



UNIVERSITY OF
CAMBRIDGE



Raspberry Pi
Foundation

Teacher Research Projects in Computing

Session 1

CAS Conference

13th July 2024

Sue Sentance, Sophie Fenn, Rebecca Mack, Lorne
Pearcey and Alexandra Price



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

Teacher research in computing

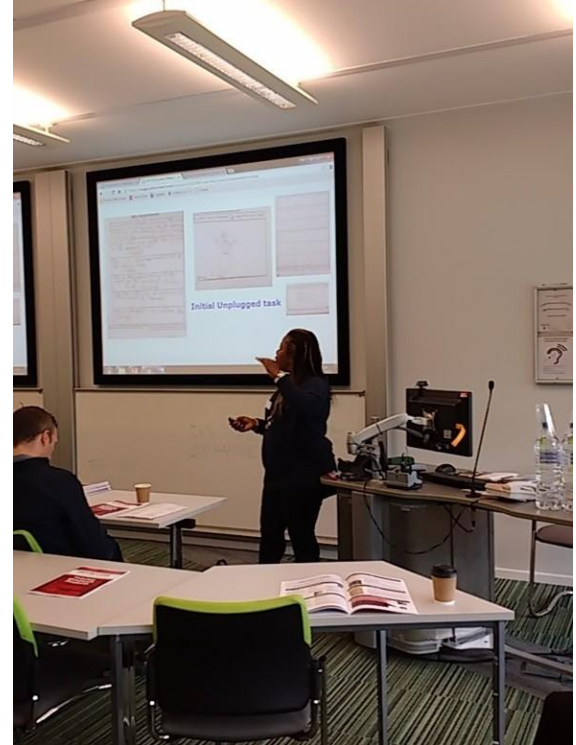
As teachers, it can be transformative to your practice to investigate what might improve your practice.

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).



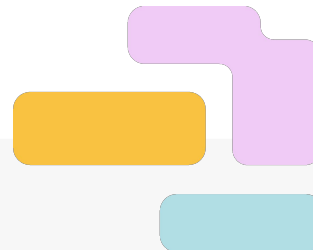
How TICE works

- 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



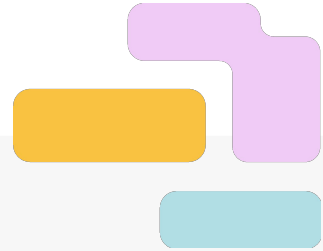
In this session

- **Sophie Fenn:** The impact of a data science art project on Year 9 students' perceptions of computing
- **Rebecca Mack:** Game on: Scratch vs Kodu in Key Stage 3
- **Lorne Pearcey:** The impact of handwriting programs on the accuracy of the code produced
- **Alexandra Price:** 'It's useful, but it's not interesting' why do Key Stage 3 girls opt out of Computer Science GCSE?



Sophie Fenn





The Impact of a Data Science Art Project on Year 9 Students' Perceptions of Computing

Sophie Fenn | Pate's Grammar School, Cheltenham
sfenn@patesgs.org

TICE 2024





Motivation

Increase engagement

Broaden skills

Boost participation

Challenge stereotypes



Evidence Informed Intervention Design

- Authentic learning
- Problem based learning (PBL)
- Cross-Disciplinary
- Role models and diversity

Inspiration

↳ WIPSCe primary and secondary computing conference reposted

Rachael Coultart @rcoultart · Sep 29, 2023

What a great gang to hang out with @wipsce_ #wipsce23 Thank you @googleeurope @suesentance for enabling this to happen and @janewaite for looking after us so well 🌞

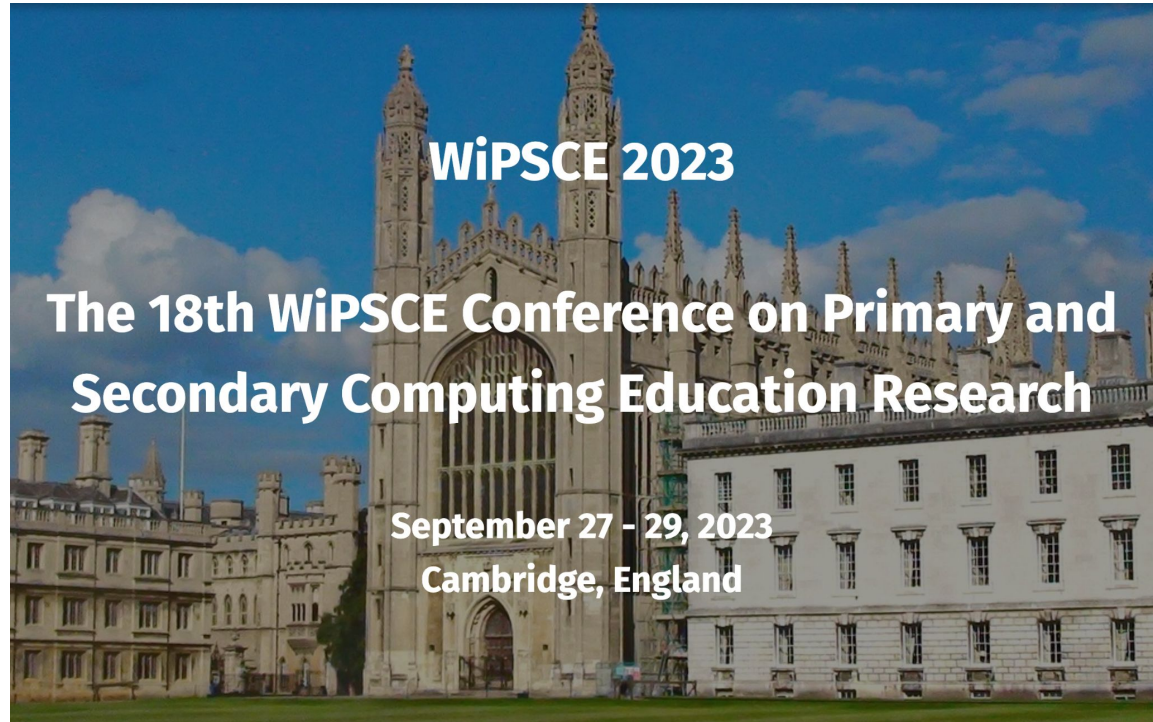


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6

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WIPSCe 2023

The 18th WiPSCE Conference on Primary and Secondary Computing Education Research

September 27 - 29, 2023
Cambridge, England

Inspiration

Kate Farrell
University of Edinburgh

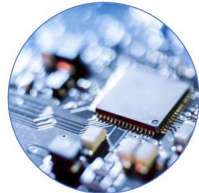
“Data Science
will change
how you see
your subject”



Maths



Geography



Computer Science



Modern Studies



“You can make all the fancy
graphs you want to, but it
has to be about using the
data to make a difference
to people’s lives.”



