

## Background

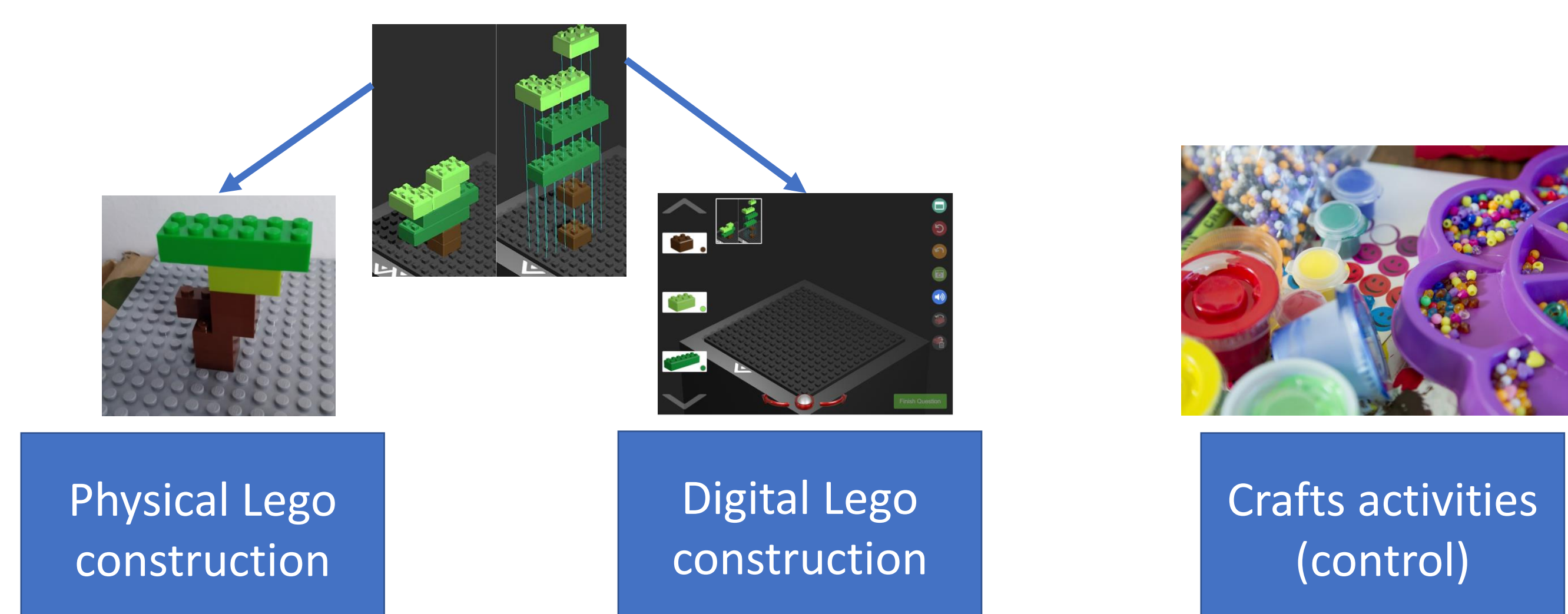
Expertise in **STEM subjects** is vital to the economy, yet performance in and uptake of STEM subjects is poor.

**Spatial skills** are important for mathematics performance and are also **malleable**. Research has shown both near and far transfer effects of spatial training, including to mathematics.

