



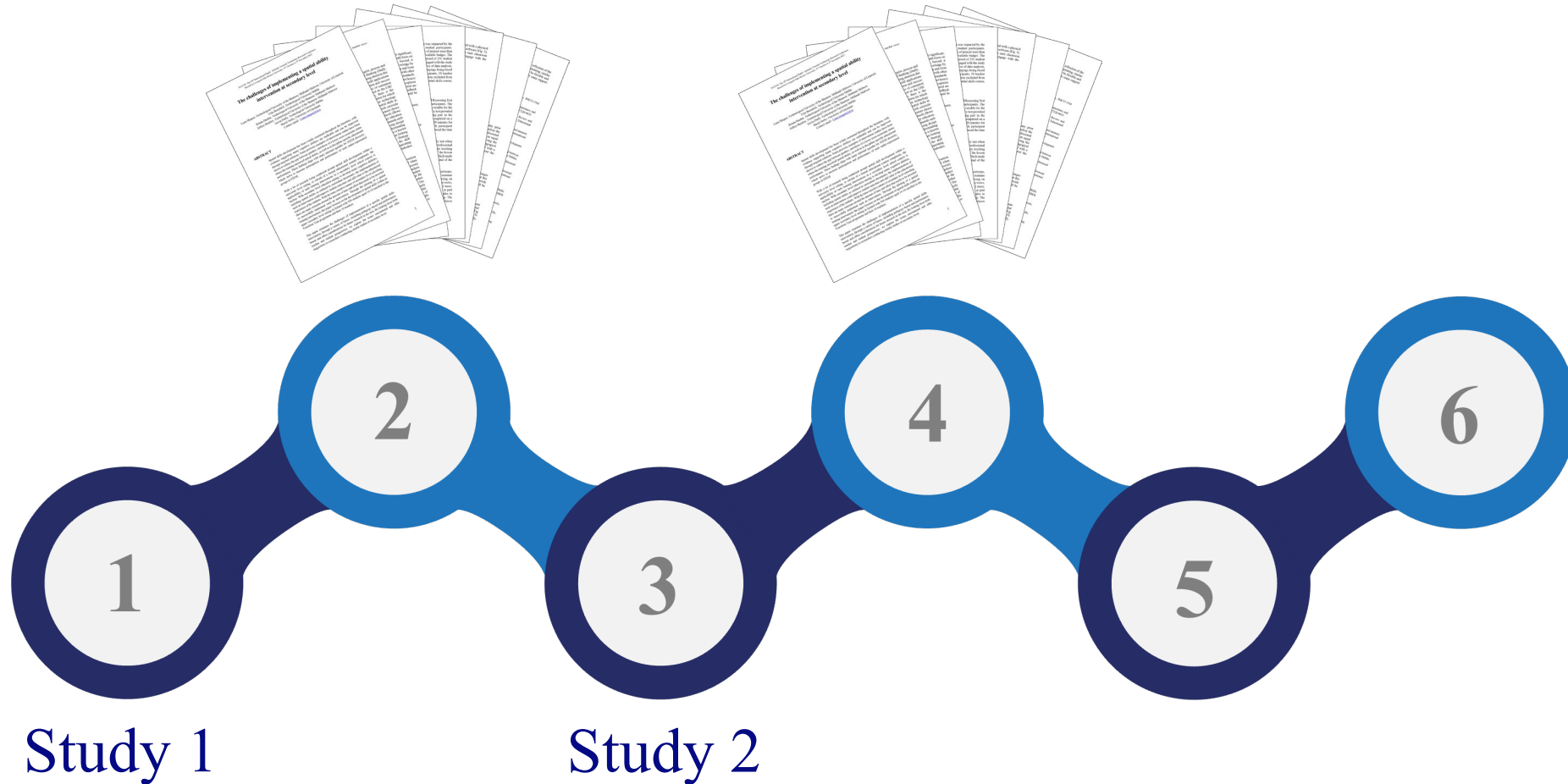
Implementation and analysis of a spatial skills course for Secondary level STEM education

Urša Benedičič, Liam Maquet, Gavin Duffy, Rónán Dunbar, Jeffrey Buckley, Sheryl Sorby

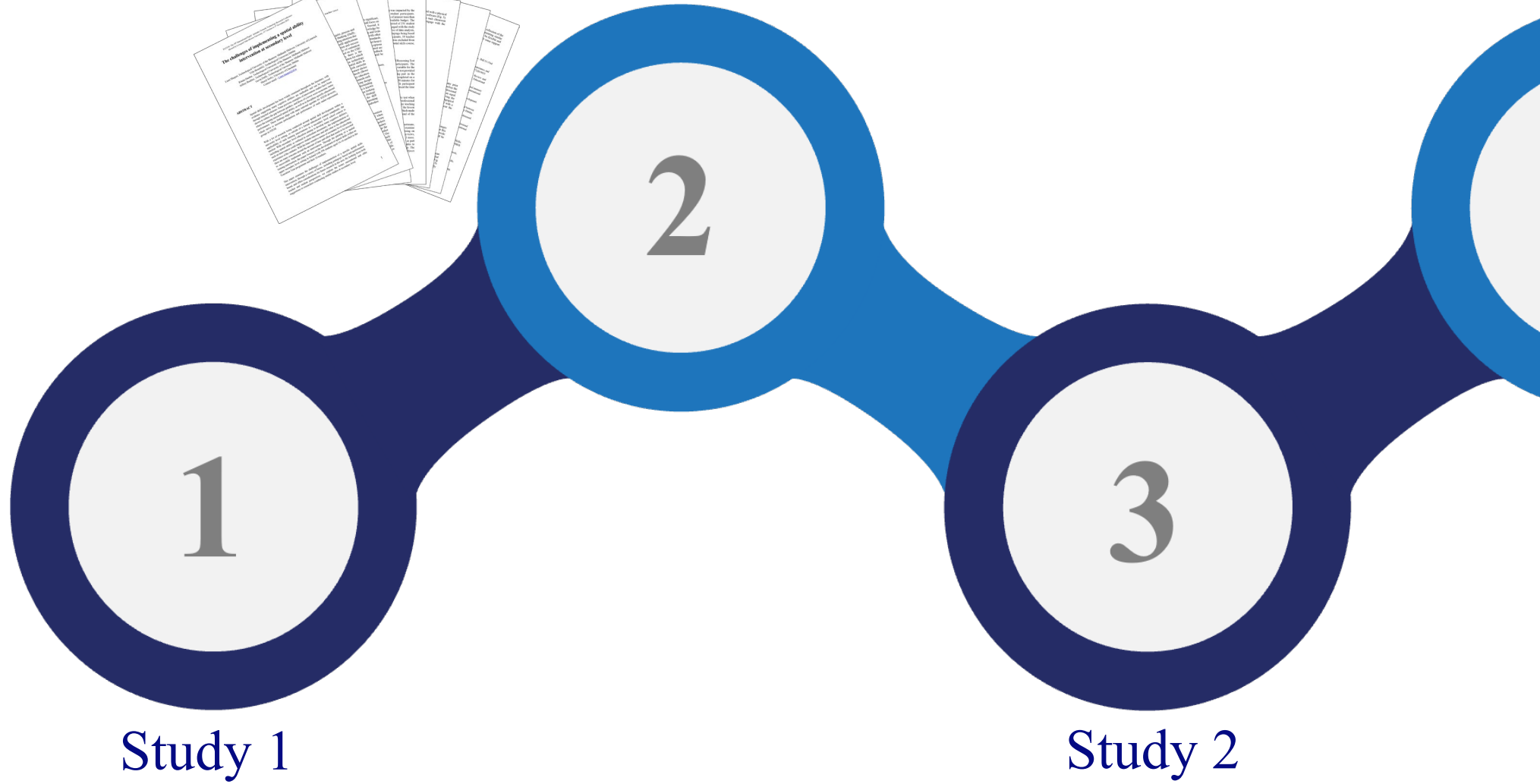
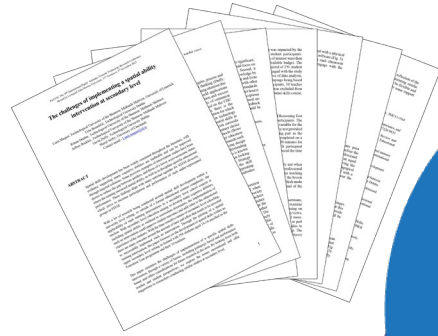