Research Questions

Q1: How does participation in a data science art project influence Year 9 students' perception of the relevance and usefulness of computing?

Q2: How do students' attitudes towards computing change before and after participating in the interdisciplinary data science art project?

Intervention Task

Data Collection: Students were required to collect and analyse data related to a chosen topic.

Data Visualisation: Create visual representations of the data using artistic methods, demonstrating the intersection of data science and art.

Narrative Development: Develop a compelling narrative around the data, explaining its significance and insights derived.

Resources adapted from:
NCCE Data Science unit



DataFace competition by
Cheltenham Festivals

The logo for Cheltenham Festivals is shown. It features the word 'CHELTENHAM' in a bold, dark blue, serif font. Below it, the word 'Festivals' is written in a white, sans-serif font on a dark pink, ribbon-like background that has a curled end on the right side.

Implementation

Year 9 (150 students)

4 - hour long lessons
on data analysis and
storytelling with data

Plus full day internal
school competition

Near peer mentors -
Year 12 digital
leaders





“Thank you so much for running this event. It was honestly one of the most fun things I have ever done, and I have learned so much from it, from 3D designing and printing to data analysis.”



Data Collection

- Mixed-methods approach combining quantitative and qualitative data
- Pre-and post-project questionnaires
 - 137 students completed both questionnaires
- Follow-up interviews conducted by Year 12 digital leaders
 - random sample of 10 students interviewed



Questionnaire

Q1: I think I will be able to use what I learn in computing in the future.

Q2: I am interested in data science.

Q3: It is important for me to learn data skills.

Q4: Computing is a worthwhile and necessary subject.

Q5: Studying computing is one of the most important subjects for people to study.

Q6: Computer Scientists are innovative and creative.

Q7: I can think of ways to apply computing skills outside of school.

Q8: I think data science is useful for me to learn.

Q9: Studying computing is important for understanding modern technology.

Q10: Computing is helpful no matter what I decide to study.

Q11: I believe studying Computing helps me with problem-solving in other areas.

Q12: Data science is important in everyday life.

Strongly
Disagree

Moderately
Disagree

Slightly
Disagree

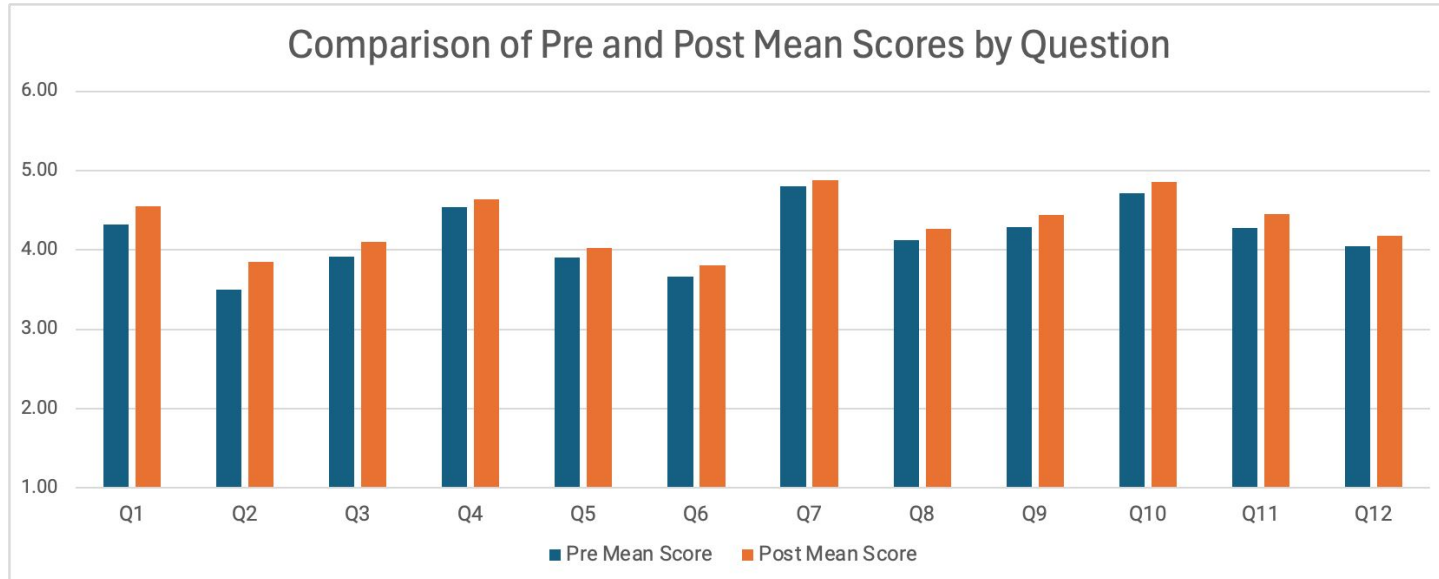
Slightly
Agree

Moderately
Agree

Strongly
Agree

Quantitative Results

Significant positive changes across most questions

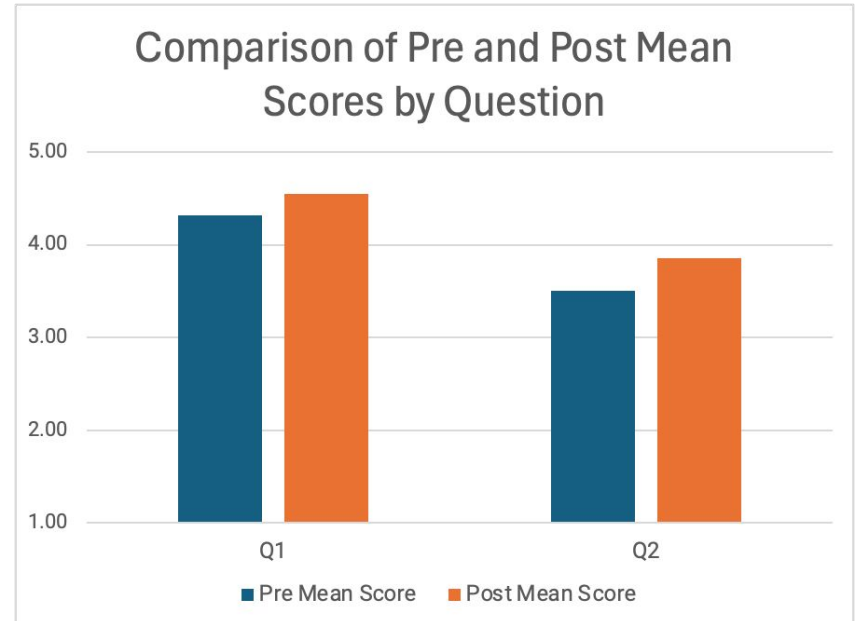


Quantitative Results

Results I found promising...

