Designing a Middle Grades Spatial Skills Curriculum in Minecraft

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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. However, research has also shown that targeted training can significantly improve students' spatial abilities. Thus, a portable and scalable technology-based spatial training system might 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 influence 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.

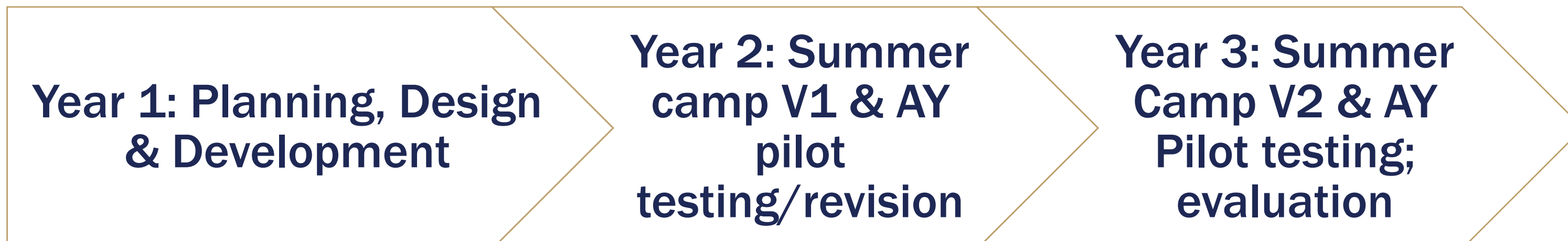

Figure 1. Minecraft Camp

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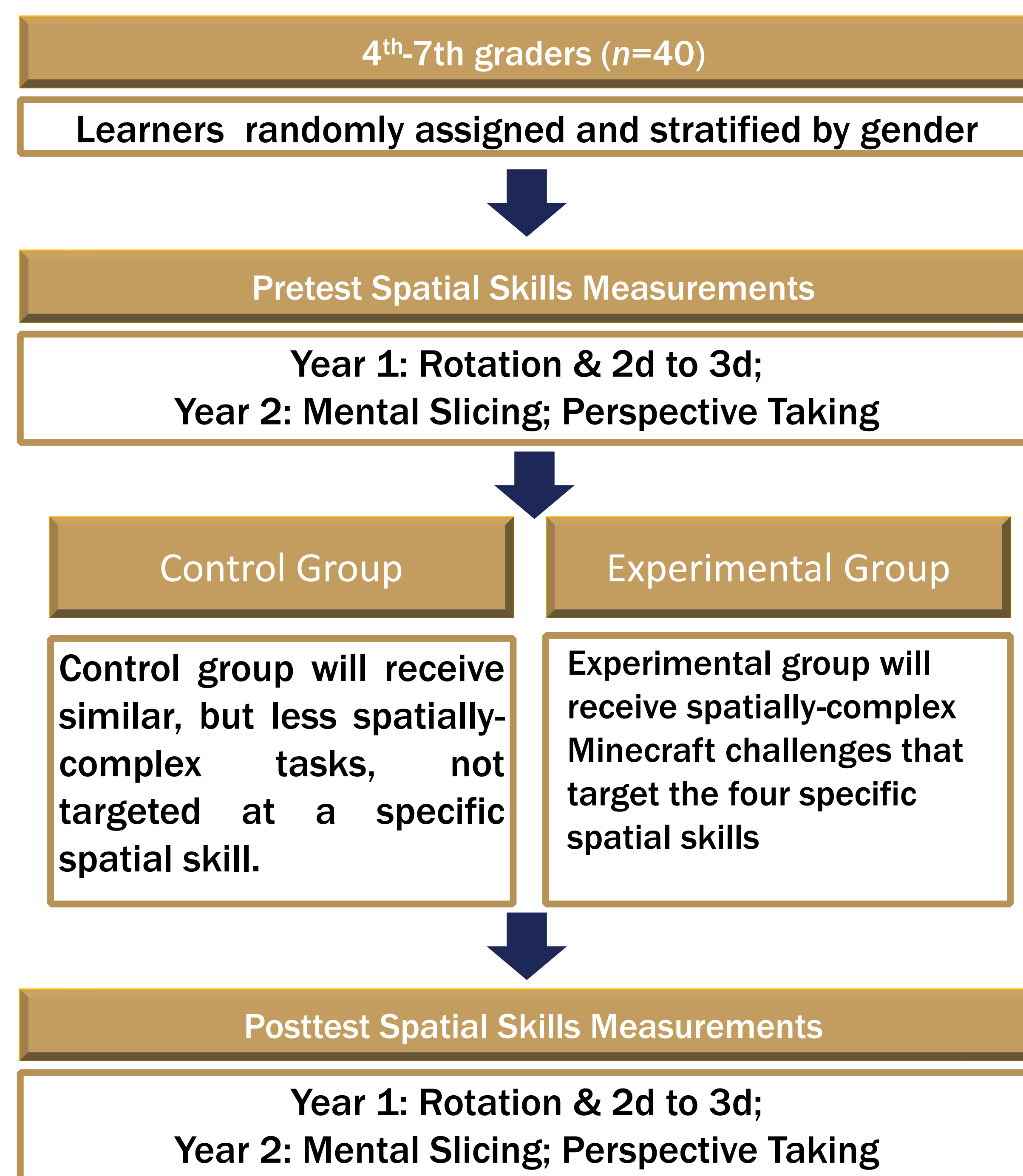
Research goals:
1) Determine if inclusion of Minecraft-based design challenges that target specific spatial skills differentially influences learners' spatial abilities compared to less targeted game play,
2) Determine which of the tested spatial skills are most positively influenced by the Minecraft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

