

Abstract

Spatial intelligence, operationalized for this study as the ability to make spatial judgment and visualize, has been shown to be significantly correlated with achievement and retention in STEM. Yet despite the role spatial skills play in STEM success, it is an area that receives little precise instructional focus in K-12 contexts. Spatial intelligence has also been shown to be one of the only areas in which males outperform females, with noticeable differences emerging in the middle school years. This difference has been suggested to be a contributing factor to the under representation of women in engineering. However, research has also shown that targeted training can significantly improve student spatial ability. And in some cases, even relatively brief interventions, some as short as three hours, have been shown to result in positive growth in spatial skills. Thus, a portable and scalable technology-based spatial training system that can be easily deployed in middle grades can have a considerable impact in improving STEM achievement of all learners.

Background & Rationale

Previous studies have indicated...

- Spatial ability is critical to success in STEM fields, and can predict success in STEM-related college courses.
- A gap exists between boys' and girls' spatial abilities and skill development.
- Gender gaps can be remediated, even with abbreviated interventions.
- Playing digital games can significantly impact students' spatial skills.

However, little research has been conducted on the visual-spatial impact of other first-person games, like Minecraft, which engages players in positioning and moving blocks to create structures.



Figure 1. Minecraft Environment

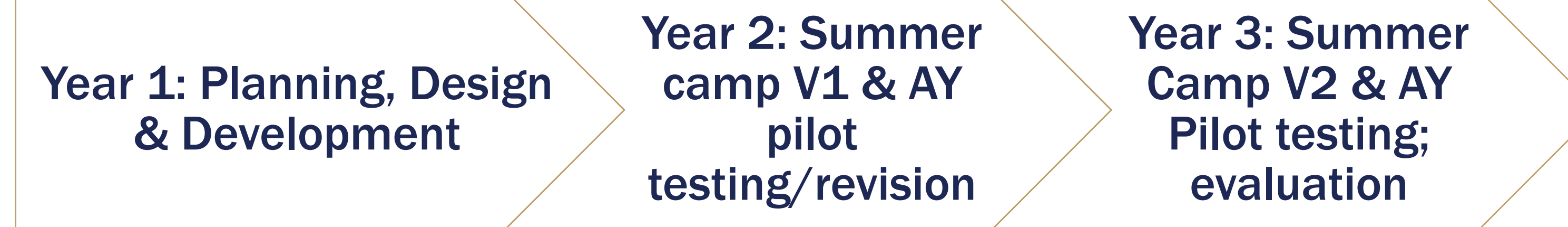
Objectives

Primary Project Objective: Develop and pilot test a functional prototype for a standards-based curriculum designed to improve spatial intelligence within the Minecraft environment.