Q1: I think I will be able to use what I learn in computing in the future.

Q2: I am interested in data science.

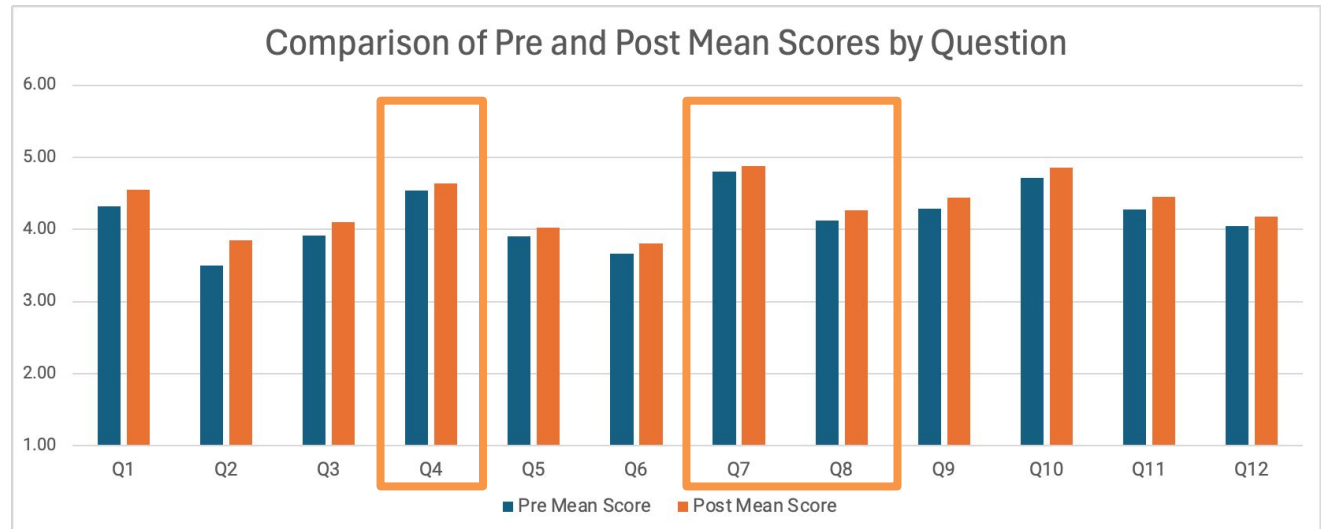


Quantitative Results

Q4: Computing is a worthwhile and necessary subject.

Q7: I can think of ways to apply computing skills outside of school.

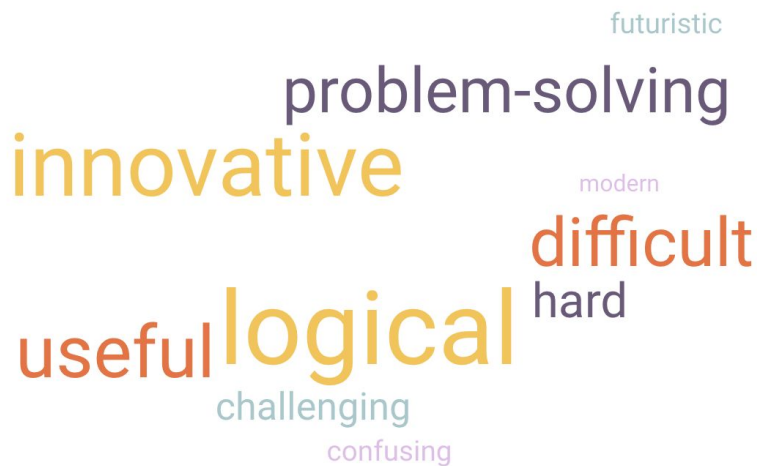
Q8: I think data science is useful for me to learn.



$p > 0.05$

Students were asked 'What three words come to mind when you think about your computing lessons?' after each unit of work

After Python Unit (Nov 23)



After Data Science Unit (May 24)





Qualitative Results

Interdisciplinary Connections

“In art, computing opens up new possibilities for creativity...”

Relevance to Daily Life and Careers

“Computing skills are incredibly important because almost every job today involves some form of technology...”

Critical Computing Skills

“Good communication skills help make sure that everyone understands and can work together well...”



Conclusions

Positive Influence on Perception: Participation in the data science art project significantly enhanced Year 9 students' perception of computing as a relevant and useful skill.

Attitude Shift: Students' attitudes towards computing improved, with increased interest and enjoyment of the subject after the intervention.

Interdisciplinary Value: Students were able to demonstrate interdisciplinary applications of computing, integrating it with subjects like art, geography, and science.



Next Steps

Curriculum Integration: Integrate the data science art project into the Year 9 curriculum over a full term to provide students with more time to embed and develop skills.

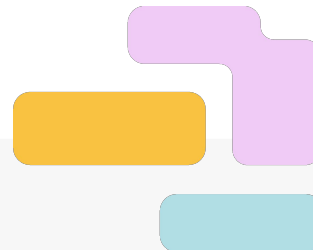
Cross-Department Collaboration: Work with geography and science departments to integrate data science into their curricula, ensuring it's seen as a multidisciplinary skill.

Ongoing Mentorship: Maintain the mentorship program with Year 12 digital leaders to support and inspire younger students in computing-related activities.

Thank you!

