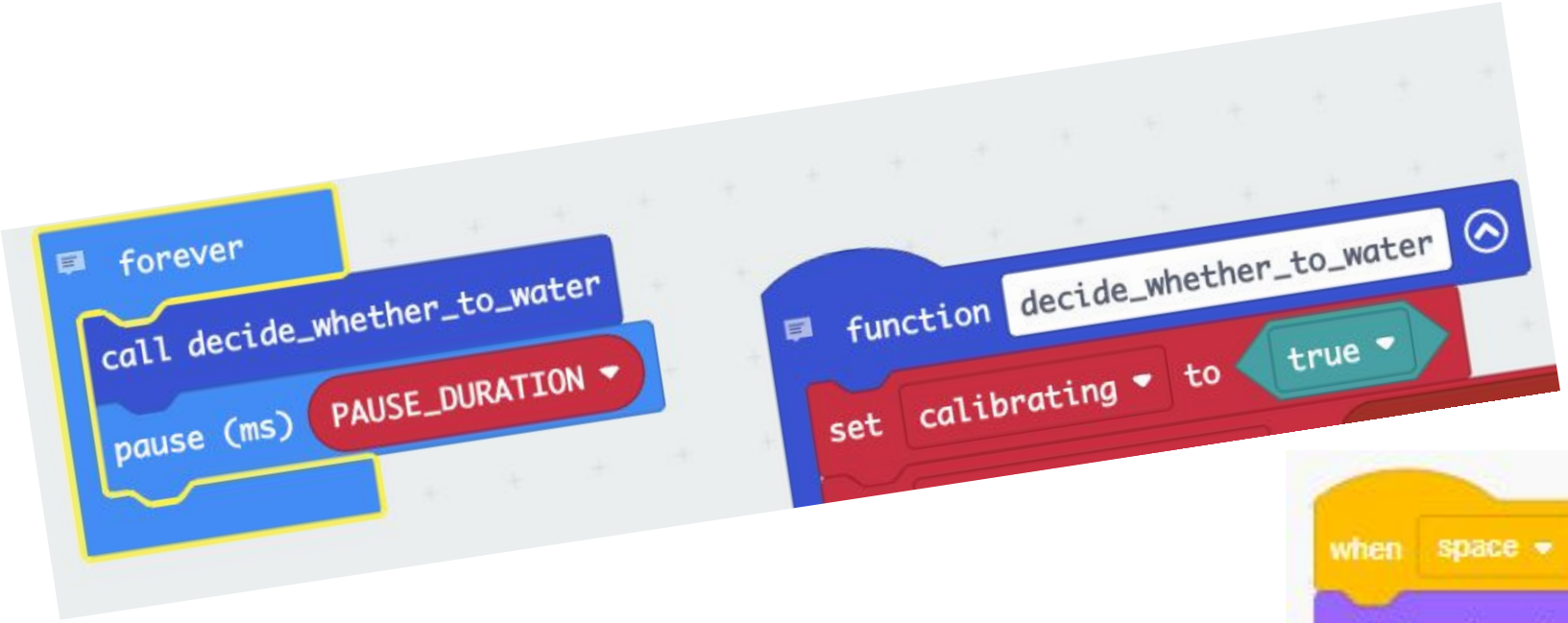


SEGMENTS - Islands of Blocks





RELATIONS - Causal Relationships

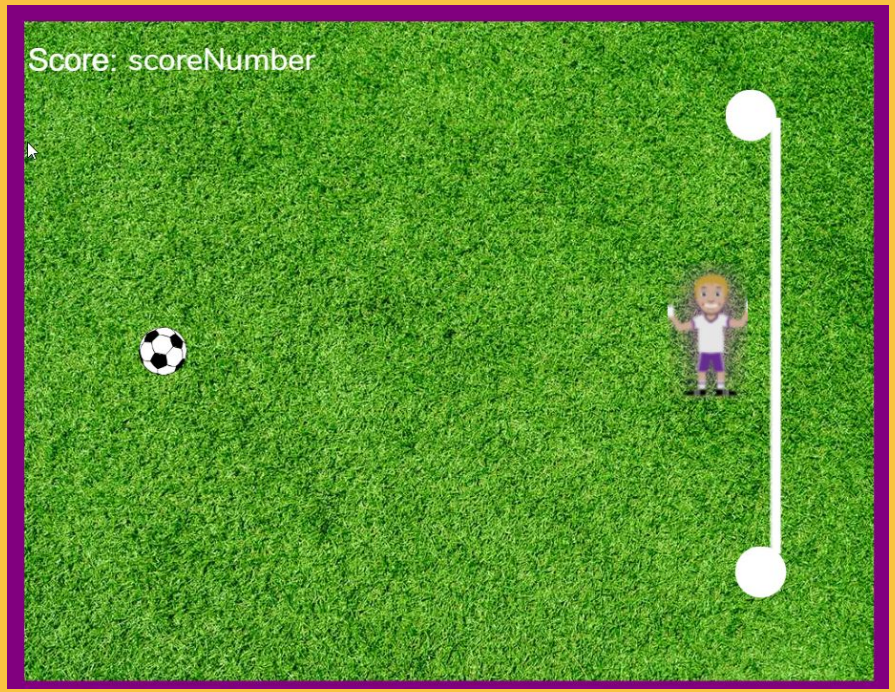


Macro - Purpose and Overall Organisation

Predict what this program does.

So what jobs would the code need to do?

Could any jobs be functions?



Possible Questions for Code Comprehension

Example Questions
1 – Introducing • Can you find the block that makes the character speak? • Show the block that controls the background colour. • Find the block that has a number inside it. What do you think this number might change? **2 - Developing** • The program uses this block to make the character move. Why did they choose this specific block? • We see [a block] a few times in the code. What do you think its purpose is? • We've used blocks like this one [shape/colour] before. What do these types of blocks often do? • Can you think of another situation in a different program where you might use this type of block? **3 - Challenging** • If we try making this number smaller, what might happen? • Is there a better way to achieve this same effect using a different type of block?

Teachers Trialling FLARE

Teacher A

Had taught programming before.

Teacher B

Never taught programming before

Teacher C

Computing Leader at another school

Trial the Model not the CPD

Deck of Slides

Detailed Descriptions of Elements

Differentiated Example Questions

A snippet suitable for the first lesson

Platforms Used

Data Collection

- Detailed interviews
- Encouraged to put the boot in
- Otter AI transcription
- Atlas to Code
- Analysis

Teachers' Responses