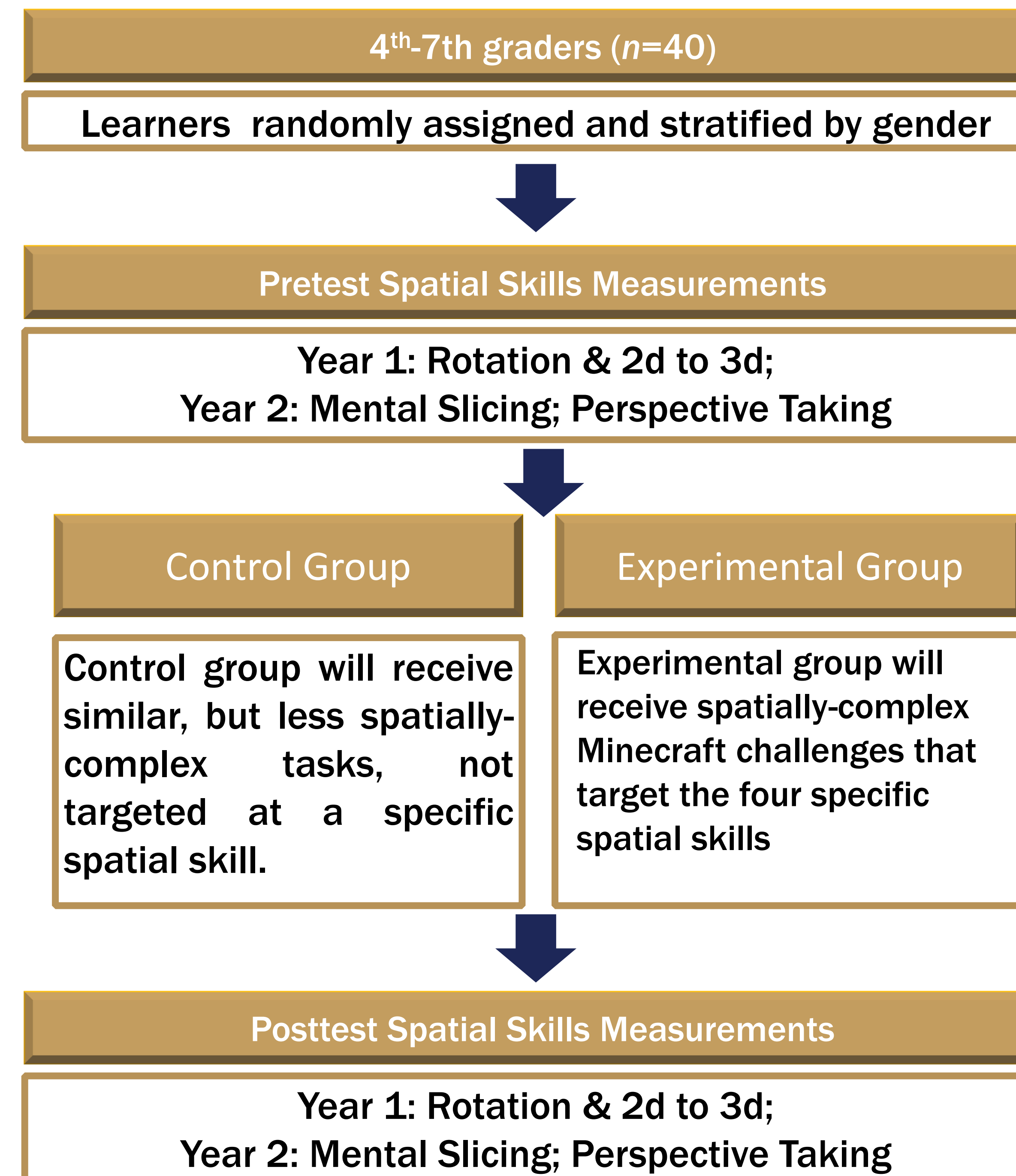
Research goals:

- 1) Determine if inclusion of Minecraft-based design challenges that target specific spatial skills differentially influences learners' spatial abilities compared to less targeted game play,
- 2) Determine which of the tested spatial skills are most positively influenced by the Minecraft activities
- 3) Determine how learning varies by gender.