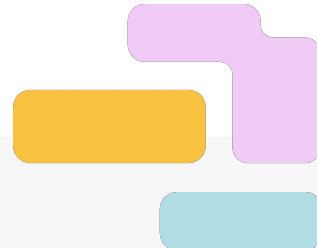


<http://tiny.cc/KS3datascience>



Rebecca Mack





Game On: Scratch vs Kodu in KS3

Rebecca Mack

Head of Computing and Digital Learning
Bilton Grange Preparatory School

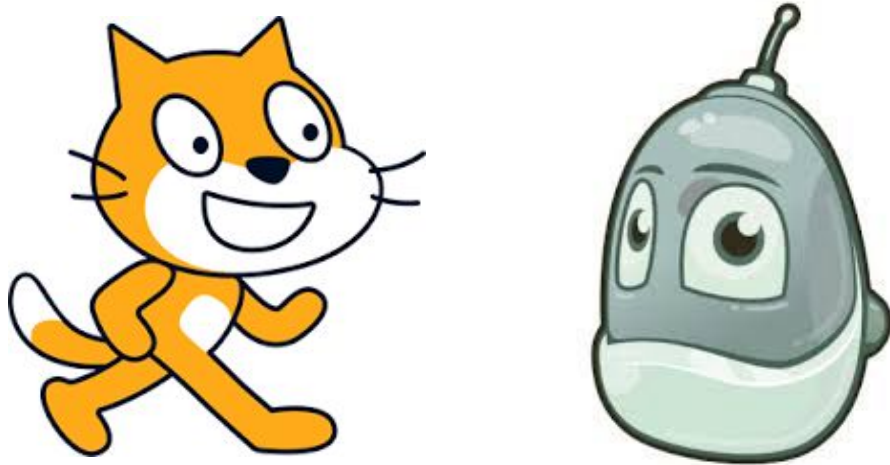


Rebecca is unfortunately unwell today

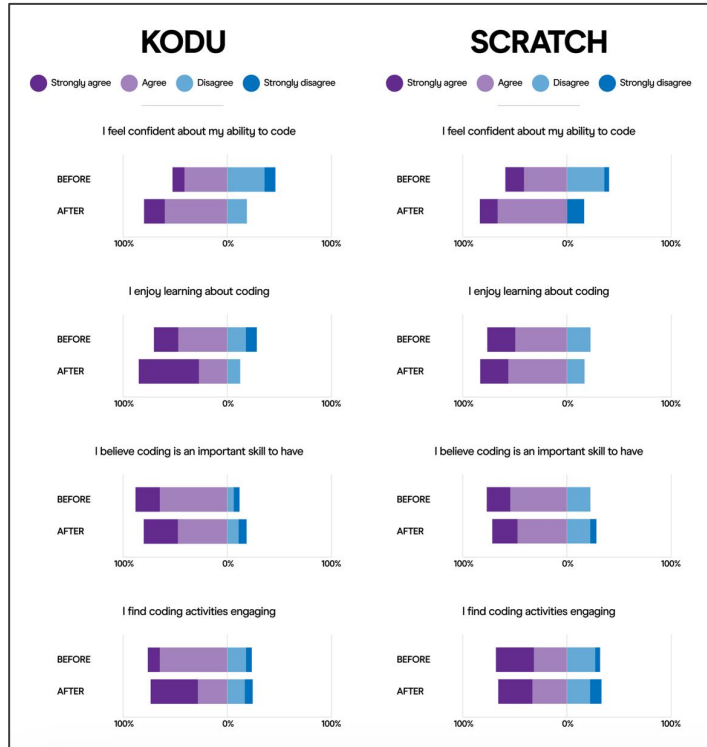


Research Question

How does student engagement differ when using Scratch compared to Kodu for introducing computing concepts at the KS3 level?



Data Collection and Results - Quantitative



Data Collection and Results - Qualitative

Kodu

'I really like it and I think that Kodu has made me have more confidence in the basic coding rules. I really like playing the games that I create and I feel happy when I create them even with help because I didn't know how to do these things before I came to this school.'

'too easy need a bit harder questions I would love to code things challenging like Python coding I think this Kodu does not help me it is too easy'

Scratch

'Coding was not the most fun thing and I did not enjoy it as much as I thought I would. It was still a great skill to learn and my knowledge of computing has definitely improved over the past few weeks if I had the choice between coding scratch and something else depending on what that something else is I would probably choose to not do scratch because it was very repetitive which was quite boring at some points in this half of term.'

'i like to make my own games and experiment with different codes.'

Conclusion

Findings:

- Overall, Kodu resulted in higher engagement and enjoyment levels than Scratch.
- Students that used Kodu were more likely to feel that “coding is for everyone”.
- Both softwares showed a decrease in the perception that “coding is an important skill to have”.

Impact on Curriculum:

- Integrate Kodu early in the curriculum to capture student interest.
- Follow with Scratch to build on foundational skills with more complex programming concepts.

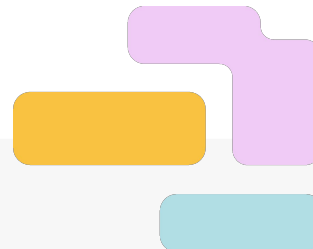




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Lorne Pearcey





The impact of hand-writing programs on the accuracy of the code produced

Lorne Pearcey, King Edward VI Camp Hill School for Boys

TICE 2024





Background and motivation

- Support for less confident coders
- Refining the programs of more confident coders
- Raising achievement
- Experience as a GCSE marker
- Research into the impact of writing by hand on memory and learning



Research questions

Can students' ability to write accurate code be developed away from the computer?

Can hand-writing code help students to become more confident in their ability to write and debug code?



Intervention

- 54 GCSE students in Year 11
- Booklet of 33 programming exercises
- Series of five weekly lessons
- Process:
 - Students hand-wrote their solution to a challenge in the booklet
 - They swapped booklets with their partner and typed the code into an IDE exactly as it was written
 - Partner ran the program and debugged as necessary, annotating the written version with any changes
 - Partners discussed changes

