

Cultivating Design Thinking in K-12 through an Origami STEAM Project

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Abstract

This paper focuses on an Origami STEAM project developed and piloted within K-12 education. Origami serves as a conduit in this project to encourage design thinking prevalent in STEAM education practices (Hare, 2015; Maslyk, 2016; Sousa & Pilecki, 2013). The project is aligned to several national standards to support K-12 curricula. The 4 C's of 21st century standards (National Education Association, 2012) including creativity, collaboration, communication and critical thinking are combined with the Next Generation Science Standards (NGSS Lead States, 2013) commitment to integrating engineering design to offer project-based, standards-aligned exploration for learners.

The basis of the project was inspired by Jeanine Mosley's Menger Sponge exhibit featuring interlocking Origami cubes made from business cards ("The Institute for Figuring", 2006). The business card cubes are linked together to build a large-scale version of a stage of the Menger Sponge fractal. In a way, the business card cubes function like Lego pieces. Individual cubes can be connected together to form other, larger designs. The units of the modular model was simple making it appropriate for novice folders. At the same time, the cube is challenging when it comes to combining the six individual business card units to form the cube. Exploration for variations for the business card cube model online revealed other 3-D designs from the cubes such as a life-size pyramid, chair and table (Kosmulski, 2004). This flexibility and adaptability of the card cube design is what lead to the Origami STEAM project featured in this paper.

The Origami STEAM project, piloted with middle school female participants of a STEM program, presented the design challenge utilizing the business card cube. Student participants were tasked with designing a 3-D object made of business card cubes that stood at least 4 inches high that could hold the average middle school's body weight (approximately 80 pounds) without crushing. The process entailed working in teams to develop, build and test Origami cube designs. Students were asked to complete a series of steps in the process including a mock up drawing, calculations for the number of business cards needed, and a plan to build the 3-D model. Figures 1 and 2 illustrate one of the student designs and the impressive amount of weight it supported.

This paper highlights the full details of the Origami STEAM project including planning, implementation, and results from the pilot program. Overall, participants were motivated by the simplicity yet flexibility of the business card cube model. The basic unit design lent itself

well to purposeful play offering an appropriate amount of challenge without frustrating builders. Though not all designs were successful students left feeling motivated and inspired to explore other cube designs on their own.

This paper provides evidence to support the use of Origami in K-12 education as a way to capture the STEAM element necessary in developing 21st century thinking and innovation. The project featured illustrates the way in which Origami can fit in and enhance existing school curricular adding the art and design element often missed within traditional school curriculum structure. Though evidence of researchers work linking Origami and STEAM education has begun to surface, further exploration and development in K-12 is needed to confirm and raise awareness of this method.



Figure 1: Sample Origami STEAM design



Figure 2: Weight test with sample (60 lb)

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