"....having a really clear structure that goes from simple to complex made it **easier for me to understand** and **teach it more effectively**."

- Teacher A

Teachers' Responses

"I didn't understand half of them. There were elements that I was **just totally baffled by."**

(Relations and Macro)

- Teacher B

Teachers' Responses

"I didn't understand half of them. There were elements that I was **just totally baffled by."**

(Relations and Macro)

- Teacher B

Teachers' Response Summary

- Improved planning and questioning
- Increased confidence
- One teacher described being able to adapt the lesson for different needs within a lesson using the structure questions
- Challenges understanding and implementing some FLARE elements
- Materials successfully used to deliver CPD by one participant.

Children's Responses

"They were actually way more engaged."

- Teacher A

"...they then also began to question me more as well….'Well, could we try that? Or how would...?'"

- Teacher C

Children's Response Summary

(Reported by teachers)

- Increased child engagement.
- More interactive and conversational classroom environments.
- Children's confidence in programming abilities raised

Integrating into the Curriculum

"I found the macro element hard."

- Teacher C

Integrating into the Curriculum

"It’s hard to ask questions about a language you’re still learning."

- Teacher B

Integrating into the Curriculum

"I used it on three separate lessons, primarily as a starter. So I would have the bit of code on the screen and I knew what my questions were because I'd used the template. …

But equally, when I was moving around when they were working, it structured my questioning."