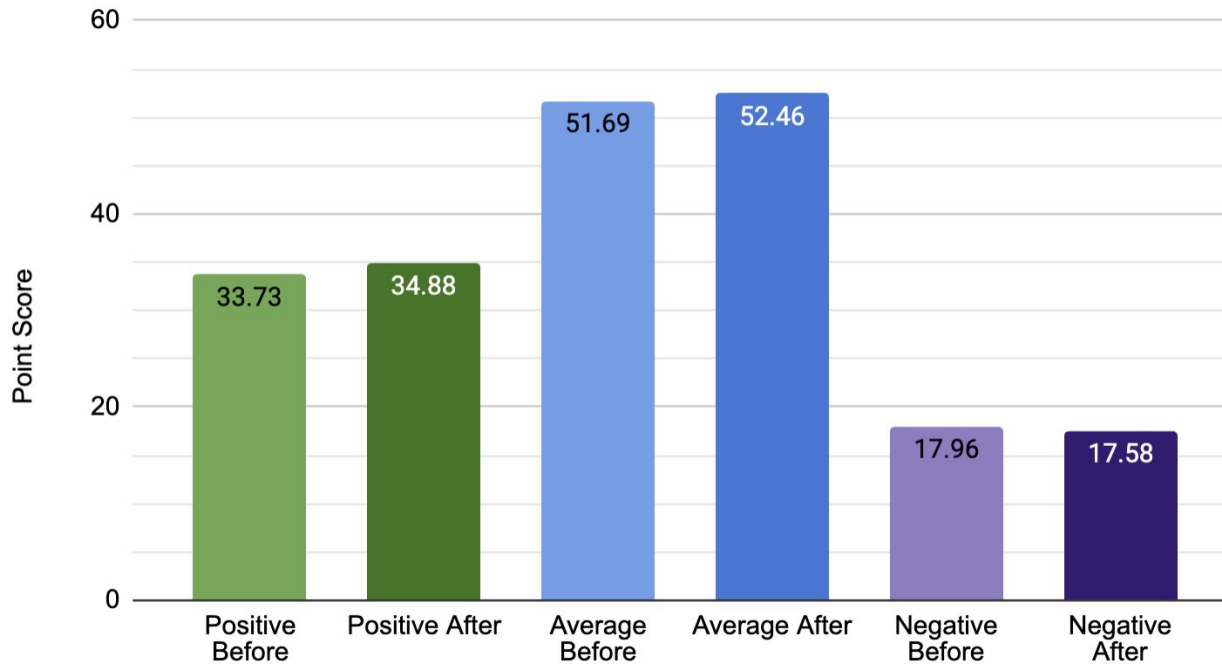


Data collection

- Computational thinking assessment pre- and post-intervention (no change)
- Attitudes towards programming questionnaire pre- and post-intervention
- Analysis of students' programming booklets

Results

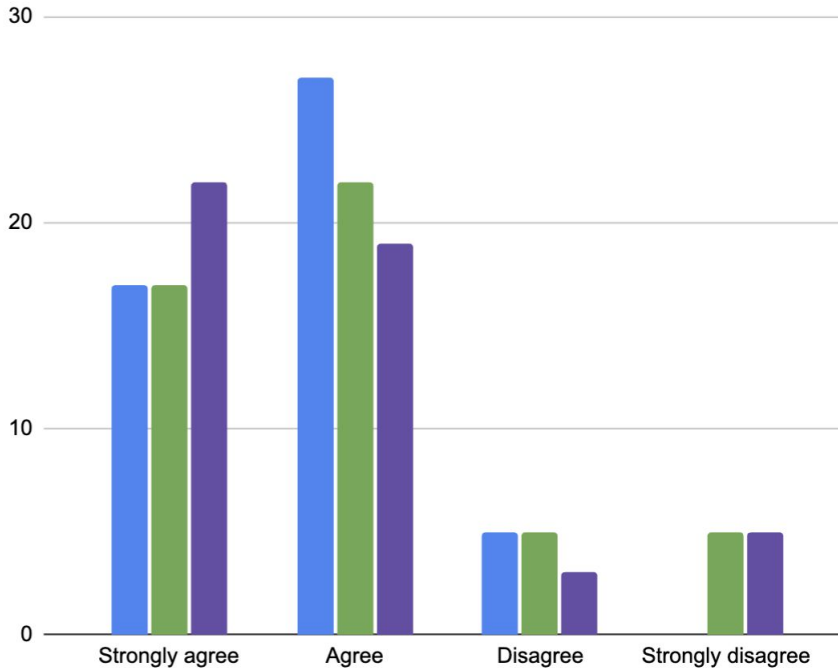
Attitudes Towards Programming



Results

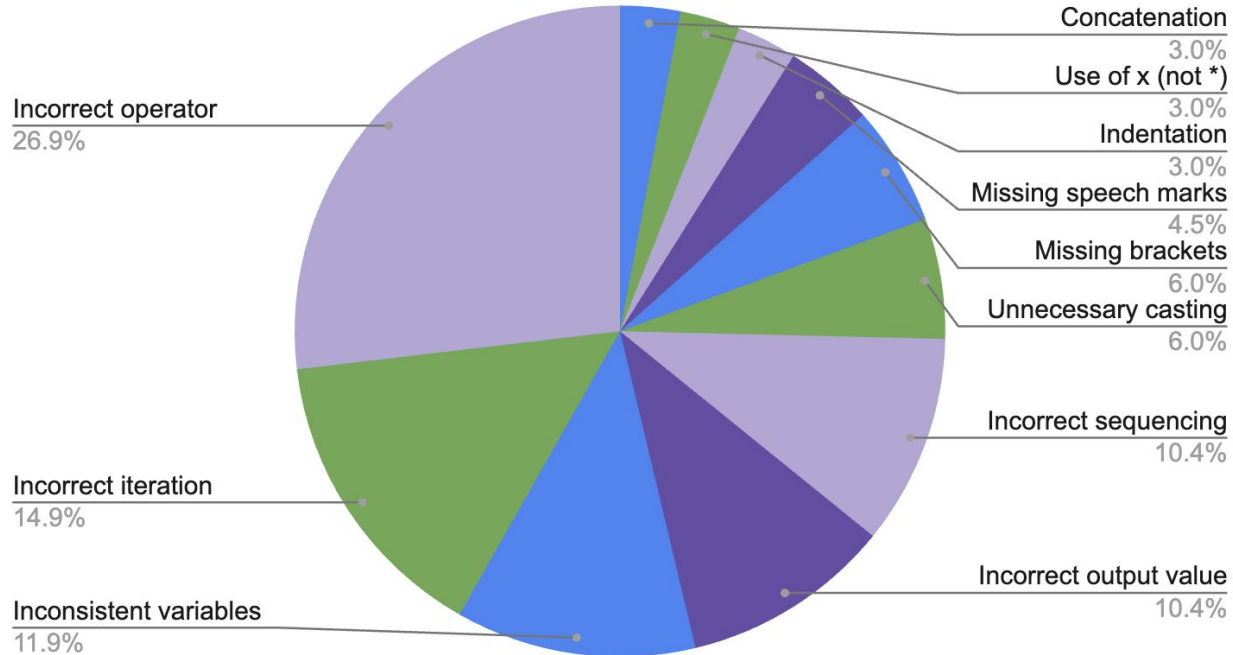
Attitudes towards the intervention activities

- I am becoming more confident in my coding abilities
- The paper programming activities have been helpful.
- I am more aware of any small errors I make when hand-writing code.



