Gender Balance in Computing: what the research says

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#rpfseminars

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Overview

- Context
- Metaphors
- Key themes from the literature
- Deep dive into some of the themes
- Where next?
Context: English education system

### Primary phase

<table>
<thead>
<tr>
<th></th>
<th>1</th>
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End of Key Stage SATs

### Secondary phase

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### Post 16

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<tr>
<th></th>
<th>16 - 18</th>
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Subject choices

Formal qualifications
## Context: English education system

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### Computing

- Computer Science
- Digital Literacy
- Information Technology

### Subject choices

- Computer Science GCSE, A level, degrees
- Vocational certificates, diplomas and degrees
Context: Gender imbalance

<table>
<thead>
<tr>
<th>Computer Science</th>
<th>2018</th>
<th>2019</th>
</tr>
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<tbody>
<tr>
<td>GCSE</td>
<td>20.2%</td>
<td>21.4%</td>
</tr>
<tr>
<td>A level</td>
<td>11.8%</td>
<td>13.2%</td>
</tr>
</tbody>
</table>

Source: jcq.org.uk

Girls are not currently well represented in computing at GCSE and A-level in England
Girls are not currently well represented in computing in undergraduate degrees in the UK

Source: Stemwomen.org.uk
Metaphors in the literature

● The ‘incredible shrinking pipeline’ (Camp, 2002)

● Unlocking the clubhouse (Margolis and Fisher, 2002)

● The social turn (Kafai and Burke, 2013)
Key questions

1. What are the barriers which prevent girls’ participation in computing?

2. Which interventions can support girls to choose computing qualifications and careers?
Why should schools teach computing?
Attainment in computing

A high-quality computing education equips pupils to use computational thinking and creativity to understand and change the world. (DfE, 2013)

- GCSE Computer Science – strong attainment but underperformance compared to boys (Kemp, Wong and Berry, 2019)
The social turn in programming

<table>
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<tr>
<th>Writing code</th>
<th>Creating applications</th>
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<td>Individual tools</td>
<td>Facilitating collaborative communities</td>
</tr>
<tr>
<td>Composing from scratch</td>
<td>Remixeding the work of others</td>
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Kafai and Burke, 2013

Collaborative teaching approaches in STEM subjects have been shown to improve self-efficacy and achievement in girls

(Werner and Denning, 2009; Lorenzo et al 2006)
Where is computing relevant in society?
Real-world contexts

- Computing can seem like a very theoretical subject

- Bubble sort algorithm
  - theory - mechanics and efficiency of how the sort works
  - application - the usefulness of the data it is sorting

- Example data sets
  - Playing card values, ages, size of sports balls, heights
  - Number of fish eaten by dolphins in an aquarium
Real-world contexts

- Context is often very important for female students (Margolis and Fisher, 2002, Lyons 2006)
  - Realistic data sets
  - Choice of contexts
  - Agency to make own choice

- Female students had more positive attitudes towards a subject they can link to real world problems (Guzdial and Elliot, 2006)

Source: Pixabay
Who is computing for?
Self-determination theory

- Relatedness is the most important of these three conditions for girls’ motivation to study computing.
- A sense of belonging is a significant predictor of girls’ motivation (Mishkin, 2019)
Representation & role models

• Two interpretations of ‘role models’

  1. Behaviours, attitudes and emotional reactions
  2. Aspirations and achievements

• Links to self-esteem (Wohlford, Lokman and Barry, 2004)
Parental support

- Denner (2011)
  - emotional support
  - more support = higher perceived relevance

- Parental understanding and support affects attitudes toward a subject
Non-formal learning

- Coding clubs have better representation of girls
  - 33% of attendees at CoderDojos (2017)
  - 40% of children at Code Clubs (2018)

- There is potential to connect non-formal learning experiences to formal learning choices by showing girls how their experiences can contribute towards their goals

Source: Pixabay
<table>
<thead>
<tr>
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<th>Barrier</th>
<th>Intervention</th>
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<tbody>
<tr>
<td><strong>Teaching approach</strong></td>
<td>Only individual learning</td>
<td>Collaborative learning</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>Focus on writing code and theory</td>
<td>Focus on solving real-world problems</td>
</tr>
<tr>
<td><strong>Belonging</strong></td>
<td>Lack of female representation in computing</td>
<td>Use role models to show representation</td>
</tr>
<tr>
<td><strong>Encouragement</strong></td>
<td>Unconscious bias in parent and teacher advice</td>
<td>Support to encourage girls into computing</td>
</tr>
<tr>
<td><strong>Non-formal learning</strong></td>
<td>No clear link to formal learning</td>
<td>Make links to formal learning explicit</td>
</tr>
</tbody>
</table>
Themed interventions

Teaching approach

Belonging

Gender Balance in Computing

Encouragement

Relevance

Non-formal learning
Spread the word

Information for schools: 
https://teachcomputing.org/gender-balance

Newsletter sign-up: 
ncce.io/gbicgenreg

Source: clipartmax.com
Emerging themes

● Inclusivity
  ○ Non-binary lens for gender approaches to explore statistically significantly differences
    (Pournaghshband and Medel, 2020)

● Intersectionality
  ○ Race, socioeconomic status, ability
    (Kemp, Wong and Berry, 2019, British Science Association, 2020)
Thank you

With grateful acknowledgement for work and support from colleagues across our partner organisations
Discussion ideas

- Teaching approaches
- Role models
- Real-world computing
- Something else?
References (1)


British Science Association (2020) Inquiry on equity into STEM education. Available at; https://www.britishscienceassociation.org/appg


References (2)


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<tr>
<td><strong>Context</strong></td>
<td>Secondary schools, UK, booklet telling stories of women in tech (n=?)</td>
<td>Middle school girls, US, video taped college students (n=24)</td>
<td>Digital Divas program. secondary schools, Australia (n=24)</td>
</tr>
<tr>
<td><strong>Modelling</strong></td>
<td>Achievement</td>
<td>Behaviours, attitudes, achievements</td>
<td>Behaviour, attitudes</td>
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<tr>
<td><strong>Proximity</strong></td>
<td>In a printed booklet</td>
<td>On videotape</td>
<td>In the classroom as additional facilitators</td>
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<tr>
<td><strong>Plurality</strong></td>
<td>Individuals</td>
<td>Individuals</td>
<td>Individuals</td>
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<tr>
<td><strong>Outcomes</strong></td>
<td>Measured by distribution figures and qualitative teacher feedback</td>
<td>Attitude surveys (treatment vs control) immediately and after four months</td>
<td>Qualitative feedback from the students, teacher and university students</td>
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