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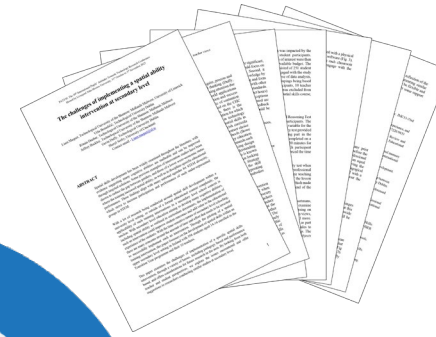
Study so far



Study so far



Study so far



2

4

3

5

Study 2

Study so far

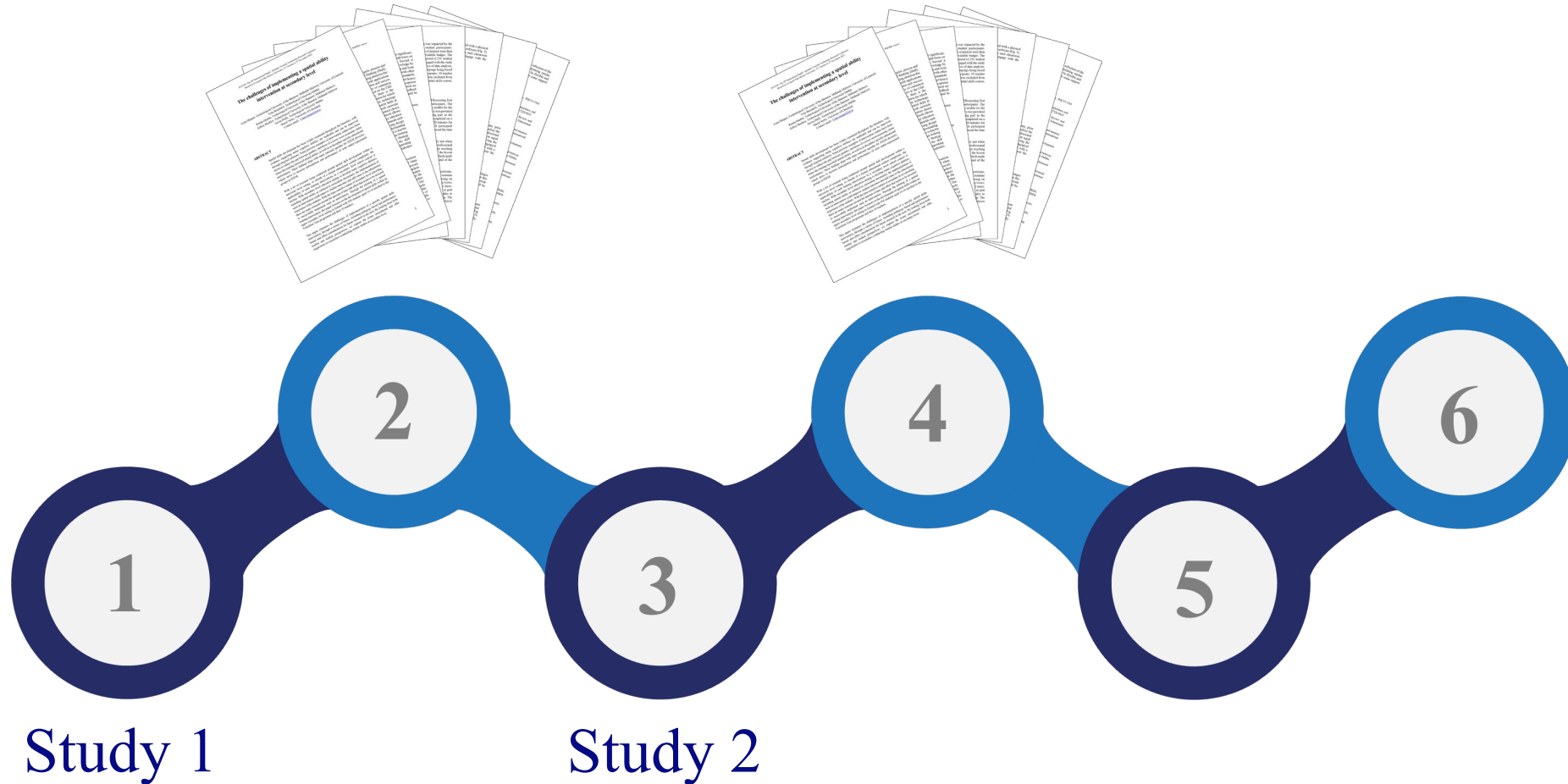
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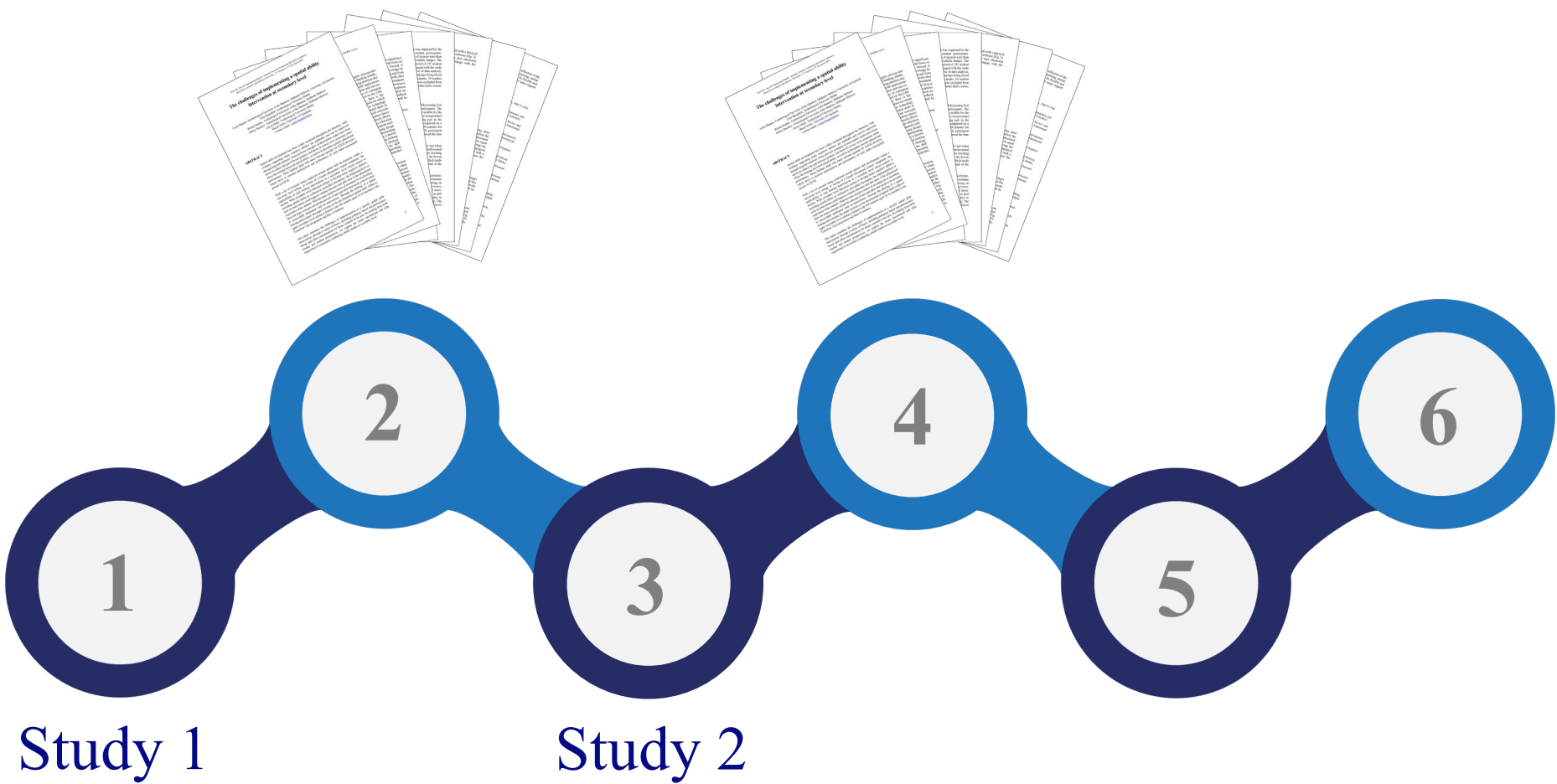
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Move to technology education

