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STEAM Workshops for Collaborative Problem Solving Based on Connecting Hands-on 4dframe Activities with the Implementation of Geogebra

A construction system and educational building set, the 4Dframe was developed by Ho-Gul Park, a Korean engineer and model maker originally inspired by classical, Korean architecture. 4Dframe's concept is based upon the structural analysis and geometric formalization of building techniques utilized in the construction of Korea's traditional, wooden buildings. The set itself consists of just a small number of elegantly structured, simple module pieces. The wealth of structural variability offered by this versatile device renders it an excellent educational tool for conceptualizing, modelling, or analyzing topics relevant to science, technology, engineering (including robotics), arts (including architecture, or design), and mathematics. Due to its numerous advantages, the 4Dframe is perfectly adaptable to a wide variety of educational uses (Park, 2006) related to phenomenon-based learning and to the STEAM (Science, Technology, Engineering, Art & Mathematics) approach (Ge et al., 2015)

The central aim underlying 4Dframe educational methodology (Manninen, 2010) is to activate students' familiarity with geometric structures, within the context of problem-solving. This approach is based upon the creative exploration of these structures, attained through the step-by-step, scientific analysis of each stage in the construction process. The 4Dframe set is an effective tool that can be used to demonstrate and actively analyze any variety of geometric structures, problems, from planar tessellations to complex spatial structures.

The 4Dframe set was made in polypropylene, a material not only flexible enough for the construction of "unbreakable" modules, but also appropriate for inexpensive mass-production. The tubes included in the basic set are 2-30 centimetres in length; but to fulfill individual requirements, a pair of scissors is all that is needed to adjust their size. At the same time, a slit can be made into tube's opening in order to adjust the tube's diameter, thereby making it possible to use each tube as a connecting piece. While the set contains various types of connectors, these can also be easily adjusted, opening the door to an infinite number of creative solutions. The 4Dframe system's high degree of variability makes it the perfect medium for the modelling of any type of geometric construction or structure. (Park, 2015).

In this paper, we will introduce several examples for collaborative problem solving STEAM workshops connecting hands-on 4dframe activities with the implementation of Geogebra software.