- Teacher A

Integrating into the Curriculum

- Successful use within the existing curriculum
- Difficulties applying the Relations and Macro Elements
- Needs understanding of the coding concepts being taught as well as FLARE.

Teachers' Responses

"I would have no hesitation in doing it again next year."

-Teacher B

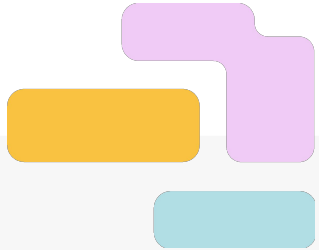
Conclusion and What Next

Encouraging, but still some way to go…

- Improved Clarity for relations and macro
- Visual Aids
- Separate versions for different programming platforms
- Combining with other models from research
- Integrating into the curriculum as a spiral model
- Introducing to more teachers

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation



Jo Hodge

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

Which PRIMM activities lend themselves to assessment?

Jo Hodge - Our Lady of Lourdes Primary School

UNIVERSITY OF CAMBRIDGE Raspberry Pi Foundation

Motivation - Why?

- Looking at assessment within all curriculum subjects.
- PRIMM - assessment tool
- Research- based practice

UNIVERSITY OF CAMBRIDGE Raspberry Pi Foundation

Intervention - How?

- Two year 4 classes - adapted Teach Computing Unit to include PRIMM
- Explicit use of PRIMM vocabulary and actions
- Fellow colleague delivered the units independently

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

PRIMM Activities

- Code snippets around code reading, tracing and matching.
- Parson's problems
- Identify gaps in their learning - predict
- Like a maths starter

UNIVERSITY OF CAMBRIDGE Raspberry Pi Foundation

Data Collection:

Interview pupils

- How did PRIMM help you learn programming?
- What PRIMM activity did you like best and why?
- What have you enjoyed about the lessons?
- What have you found challenging?

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

Data Collection:

Interview teacher

- Informal dialogue
- Recorded

‘Sometimes it is not about the final outcome, as you learn more about seeing what they’re doing at the time. The actual final piece doesn’t always tell you everything that’s gone on before. The PRIMM journey helps, you know, even without that final piece, who has achieved in your class.’ —Year 4 teacher

UNIVERSITY OF CAMBRIDGE Raspberry Pi Foundation

Results: Impact

47 Pupils interviewed

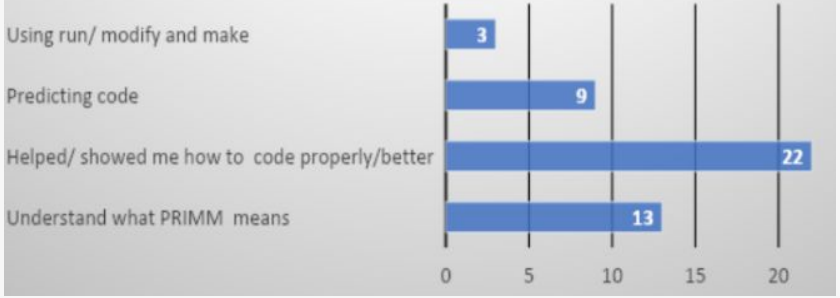
- Supported the teacher in lesson delivery - independent/resilient
- Supported the SEND/EAL and less able coders - level of challenge/ clear structure
- Provided ongoing assessment opportunities
- PRIMM - predict like a starter very effective

:

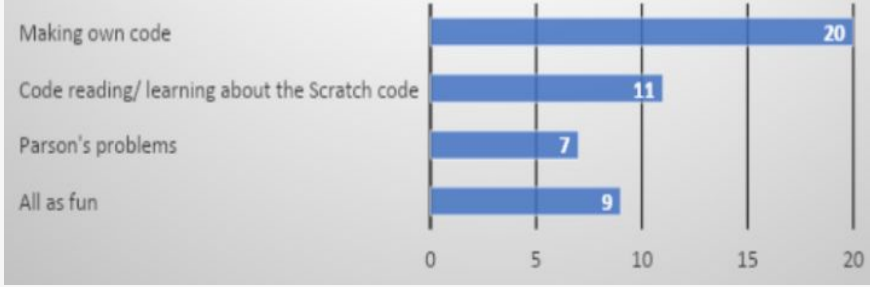
UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