Study so far

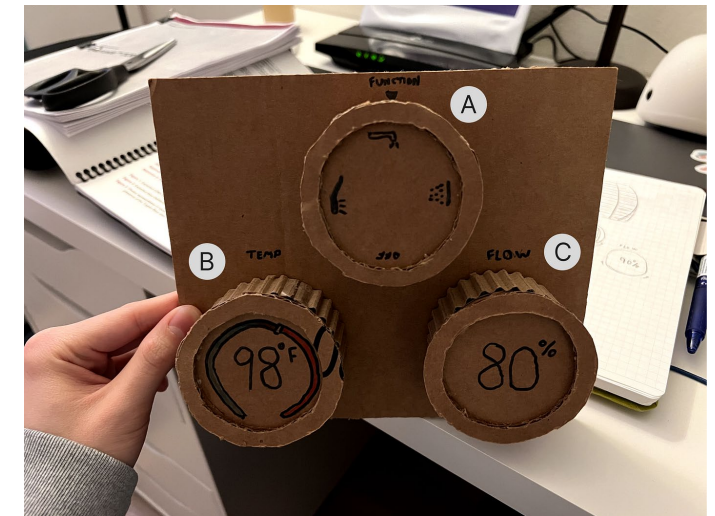
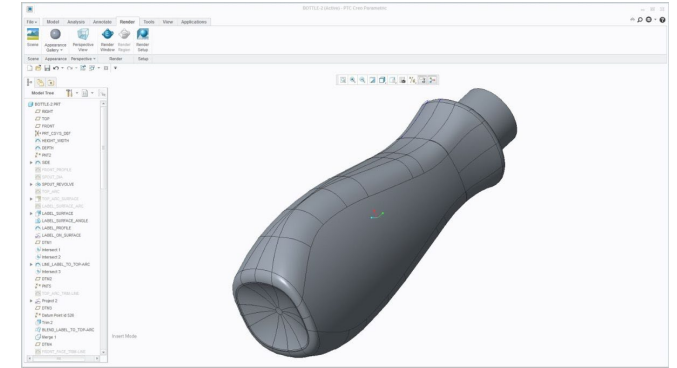
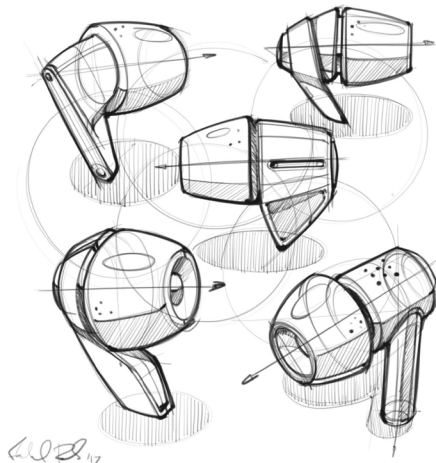
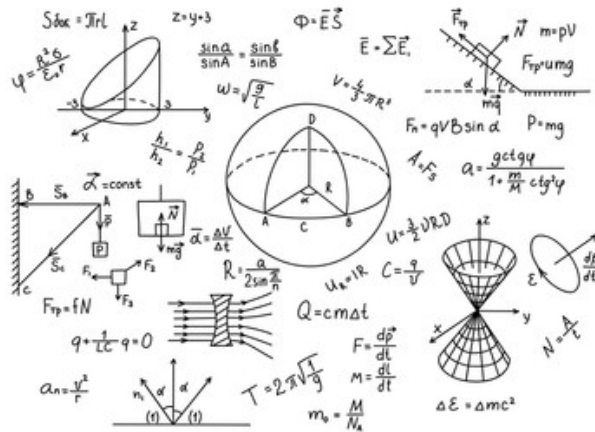


Focus of this presentation



Motivation for study

- Direct links to STEM activity
 - Mental rotation
 - Visualisation of design solutions
 - Imagining complex systems
 - Understanding space and proportion



Spatial ability and STEM performance

- Spatial ability has gained increasing attention due to its importance in various STEM disciplines (Wai et al., 2009)
- Spatial ability has been found as a predictor for participation and success in STEM fields later in life (Uttal et al., 2013).