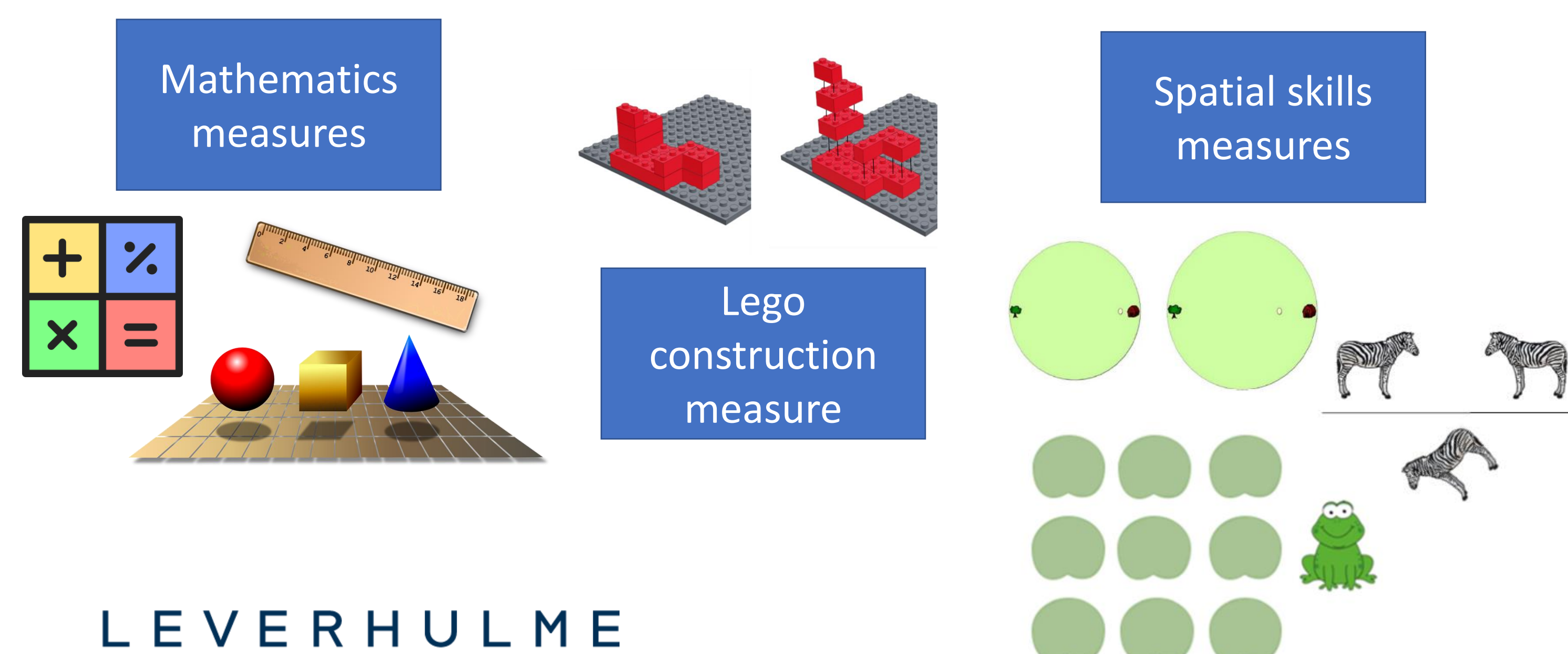
**LEGO®** is one of the most popular toys worldwide and Lego construction recruits spatial skills, together making it a **potential candidate for spatial training in school**.

## Method

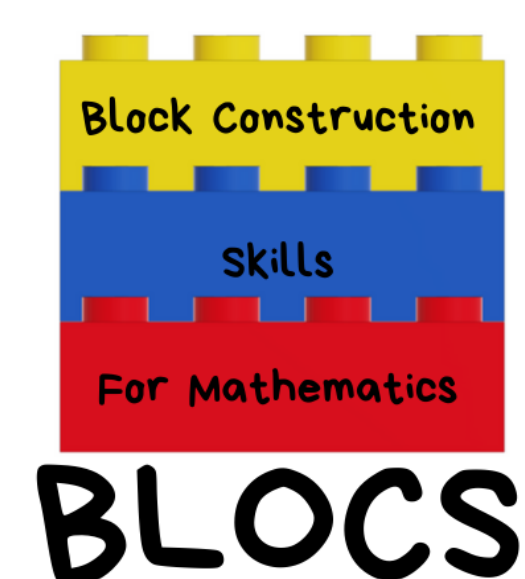
N=206 Key Stage 2 children (7- to 9-year-olds) will take part in one of three training programmes, each consisting of 12 x 30-minute sessions delivered over six weeks as a school lunchtime club:



Pre- and post-training assessments will be used to measure training impact:



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# Assessing the impact of LEGO® construction training on spatial and mathematical skills: reflecting on the strengths and challenges of a Stage 1 Registered Report

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## Stage 1 Registered Report

We received 'In Principle Acceptance' from *Developmental Science* in December 2020. The first author joined the project as the postdoctoral researcher in May 2021. Data collection was delayed due to the pandemic but began in January 2022 and will be complete by December 2022.

Below are some of the strengths and challenges of conducting a Stage 1 Registered Report within this context.

### Strengths

Reduces bias against publishing null results (replication crisis).

This also puts more emphasis on conducting 'good science' rather than on achieving positive findings.

Protocols, research design and planned analyses are clear, increasing efficiency.

This also facilitated a seamless transition between postdoctoral researchers.

Commitment to sample size facilitates more efficient project planning and ensures study will be fully powered.

Knowing exactly how many participants are needed means that data collection can be scheduled appropriately.

### Final thoughts

There are many more advantages not mentioned here that are important with respect to Open Research more broadly, and overall, the strengths outweigh the challenges.

All the above experiences are important for researcher development and for moving towards open, reproducible research practices being a part of standard research practice.

### Challenges

Barriers to making changes following unexpected obstacles.

Piloting identified that our planned control activities were not engaging for children. We will need to make these changes clear to reviewers at Stage 2.

Less ownership of the project for the first author.

Decisions had already been made and there was less flexibility compared to preregistration.

Commitment to sample size can lead to more pressure during data collection.

This pressure is not unique to Registered Reports, however it can be heightened due to the element of inflexibility.