Project Timeline



Research Design



Spatial Skills Measurements – Year 1

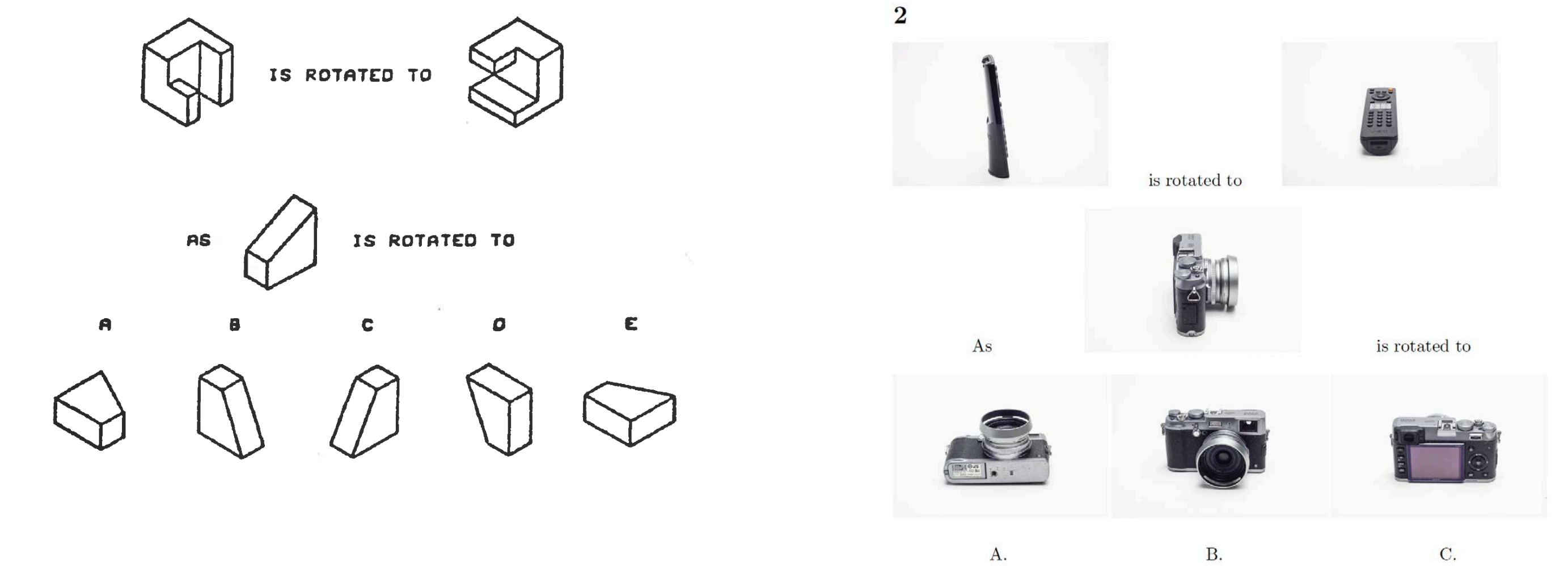


Figure 2. Rotation: Adapted Purdue Spatial Visualization Test