Results

Type and frequency of errors in hand-written code



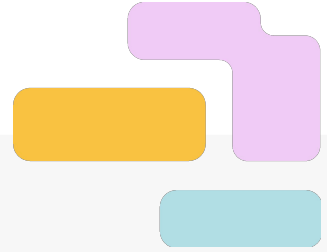


Key findings

- Students engaged positively with the activities.
- Positive impact observed on students' ability to write code more accurately and confidently.

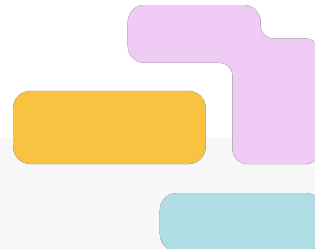


Questions?



Alexandra Price





'It's useful, but it's not interesting' – why do Key Stage 3 girls opt out of Computer Science GCSE?

Alexandra Price

a.price@st-marks.essex.sch.uk



The problem

'In 2023, girls constituted only 21 % of the GCSE Computer Science cohort' *

Year of intake	Total	Girls	% Girls
2024	17	2	12%
2023	22	6	27%
2022	23	2	9%
2021	18	2	11%
2020	23	2	9%

Our context:

Comprehensive

Catholic 11-18 school

1 hour per week of Computing in years 7 and 8; no lessons in year 9

* Kemp, P. E. J., Wong, B., Hamer, J. M. M., & Copsey-Blake, M. (2024). The future of computing education: Considerations for policy, curriculum and practice. King's College London and University of Reading.

The research question

What are the factors that influence girls' decisions to choose or not to choose Computer Science as a GCSE option in the context of our school?





Data collection

- Gathering qualitative data
- Exploring girls' own perspectives
- Survey
- Focus groups

Questionnaire – open-ended questions

1. Please think of all the reasons you might have for picking Computer Science GCSE as an option. List all these reasons: *

Your answer

2. Please now think of all the reasons you might have for **NOT** picking Computer Science GCSE as an option. List all these reasons: *

Your answer

Questionnaire – ranking option preferences

3 Year 12 Sociology students helped to pilot the questionnaire and to collect survey data.

3. The following is a list of the option subjects available in our school in alphabetical order. *

Please rank your top five preferences by clicking the button in one of the columns to show your priorities (1 = most likely to pick this option, 2 = 2nd likely to pick this option, 3 = 3rd likely to pick this option, 4 = 4th likely to pick this option, 5 = 5th likely to pick this option).

You will need to scroll to see all the subjects.

	Art	Business	Computer Science	Food Preparation and Nutrition	Creative iMedia	Design Technology	Drama	French
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Data collection – two stages

Survey

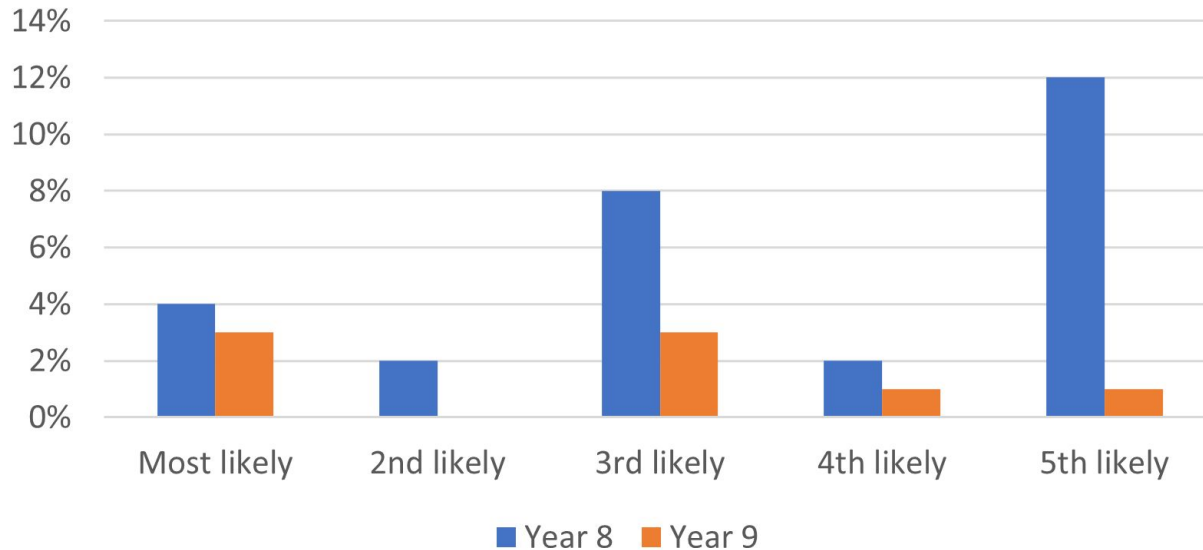
- 52 year 8 girls provided their responses online during their Computing lessons
- 71 year 9 girls responded on a paper version of the questionnaire during their PSHE lessons

Focus groups

- Each group comprised five year 9 girls
- Took place during a lunch break
- A list of questions based on common survey responses used to guide the discussions
- Both sessions were audio recorded

Results – survey Q3 (quantitative)

Rank your preferences for choosing CS GCSE
(most likely to 5th likely)



Likely to pick CS as
their 1st or 2nd choice:
6% of year 8 girls and
3% of year 9 girls

Results – survey Q1-2 (qualitative)

- Responses to open-ended questions were coded to identify the themes that reflect the reasons for choosing or not choosing CS GCSE
- The number of pupils who expressed the views relevant to each theme was recorded to identify the relative prominence of these themes

Year 9 reasons for choosing CS GCSE – themes outline

No reason (23)

No answer (21)

No reason (2)

[answer refers to reasons for not picking CS]

Useful (28)

Useful for future careers (4)

Useful if future career is relevant (1)

Useful for future jobs (5)

Useful for future jobs/ Useful skills (1)

Useful for future jobs/ Future income (1)

Useful for future jobs/ Future opportunities (1)

Useful for a future computing job (potentially) (1)

Useful (1)