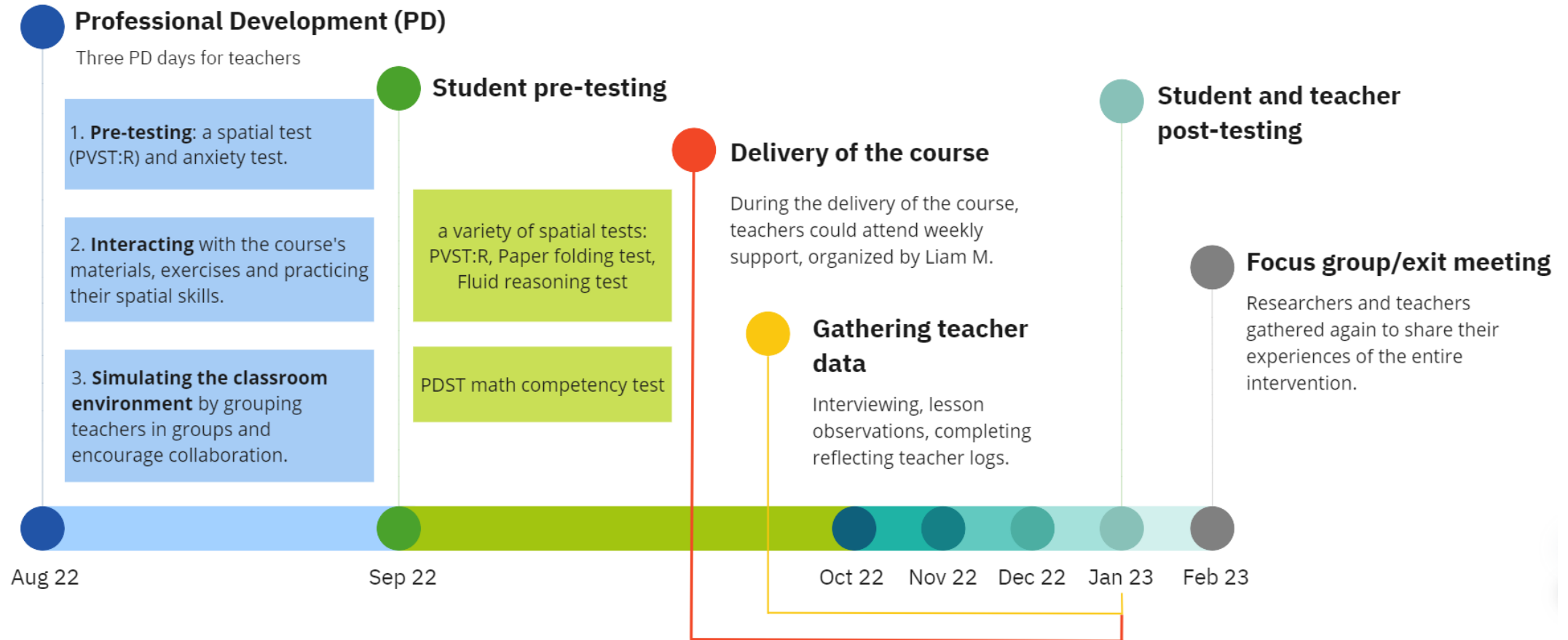
What the previous study taught us

- “*The challenges of implementing a spatial ability intervention at secondary level*” ~ (Maquet et al., 2023)
- Need for:
 - Extensive professional development
 - Continuous support for teachers
 - Implicit teaching resources
 - Teacher input when planning the structure and sequence of the intervention

Study 1 vs Study 2

- Changing focus of research questions
- Moving from feasibility towards higher level analysis of impact
- Focussing on:
 - Impact on students' spatial skills
 - Impact on teachers' spatial skills
 - Link between teachers' spatial skills and student gains in spatial testing
- Points of interest:
 - Gender differences
 - SES differences (DEIS)

Timeline of this paper

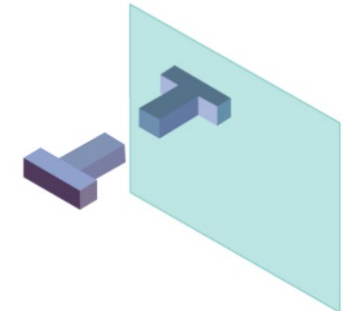
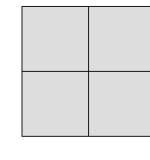
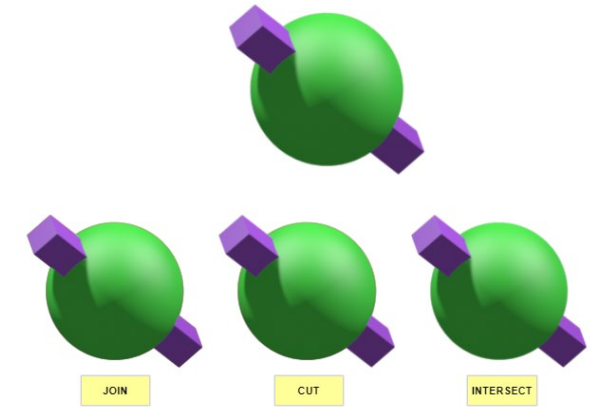


Study participants

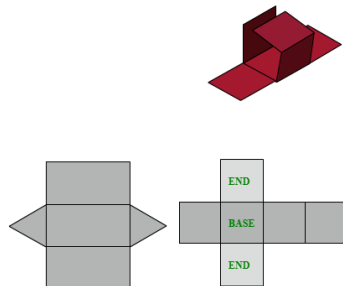
- 25 schools
- Students
 - 1199 Transition Year students across Ireland
 - 488 male
 - 711 female participants
- Teachers (math)
 - 25 experimental
 - 25 control

Intervention content

- Development of spatial skills through 6 modules:
 - Surfaces and Solids of Revolution
 - Combining Solids
 - Isometric Sketching and Coded Plans
 - Flat Patterns
 - Rotation of Objects about a Single Axis
 - Reflection and Symmetry.



CHECK YOUR RESPONSE



Visualizing Revolutions

• To visualize a revolution, first think about mirroring the shape about the axis of revolution and then forming a cylindrically-shaped object from the two shapes

2-D Shape

2-D Shape Mirrored About Axis of Revolution

2-D Shape Mirrored About Axis of Revolution

Choose the rotation code that will rotate the object on the left to match the object on the right.

1.

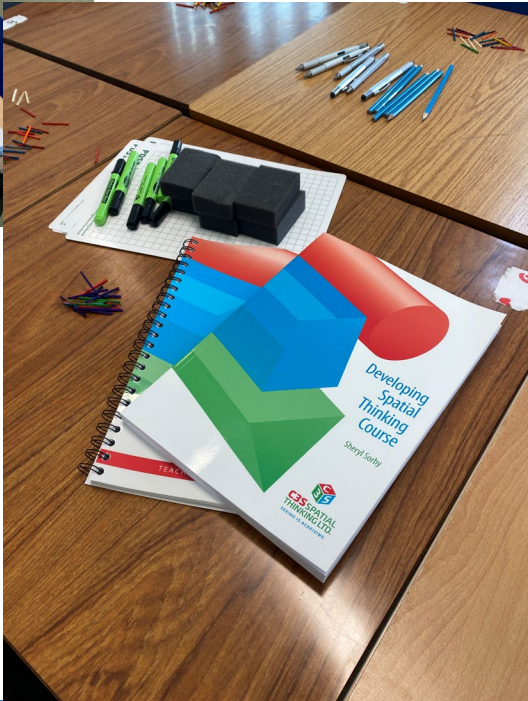
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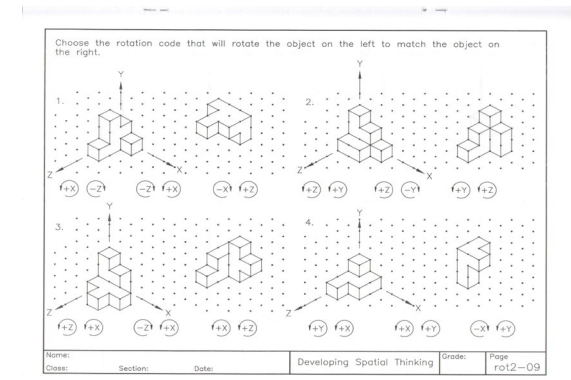
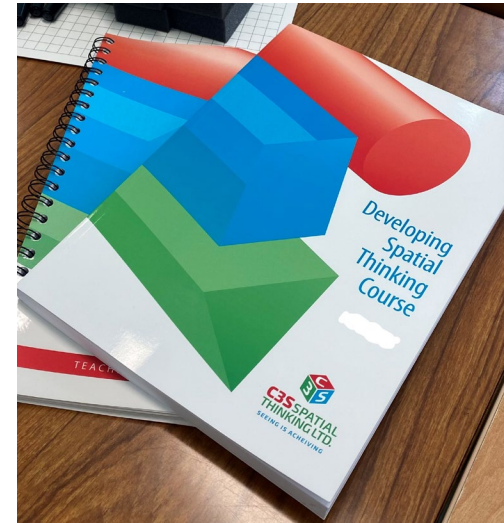
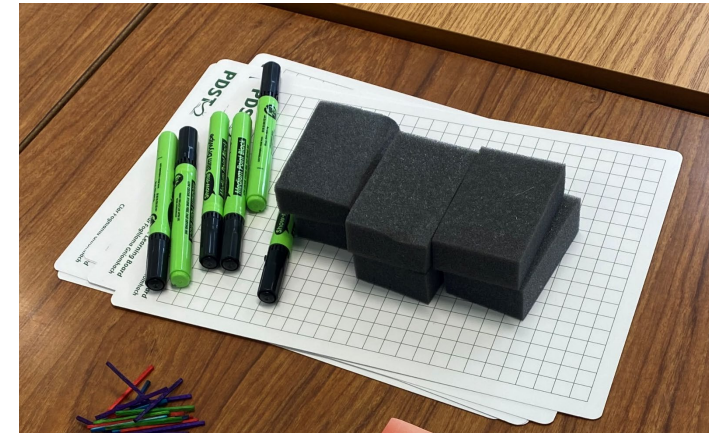
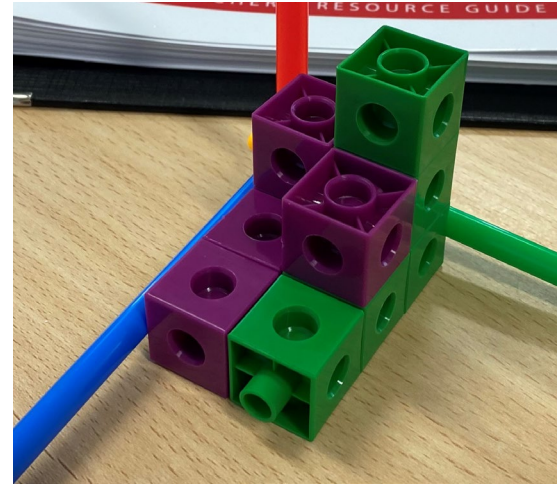
Name: _____ Class: _____ Section: _____ Date: _____ Developing Spatial Thinking Grade: _____ Page: rot2-09