Project Timeline

Year 1: Planning, Design & Development → Year 2: Summer camp V1 & AY pilot testing/revision → Year 3: Summer Camp V2 & AY Pilot testing; evaluation

Research Design

4th-7th graders (*n*=40)

Learners randomly assigned and stratified by gender

Pretest Spatial Skills Measurements

Year 1: Rotation & 2d to 3d;
Year 2: Mental Slicing; Perspective Taking

Control Group	Experimental Group
Control group will receive similar, but less spatially-complex tasks, not targeted at a specific spatial skill.	Experimental group will receive spatially-complex Minecraft challenges that target the four specific spatial skills

Posttest Spatial Skills Measurements

Year 1: Rotation & 2d to 3d;
Year 2: Mental Slicing; Perspective Taking
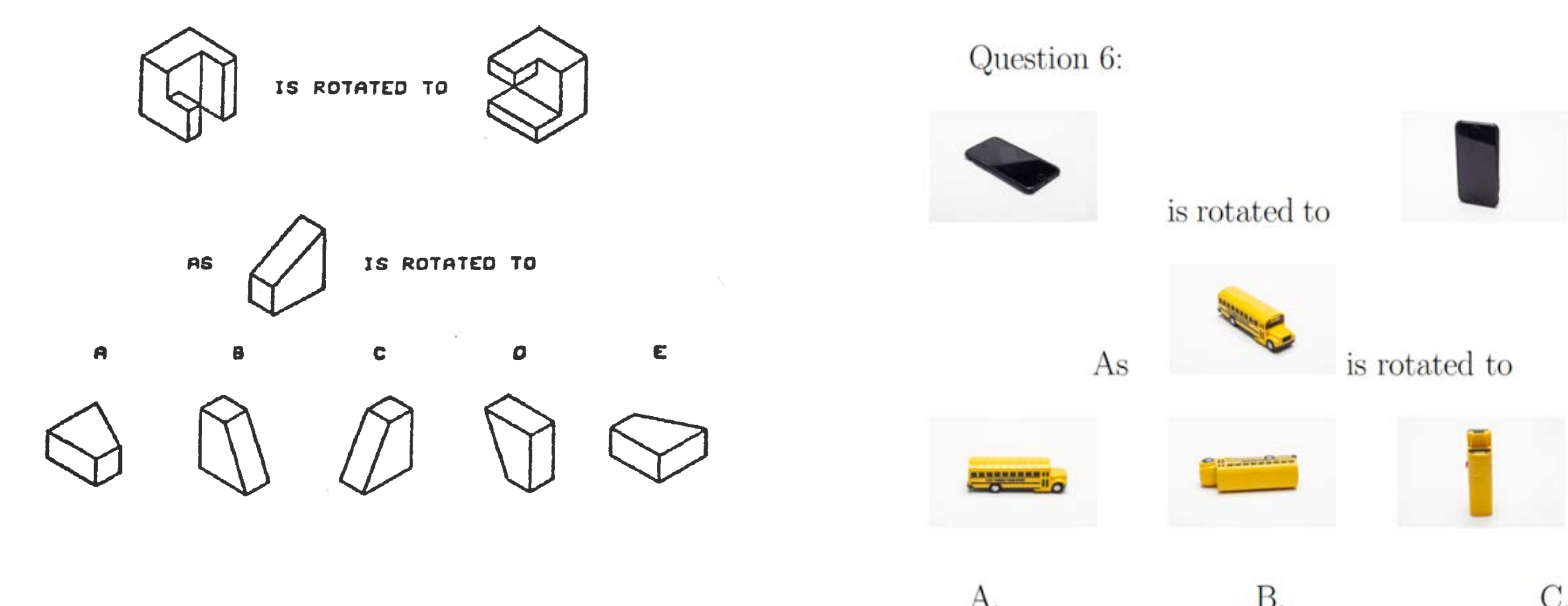
Spatial Skills Measurements – Year 2