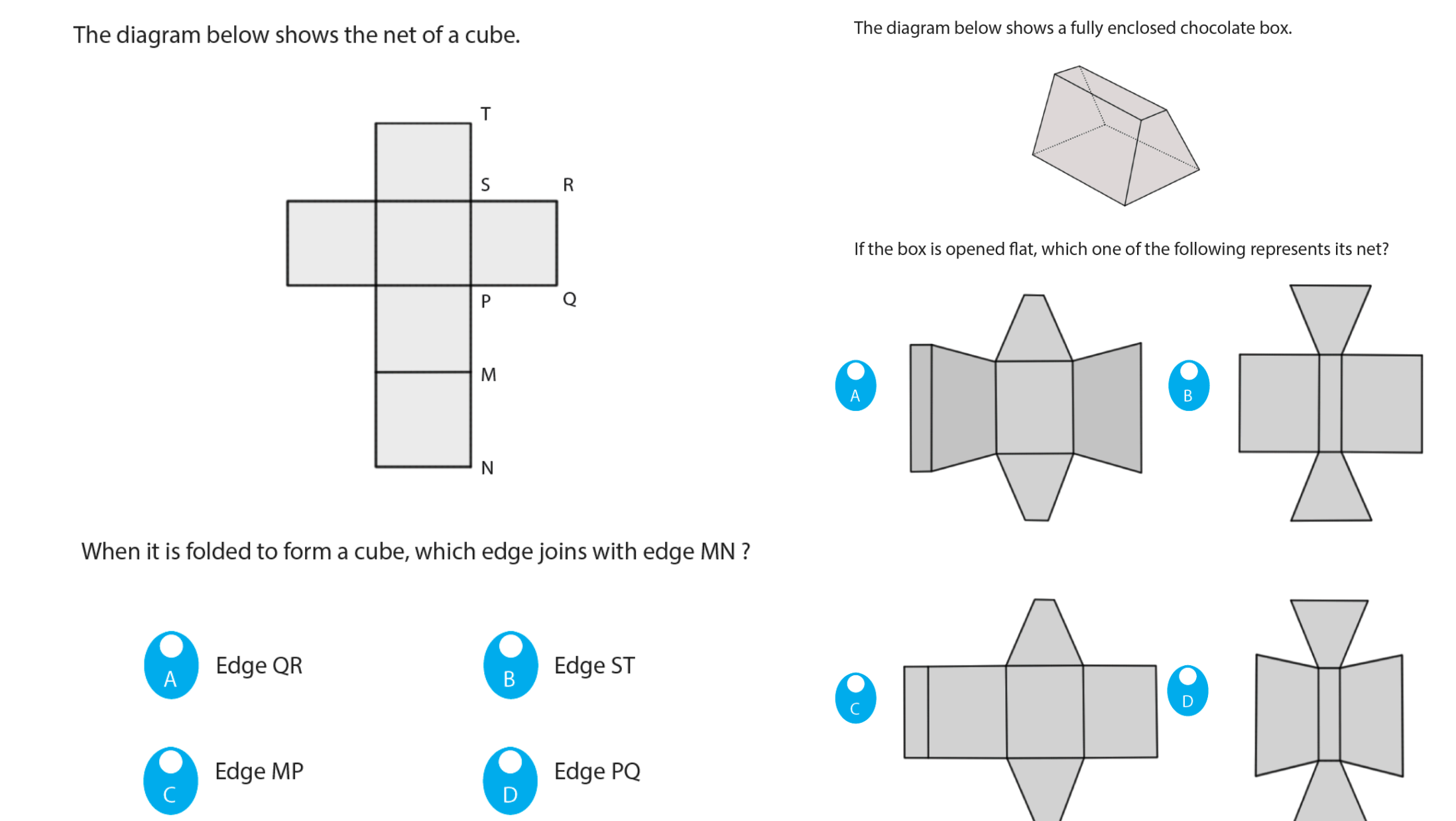


Figure 3. 2d-3d Transformation: Adapted Spatial Reasoning Instrument

Spatial Skills Activities – Year 1

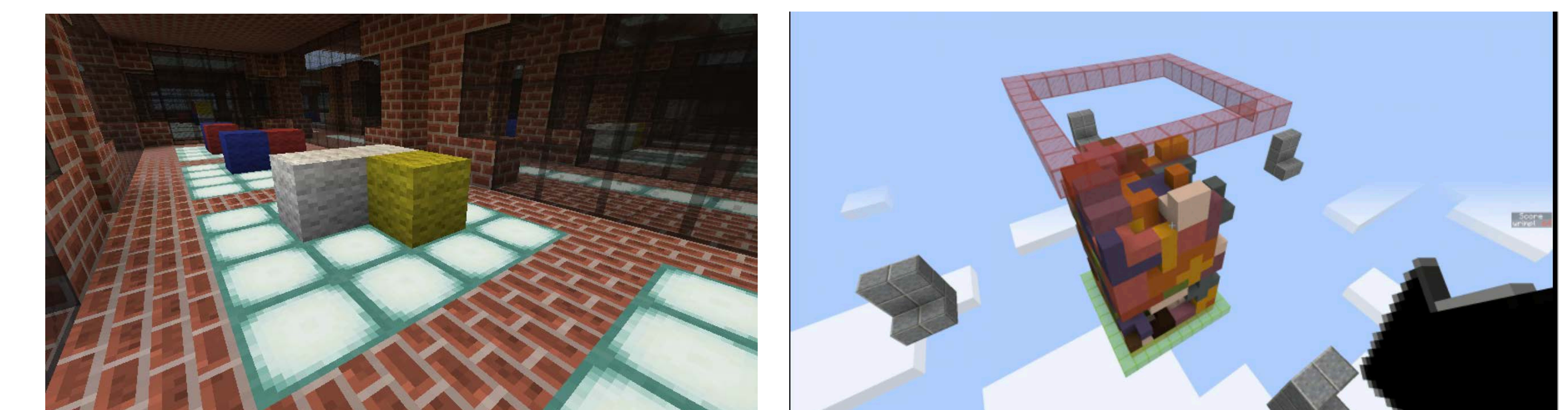