Professional development



Pedagogical approach - PD

- Teachers provided with:
 - Sample lesson plans
 - Sample PowerPoint slides
 - Workbooks (class set)
 - Teacher guidebook
 - Snap cubes
 - Axis
 - Show-me boards

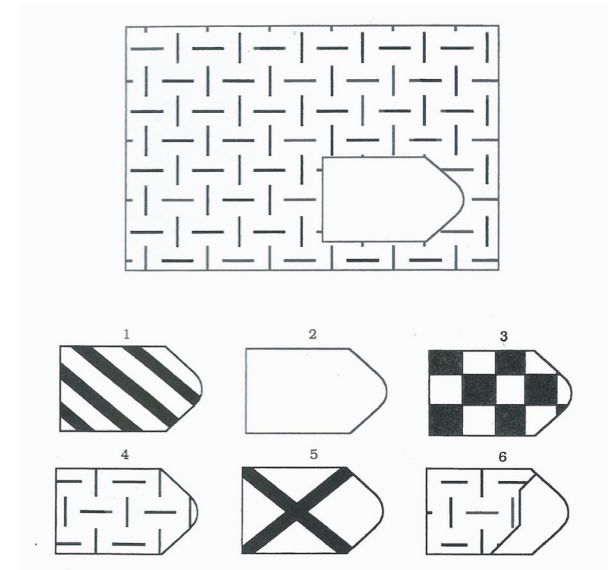
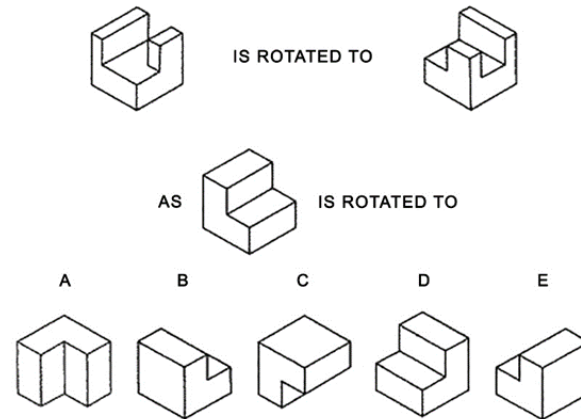
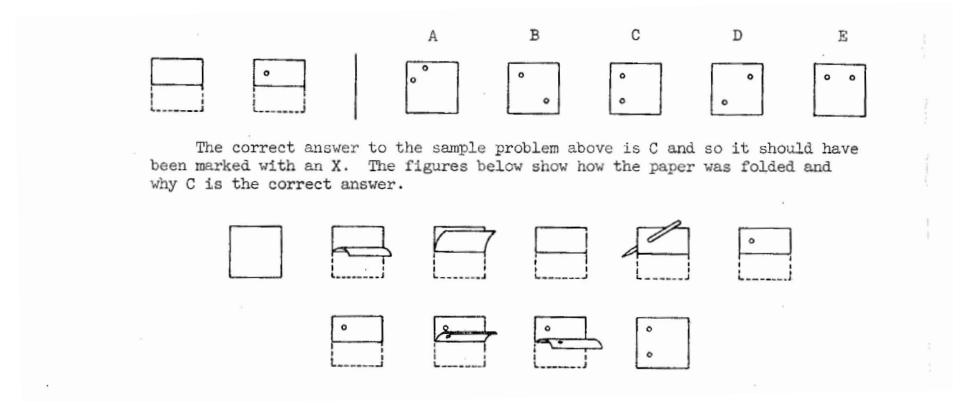


Pedagogical approach - PD

- Emphasis on:
 - Exploratory approach
 - Student centred learning
 - Group/pair work
 - Peer/self assessment
 - Subject specific extension activities