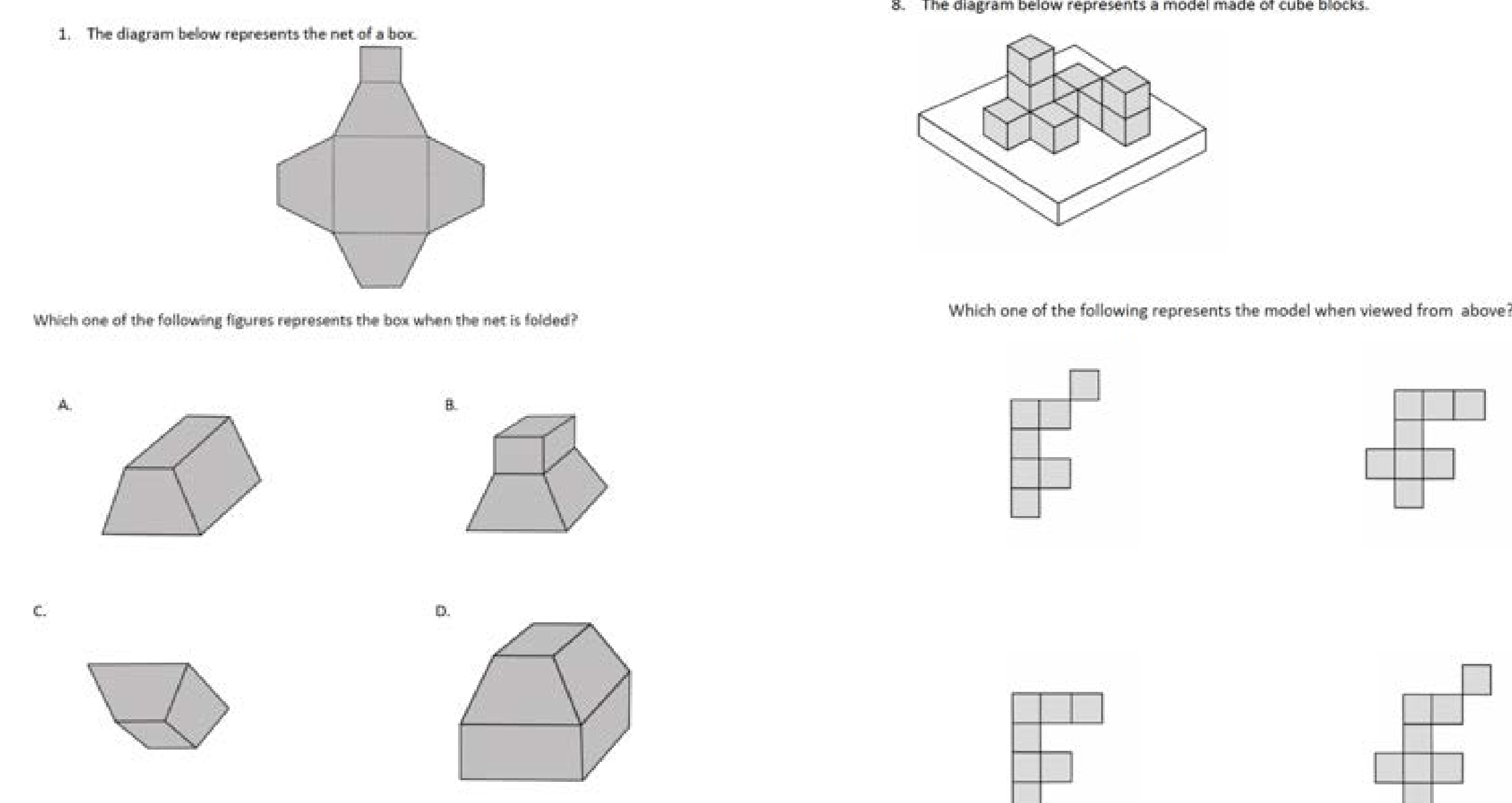Figure 2. Rotation: Adapted Purdue Spatial Visualization Test