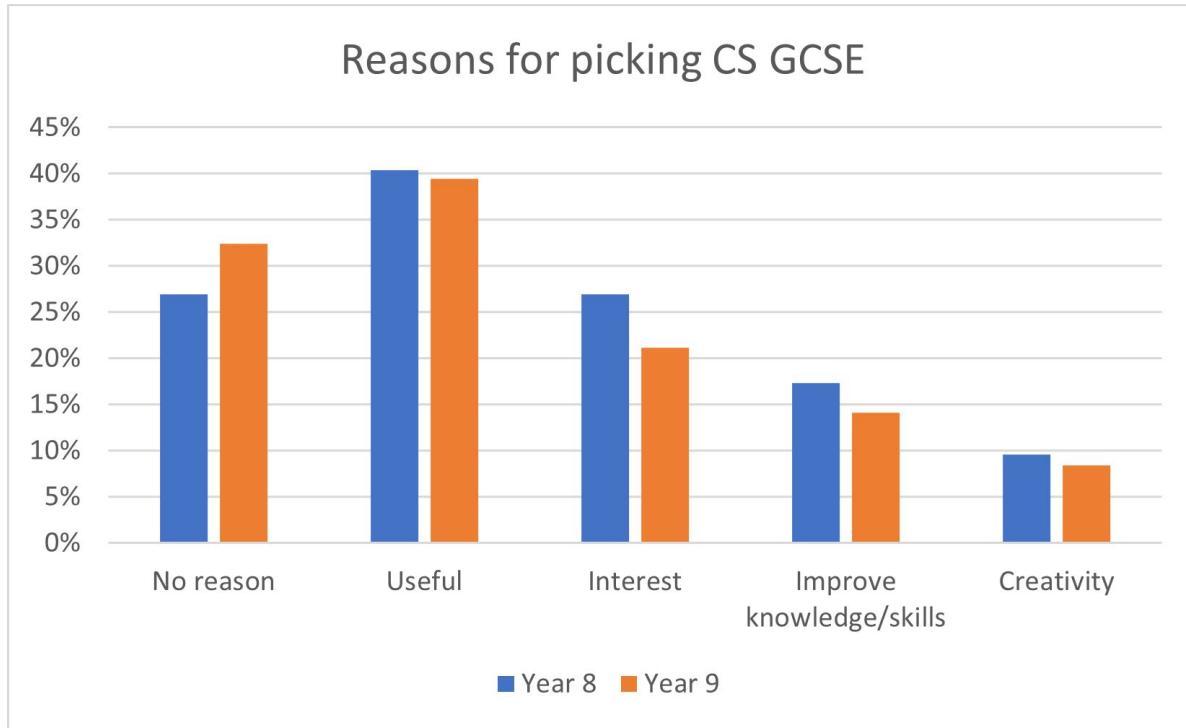
Useful (together with 'Not useful in the future') (1)

Useful (but not for me) (1)

Useful skills (1)

Useful for/in the future (5)

Results – survey Q1-2 (qualitative)



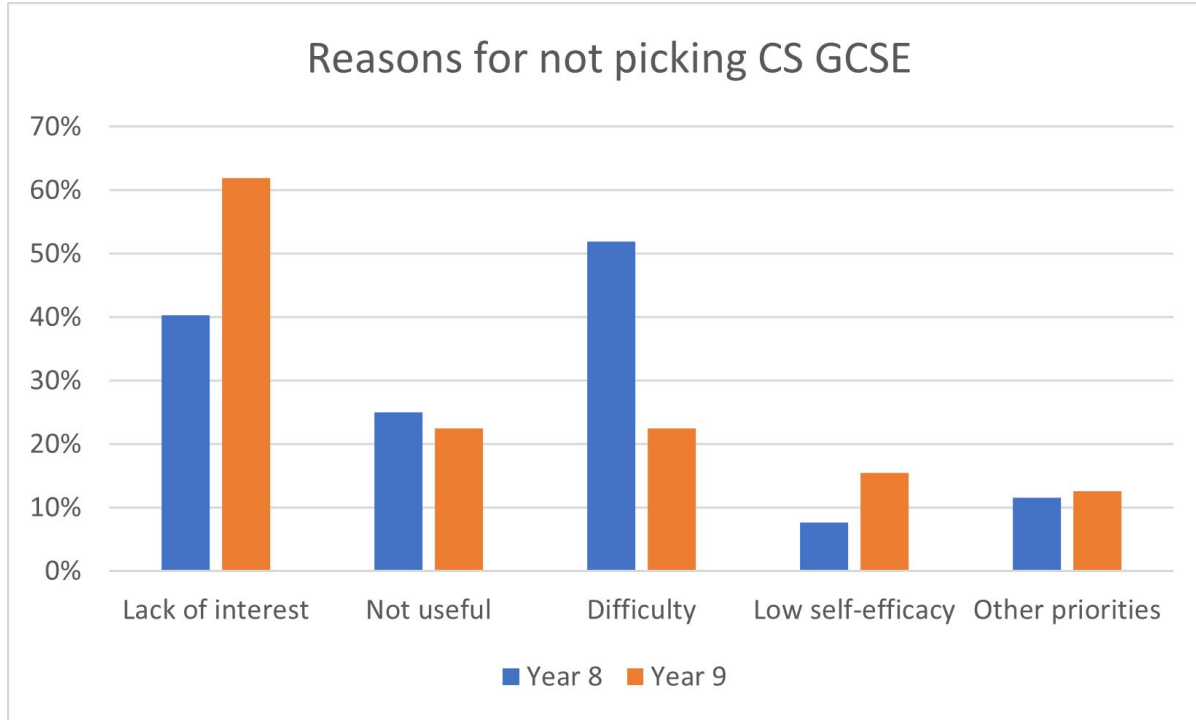
Useful is the main reason:

40% of year 8 girls

39% of year 9 girls

(future career opportunities and income)

Results – survey Q1-2 (qualitative)



Year 8:

52% - difficulty

40% - lack of interest

25% - not useful for me

Year 9:

62% - lack of interest

23% - difficulty

23% - not useful for me

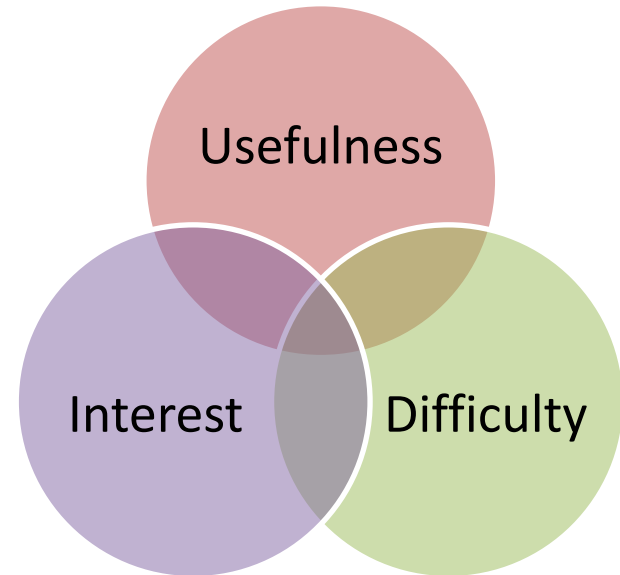


Survey results that surprised me

- Relative lack of concern about the belonging in CS
- Only one year 8 girl referred to not feeling 'comfortable doing the subject with so many boys'
- Only two year 9 girls mentioned poor career prospects for women as reasons for not picking CS GCSE
- 27% (Y8) and 32% (Y9) could not give a reason for picking CS GCSE
- only 2% (Y8) and 7% (Y9) could not find any reasons for **not** picking it