Testing

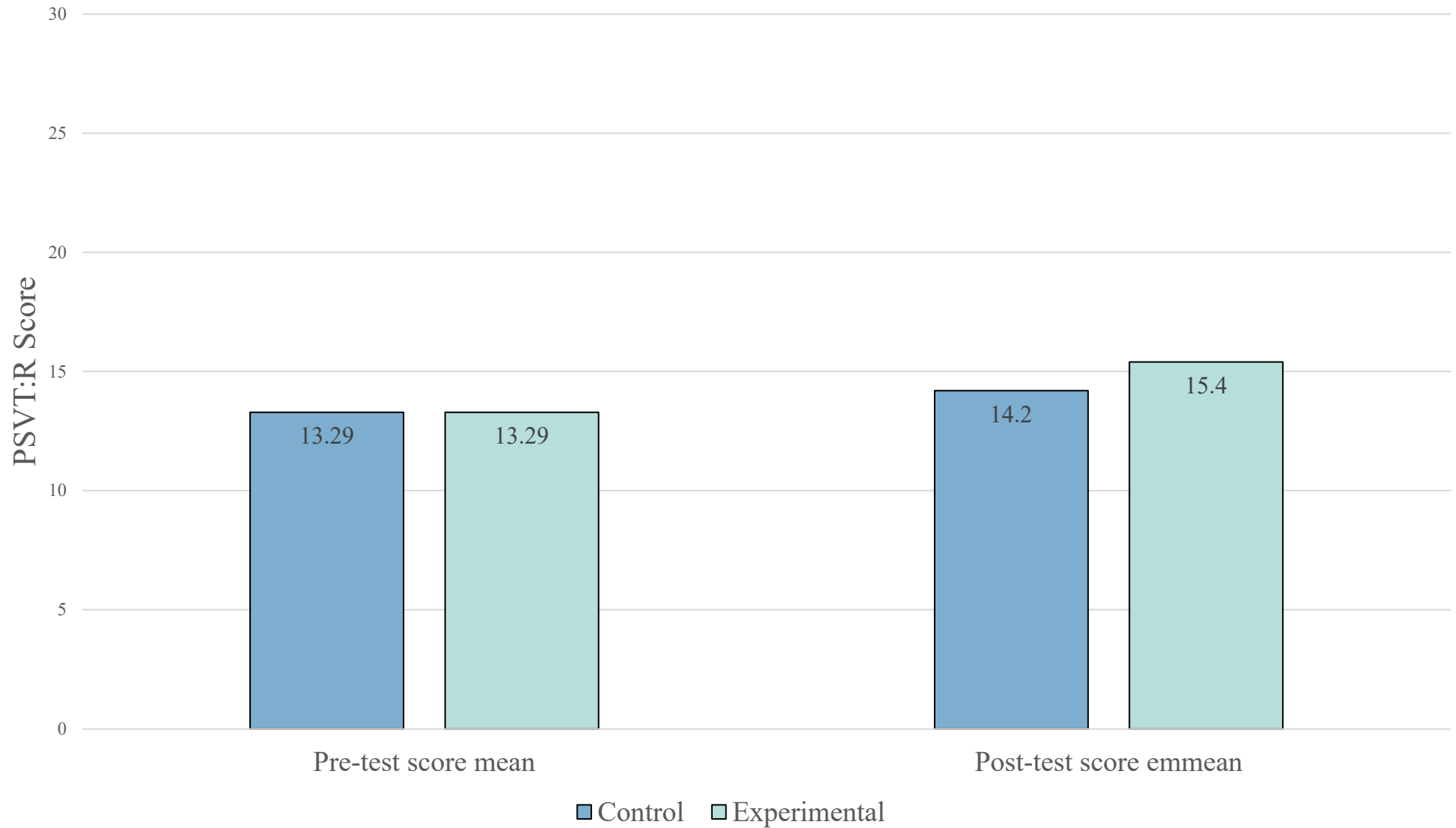
- Pre and post testing
- PSVT:R
- PFT
- FRT
- Math test



