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Increasing the Spatial Intelligence of 7th Graders using the Minecraft Gaming Platform

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Increasing the Spatial Intelligence of 7th Graders using the Minecraft Gaming Platform (Work in Progress)

Introduction

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[1, 2]. 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[3], 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[1]. However, research has also shown that targeted training can significantly improve student spatial ability[4-7]. In some cases, even relatively brief interventions, some as short as three hours, have been shown to result in positive growth in spatial skills[8]. 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 for all learners.

Research Design

The research goals during this study are to determine: 1) if inclusion of Minecraft-based design challenges that target specific spatial skills differentially influences learners' spatial abilities compared to less targeted game play, 2) which of the tested spatial skills are most positively influenced by the Minecraft activities, and 3) how learning varies by gender. Findings from data collected during a series of summer camps, will ultimately be used to design a functional prototype that most effectively grows spatial skills.

Experimental Design and Procedure

Learners will be randomly assigned to either the control or treatment group, divided by gender, whose summer camp experience will differ only in the actual Minecraft challenges they are given. The treatment group Minecraft challenges will target the four specific spatial skills. The control group will receive similar, but less spatially-complex tasks, not targeted at a specific spatial skill. For example, the treatment group might be tasked with building a sliced section of a bridge over a gorge. Conversely, the control group might be tasked with building just the bridge over the gap. An example of these design challenges, describing the Minecraft activity and accompanying spatial skills measurement, including NGSS alignment, has been provided below in Table 1.

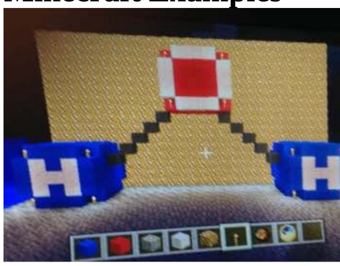
Table 1. Examples of Challenges, Spatial Skills Instrument Items

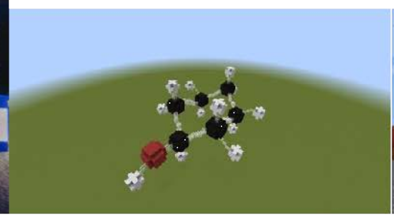
Example Module 1: Molecule Art Park
Spatial Skill: Rotation *Description:* Your challenge is to build a molecule art park. People will come visit your park to learn about the structure of various molecules. They will stand on a viewing platform, and will be able to see a molecule from multiple angles while they stand stationary. Begin by building three versions of a water molecule. Build three different versions of this molecule, so that people who view it can see how the molecule will look from the top down, from the side, and from the front. Make sure you label each version so your visitors know which vantage point they are seeing!

Example NGSS Alignment

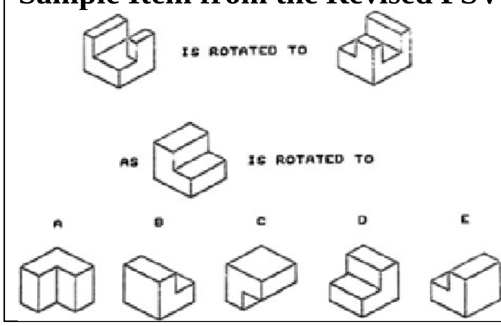
DCI: Develop models to describe the atomic composition of simple molecules and extended structures. SP: Develop a model to describe unobservable mechanisms. CC: Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Minecraft Examples





Sample Item from the Revised PSVT:R (Maeda & Yoon, 2013)



Preliminary Findings

Data collection is currently underway and findings will be shared in the full proceedings.

Preliminary Conclusions & Implications

Once data have been collected and analyzed, interpretation, conclusions, limitations, and implications for research and practice will be shared in the full proceedings. Our work will contribute to the body of knowledge of using gaming systems to teach skills critical to achievement in STEM. Specifically, our proposal is one of the first to empirically measure how intentional spatial reasoning training using the Minecraft 3D building system improves spatial intelligence in middle grade learners. Moreover, our work will contribute to the body of knowledge of gender differences in spatial skills, and will measure if differences exist between genders in spatial skills growth. Therefore, this project aligns well with calls to study the design of STEM learning experiences and whether those experiences improve valued outcomes.

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