Figure 4. Rotation Activities – APVST Activity & 3d Tetris

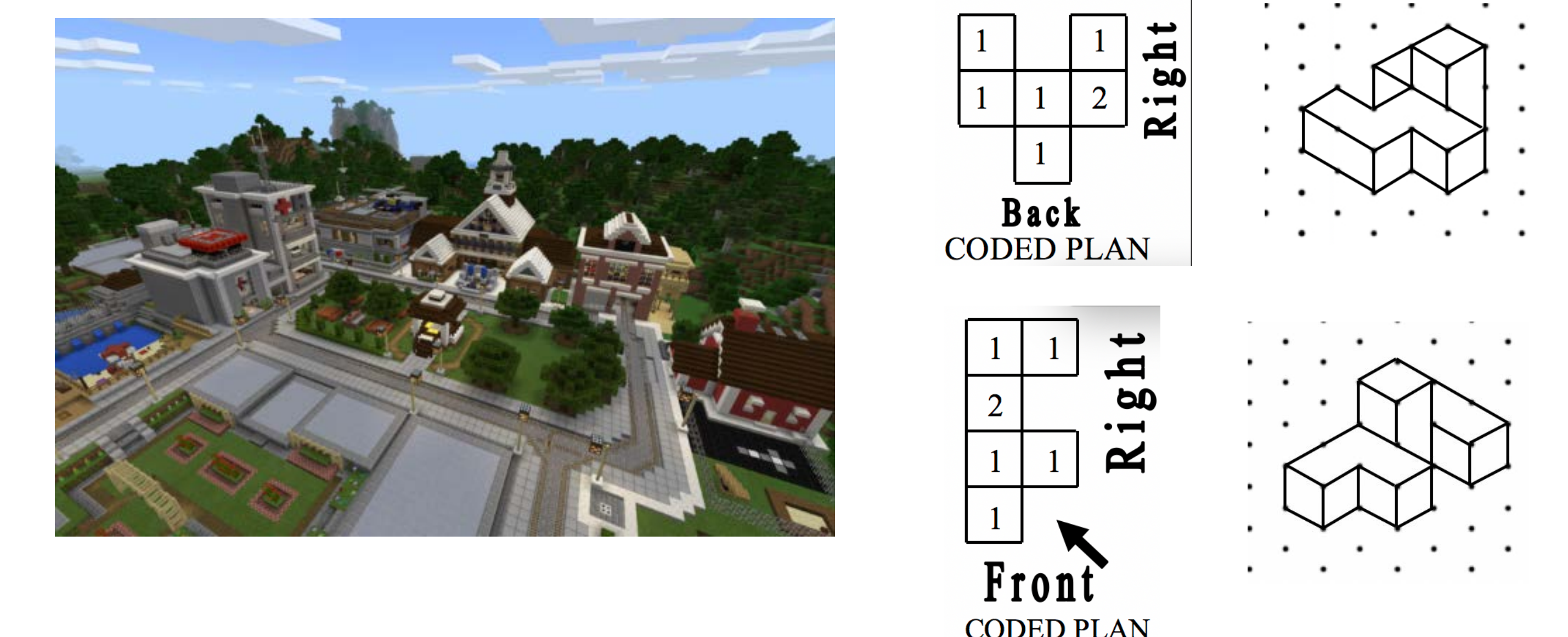


Figure 5. 2d-3d Activities – Pizza Delivery and Lappen's Coded Plans