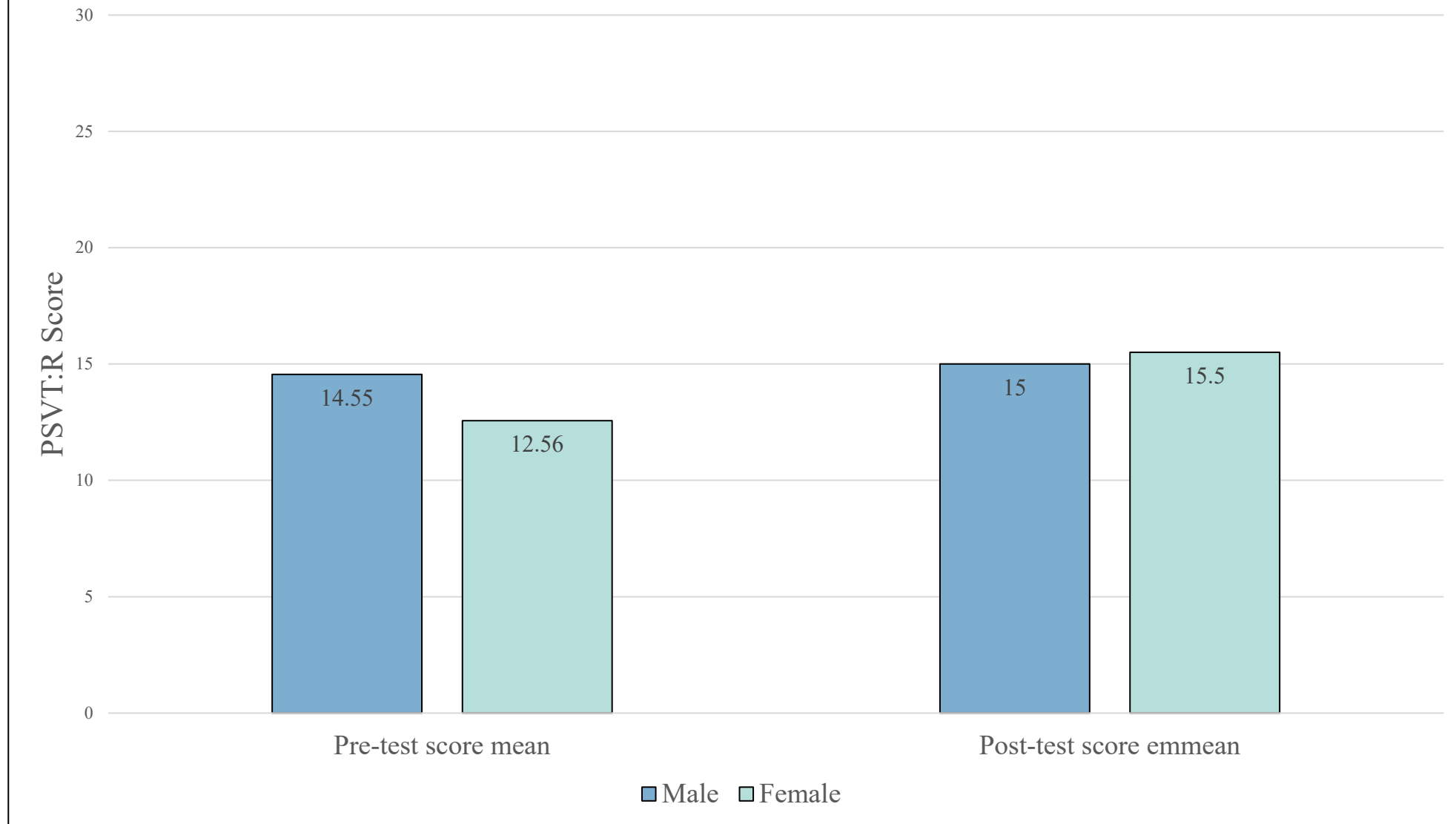


Results

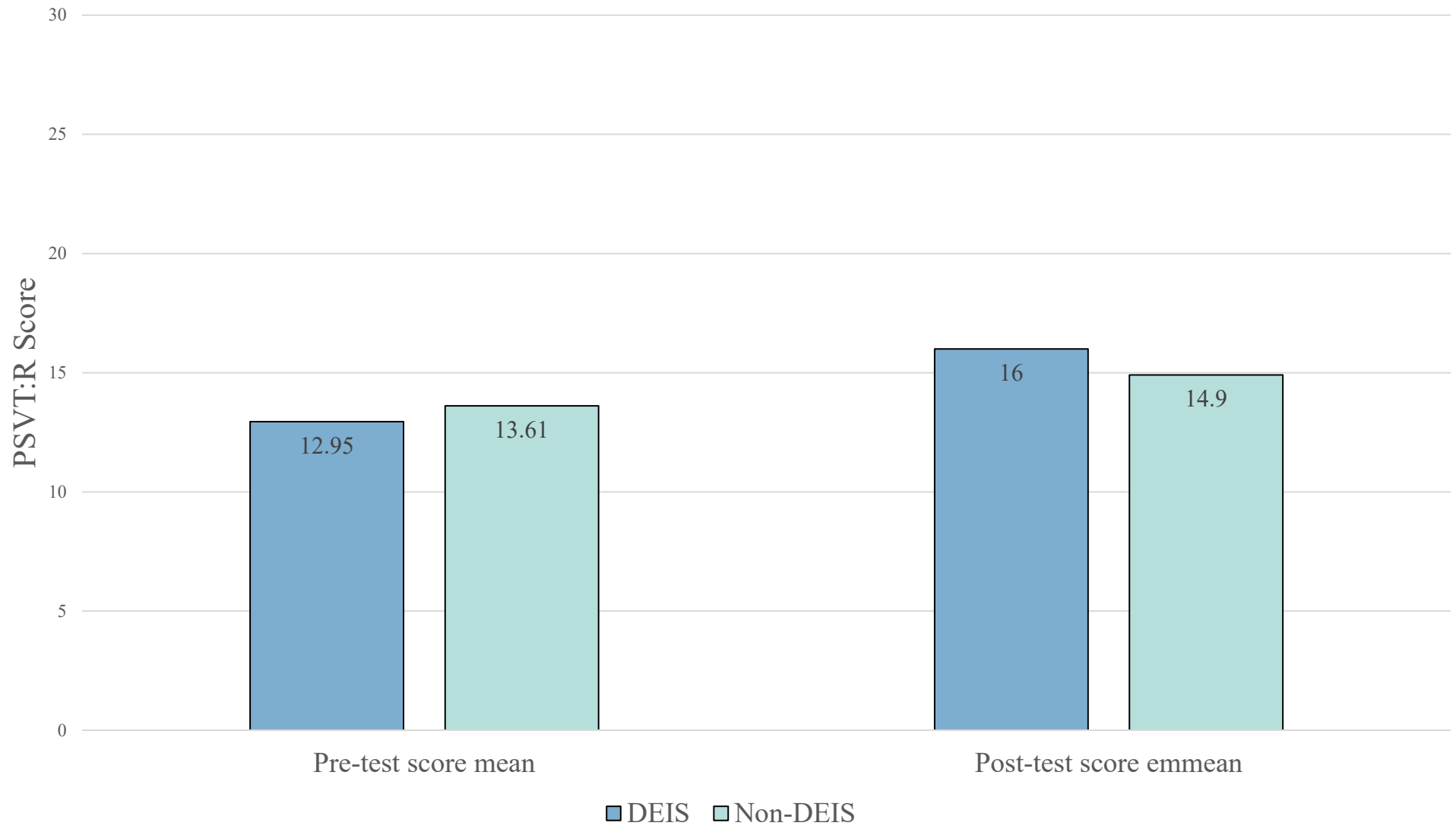
PSVT:R Performance - Control vs Experimental



