

Engaging Students in Spatial Thinking through Design Education: Case Study of a Biomimicry Design Project in the Primary Classroom

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Abstract : Spatial thinking, a way of thinking based on the understanding and reasoning of spatial concepts and representations, is embedded in science, technology, engineering, arts, and mathematics (STEAM) learning. Aside from many studies that successfully used targeted training to improve students' spatial thinking skills, few have closely examined how spatial thinking can be trained in classroom settings. Design and technology education, which receives increasing attention towards its integration into formal curriculums, inherently encompasses a wide range of spatial activities, such as constructing mental representations of design ideas, mentally transforming objects and materials to form designs, visually communicating design plans through annotated drawings, and creating 2D and 3D design artifacts. Among different design topics, biomimicry offers a unique avenue for students to recognize and analyze the shapes and structures in nature. By mapping the forms of plants and animals onto functions, students gain inspiration to solve human design challenges. This study is one of the first to highlight opportunities for training spatial thinking in a biomimicry design project for primary school students. Embracing methodological principles of educational design-based research, this case study is conducted along with iterations in the design of the intervention and collaboration with teachers. Data are harvested from small groups of 10- to 12-year-olds at an international school in the Netherlands. Classroom videos, semi-structured interviews with students, design drawings and artifacts, formative assessment, and the pre- and post-intervention spatial test triangulate evidence for students' spatial thinking. In addition to contributing to a theory of integrating spatial thinking in the primary curriculum, mechanisms underlying such improvement in spatial thinking are explored and discussed.

Keywords : biomimicry, design and technology education, primary education, spatial thinking

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