Results – focus groups

- Focus groups transcripts were coded to search for deeper meaning behind the survey responses
- Finalised the identification and description of the relevant themes.
- 3 main interrelated themes were selected to explain the factors that influence girls' decisions to pick or not to pick CS GCSE in our school



Results – Usefulness

- CS is useful in general, but studying CS GCSE is not important for their own career path
- CS is helpful for careers in gaming and web design, some office jobs and everyday organisational skills
- However, workplaces have IT specialists and AI will help to automate some computing tasks
- There was a common trend in the data to counter the idea of usefulness with lack of enjoyment

'AI is becoming more involved in like our everyday life and soon in the future it's gonna be like the main thing in the world.'

'it's quite useful for everyday skills and, but I think it also depends on like what career you want to do'

'It would be more suitable if you had like an IT involved job.'

'It's not interesting, that's all, it's useful, but it's not interesting.'

Results – Interest

- Interest in CS depended on the topics studied, learning activities and individual understanding
- Interest is affected by other priorities – CS competes with other subjects for 1-2 option choices; it is not seen as an area prioritised in the curriculum with only 1 lesson per week in years 7-8 and no lessons in year 9
- Girls are interested in learning about Computing at KS4 if it was a non-examined subject like PSHE

‘Python that was a bit boring, but it's like Scratch and stuff it's really fun’

‘definitely working in groups is more fun than working alone’

‘but like if you understand it, you can see some fun in it but like not everyone can experience that’

‘When you come to options, you can think about the subjects you have now rather than the ones that you had like in year 8, right?’

'it's a bit too complex for my liking'

Results – Difficulty

- Hard, confusing, complex, complicated, frustrating, 'energy wasting', 'long'
- This perception of difficulty depended on the topic (textual programming is the hardest) and on the individual ability
- Year 9 pupils noted low self-efficacy
- This lack of confidence could be due to missing a years' worth of study in year 9

'for people that don't understand as much as the others, they do find it like really difficult...'

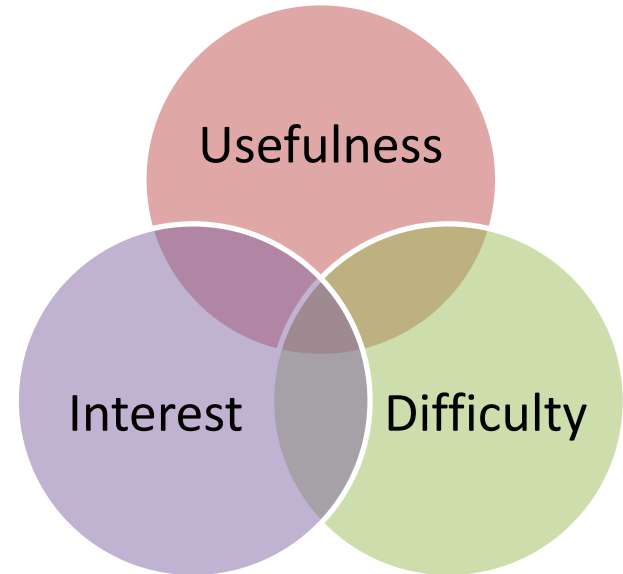
'it can also fail sometimes and for people with short tempers it would not be the best option'

'I could never be that smart to work with computers and I would fail'

'after the summer, ... they probably forget about all the computing they did in year 8 and then when they picked their GCSEs like they'll get so confused'

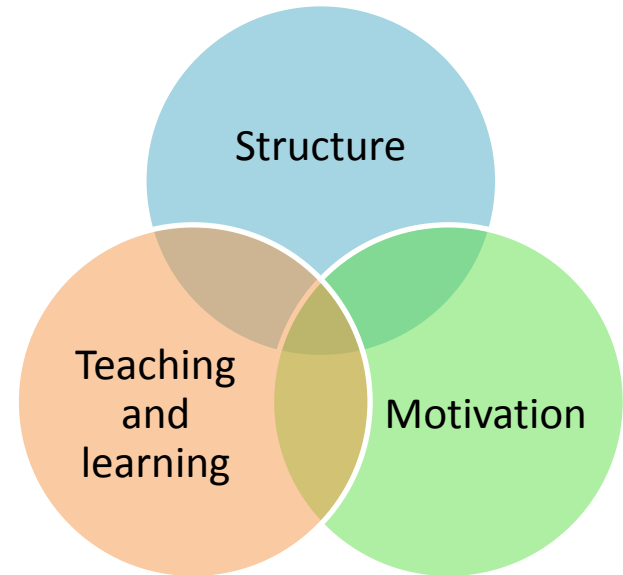
Conclusion

- Complex relationships between various factors affecting girls' decision making
- Participants shared ideas on making CS more accessible and engaging
- Girls' participation in CS GCSE courses in our context and other similar settings can be increased if the issues related to usefulness, difficulty and interest were addressed together



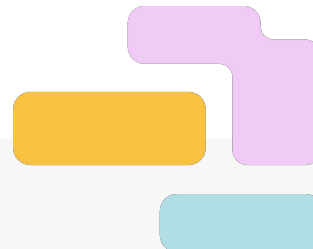
Conclusion – future interventions

- Structural change is hard and slow (curriculum, time-tabling, options system)
- Short term, can focus on making textual programming more visual, use of physical computing and group activities
- as well as field trips and face-to-face meetings with female computer scientists





Questions?



TICE 3 - 2024/2025

Introducing a new partnership between CAS and RPCERC



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

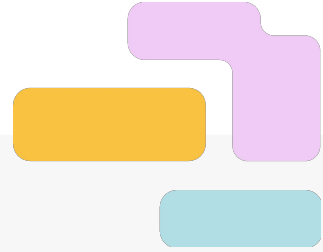
The rest of the programme will be similar to the online option

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>



Any questions?