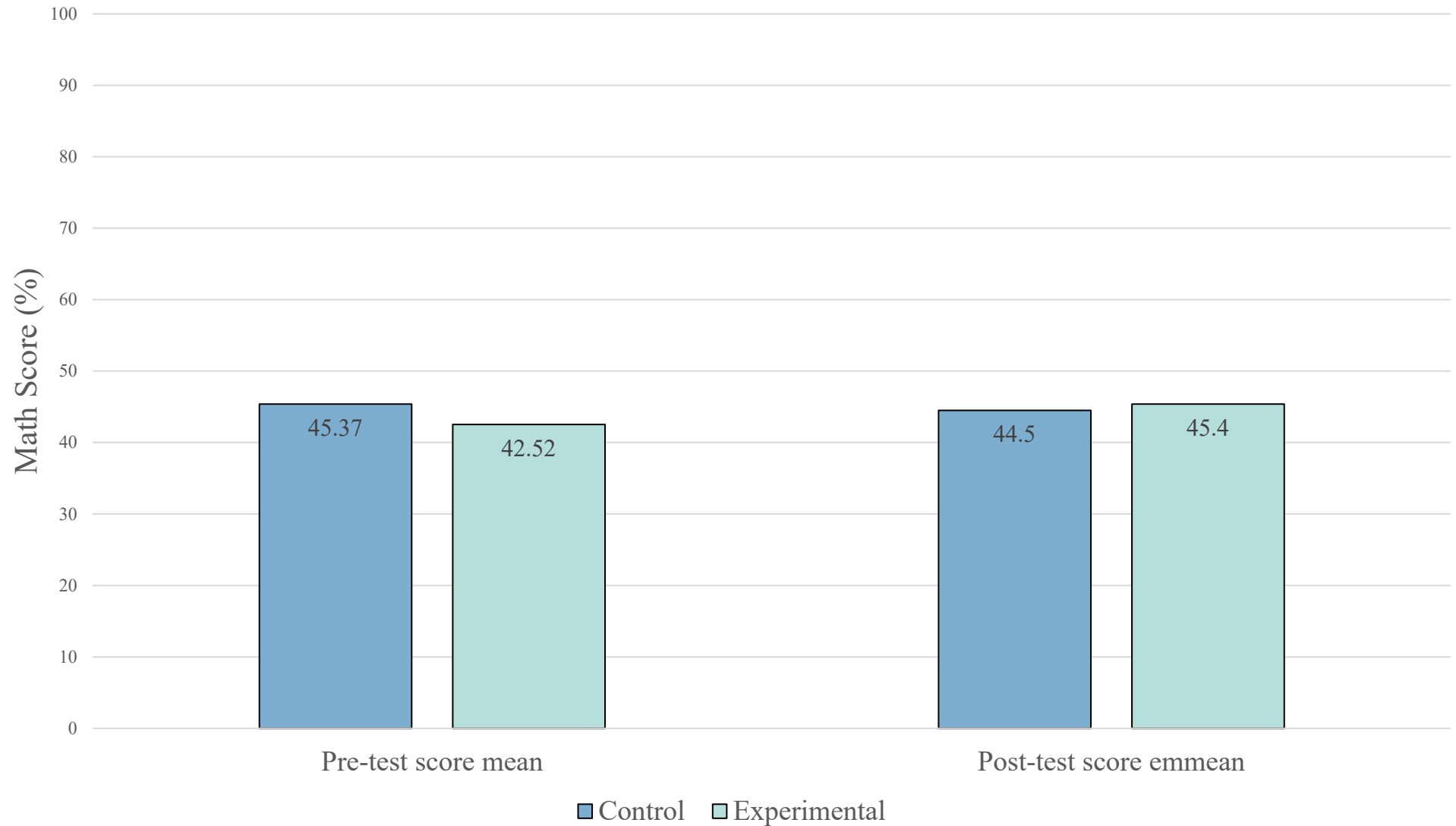
PSVT:R Performance - Male vs Female



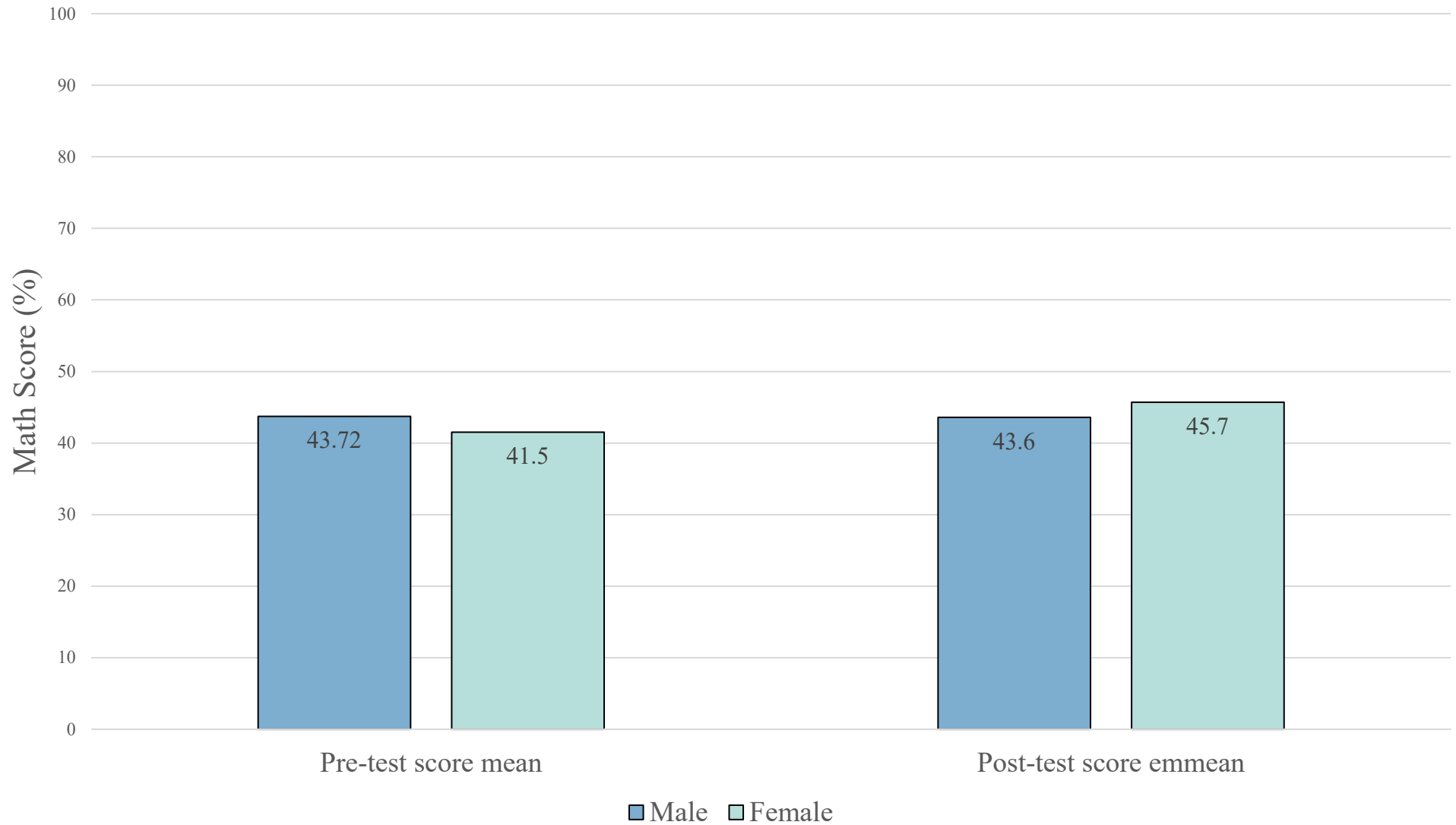
PSVT:R Performance - DEIS vs Non-DEIS



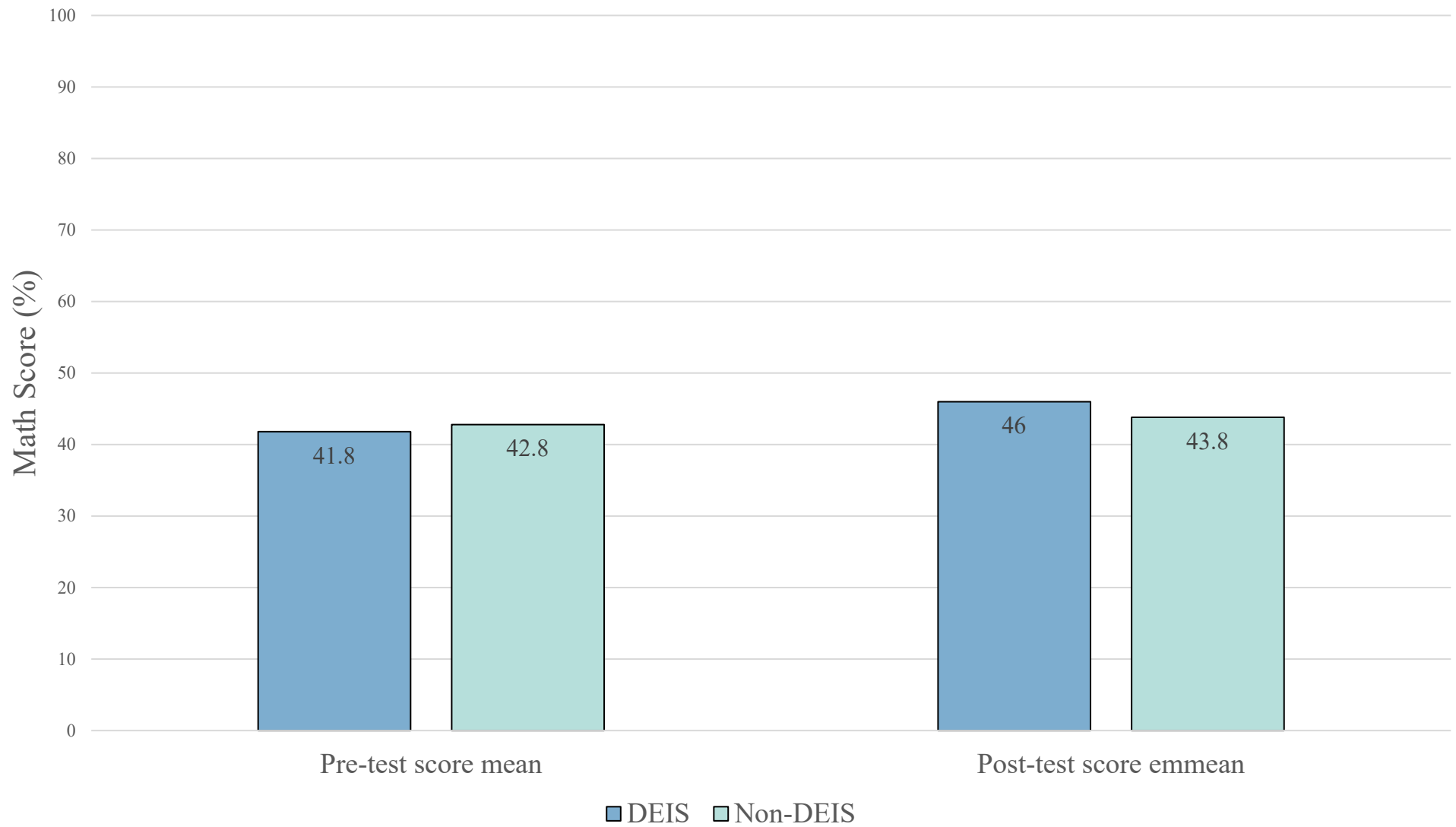
Math Performance - Control vs Experimental



Math Performance - Male vs Female



Math Performance - DEIS vs Non-DEIS



And more...

- Outlined in the paper

Discussion

- Was the intervention effective in improving students spatial scores?
 - Yes
- Was the intervention effective in improving teachers spatial scores?
 - Yes
 - Statistically significant difference – pre and post
- Was there a link between teachers spatial scores and student achievement?
 - Still unclear
 - Lack of evidence to suggest there was

Discussion

- DEIS Schools (lower SES)
 - Underperformed in pre test
 - Outperformed in post test
- Females
 - Underperformed in pre test
 - Outperformed in post test

Next steps for this project

- How do we take this into a technology education space?

Thank you for listening!

Questions / feedback welcome

X

@LiamMaquet

R^G

Liam Maquet