Figure 3. 2d-3d Transformation: Adapted Spatial Reasoning Instrument
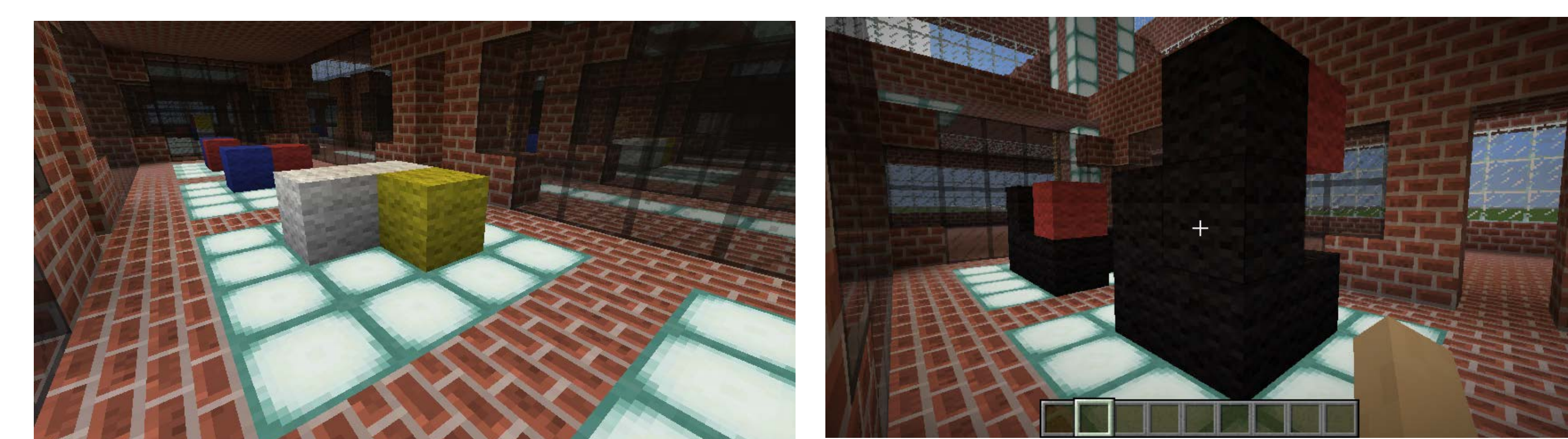
Spatial Skills Activities – Year 2

Figure 4. Rotation Activities – Spatial Skill Analogy Activities (PSVT)

Figure 5. 2d-3d Activities – Pizza Delivery Game