Spatial STEM+C: Evaluation of a Model Spatial Thinking Curriculum

**Targeted Spatial Thinking Abilities**
- Mapping and Wayfinding
- Object Rotation
- Coordinate Systems/Perspective Taking

**Targeted Computational Thinking Skills**
- Algorithm Design
- Debugging
- Deductive, Inductive, and Analogical Reasoning
- Persistence

**Mathematics Assessments**

**Comparison-Group Design**
Two treatment classrooms in each K-5 grade at Inland Leaders Charter School in Yucaipa, California, implemented spatial thinking activities for approximately 30 minutes each day during a school year; two control classrooms in each grade did not do the designated activities. The spatial activities included creating designs with manipulatives, mapping classrooms and schoolyards, using a map to find treasures, and providing directions with coordinate systems. At the beginning and end of the school year, all students completed spatial and mathematics assessments. A spatial-computational thinking assessment was also piloted with K-2 students.

**Analysis**
With each spatial skill as an outcome, several mixed models were conducted, and Type III sums of squares were calculated to find omnibus effects. Fixed effects included time, group (treatment vs. control), grade (centered at the middle grade if applicable), gender, and a time by group interaction as fixed factors. A random classroom effect was also included.

The project evaluators also acquired qualitative data through focus groups with the teachers. Information sought from teachers included feedback on spatial thinking activities, spatial thinking assessments, and computational thinking assessments, and the teachers’ perceived outcomes for spatial, computational, and mathematics abilities.

**Results**
Qualitative feedback from teachers indicated that the spatial activities increased students’ interest and engagement with spatial thinking, as well as the children’s confidence and persistence in solving problems. Quantitative analysis revealed that, on five of ten measures of spatial thinking, the treatment classrooms showed significantly better spatial skills than control classrooms across time. However, both treatment and control classrooms improved significantly during the study period. Significant improvement in computational thinking skills was noted in both treatment and control classrooms. Path analysis models revealed correlations among various dimensions of spatial thinking ability and math performance. A bidirectional relationship between computational thinking and math performance was noted. The results indicate a need for spatial and computational assessments that better measure near transfer of skills acquired in the classroom.

**People and Partners**

**Directors**
Steven Moore, Ph.D., Director, Center for Spatial Studies
Gary Scott, Ed.D., School of Education

**Advisors**
Puni Chakrapani, University of Redlands
Cheryl Cohen, Veteran’s Administration Information Resource Center
David Uttl, Northwestern University

**Partners**
Center for Educational Justice, University of Redlands
Esri, Redlands, California
School of Education, University of Redlands

**Evaluator**
Center for Evaluation and Educational Effectiveness (CEE) at California State University, Long Beach

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