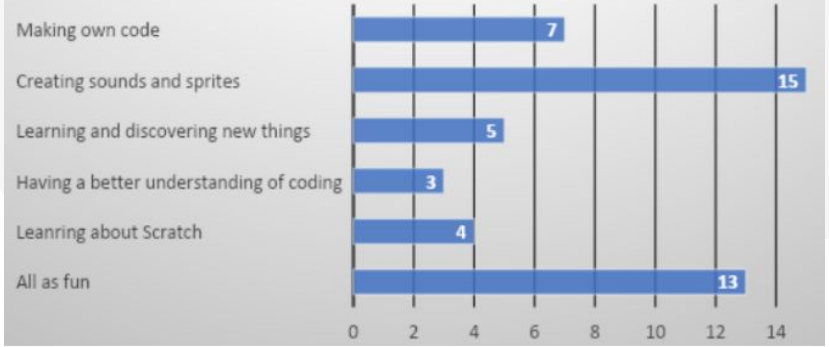
How did PRIMM help you to learn programming?



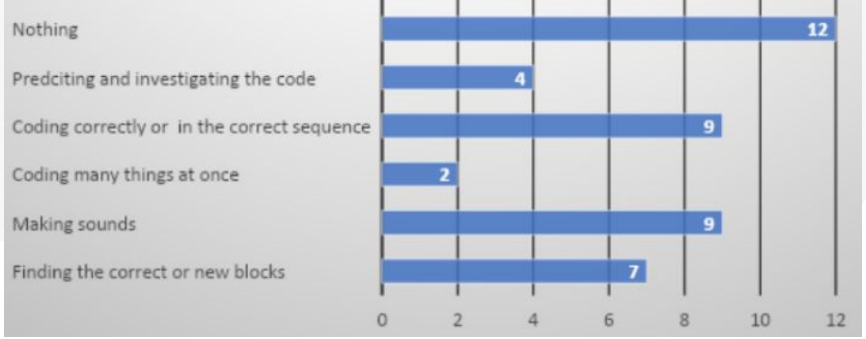
What PRIMM activity did you like best and why?



What have you enjoyed about the lessons?



What have you found challenging?



UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

I like PRIMM because...

It helps me know what to do

It helped me to do it in the right order

It helped me to make cooler codes

Doing the actions helped me remember

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

‘This doing it through PRIMM and giving them a chance to just modify it themselves and have a go for themselves. I had nobody coming up to me and saying right, what’s next? Or I’ve finished that, or I don’t know what I’m doing now. Can you come and help me? There was nobody that needed any help.’—Year 4 Teacher

UNIVERSITY OF CAMBRIDGE Raspberry Pi Foundation

Next steps…

- Introduced to whole staff
- Integrate into TC curriculum

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation

TICE 3 - 2024/2025

Introducing a new partnership between CAS and RPCERC

RASPBERRY PI COMPUTING EDUCATION RESEARCH CENTRE

Computing at School

We will shortly be recruiting for next year's TICE!

Face-to-face option (restricted to 10 teachers)

This will include bursary support from CAS to attend 2 full-day research meetings at the BCS offices in London

The rest of the programme will be similar to the online option

Online option

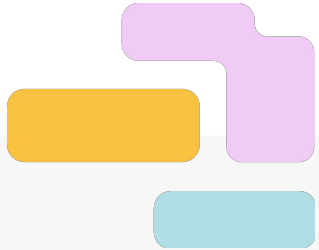
No need to travel to London, and everything is provided online, but no funding is available.

As this year, webinars, workshops, and your helper will guide you through on both options

Sign up forms will be available before 26th July at http://computingeducationresearch.org

UNIVERSITY OF CAMBRIDGE

Raspberry Pi Foundation



Any questions?