Early exposure to Computer Science (CS) & Computational Thinking (CT) is important

To broaden participation in the field & promote equity, two types of barriers need to be addressed (Wang & Hajazi Moghadam, 2017)

- **Structural barriers**: lack of access to Computer Science and Computational Thinking experiences
- **Social barriers**: often stereotype induced, arising despite equal access and similar socio-economic status

→ Lead to under-representation in the field

→ Require a system-wide implementation of Computer Science and Computational Thinking curricula for all students starting early foundational years (Ottenbret-Leftwich & Yadav, 2022; Bers et al., 2022)

But are curricular reforms contributing to learning and reducing performance gaps?

- Many initiatives are introducing CS & CT into formal K-12 education
- Curricular reforms and professional development programs are seldom evaluated at the student-level (Mason & Rich 2019; Kong & Lai 2022);
- The effectiveness of CS-curricular reforms in terms of student learning and learning gaps must be established to
  i) improve the proposed curricula and PD programs (Hickmott & Prieto-Rodriguez et al. 2018)
  ii) sustain the changes in teachers’ practices
  iii) alleviate concerns of funding agencies and government bodies (Hickmott & Prieto-Rodriguez et al. 2018)

→ We evaluate the implementation of a regional CS-curricular reform with two student learning datasets involving 3383 grade 3-6 students from 7 schools through ANOVA and hierarchical regression

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![Graph showing performance gaps between Grade 3 and Grade 4](image)

**Grade 3** Post>Pre  
**Grade 4** Post>Pre  
**Grade 4** Pre≠Grade 3 Post

Dataset: Grade 3-4 January 2021 & June 2021 test data, n=1319

**Gender gaps appear to be closing**

- **Grade 3 - Pre: Boys > Girls**  
  - Δ = 2.486; p=0.0046, D=0.161
- **Grade 3 - Post: Boys > Girls**  
  - Δ = 0.682; p=0.0042, D=0.139
- **Grade 4 - Pre: Boys > Girls**  
  - Δ = 0.723; p=0.0064, D=0.151
- **Grade 4 - Post: Boys > Girls**  
  - Δ = 0.211; p=0.5046, D=0.046

Dataset: Grade 3-4 January 2021 & June 2021 test data, n=1319

**Performance gaps are closing but there is no direct link with what was taught**

- **Students with lower performance at the pre-test are progressing more**

- **Hickmott et al. (2018)**

**Learning is unrelated to perception of CS**

- **But it depends on teachers’ perception of the professional development program**

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**Table showing regression results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>Degree of Freedom</th>
<th>R² Value</th>
<th>p Value</th>
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</thead>
<tbody>
<tr>
<td><strong>Student test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test score</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Grade 4</td>
<td></td>
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<tr>
<td>Grade 3</td>
<td></td>
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</tr>
<tr>
<td><strong>Teacher perception</strong></td>
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<td></td>
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<tr>
<td>CS Knowledge</td>
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<td>0.02</td>
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<td>0.00</td>
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<tr>
<td>CS Pedagogical Knowledge</td>
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<td>CS Knowledge &amp; PD</td>
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<tr>
<td>Perception of CS</td>
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<tr>
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</tr>
</tbody>
</table>

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**Graph showing relationship between variables**

- **Discipline Perception**  
  - **Robot Perception**  
  - **Tablet Perception**  
  - **CS Perception**  
  - **Role Models**  

Dataset: Grade 5-6 November 2021 test data & perception data, n=1583