Hands-on Math Activities that Engage Girls in Math, Science and Art

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Synopsis:

Since 2007 the presenter has led outreach programs and participated in other outreach activities that engage undergraduate math/math-ed majors and high school students. In this presentation various hands-on math engagement activities used throughout these years will be presented. Those hands-on activities show that math is fun, interesting, and exciting, and demonstrate that math is behind various applications in origami and art. In addition, feedback from participating students will be shared.

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The presenter has founded and led two outreach engagement programs: USD Math Days for Women [4] (2007-2010) and Math Girls Rock! [8] (2011-present). These programs encourage female students (high school students and undergraduate students) to study math and science and motivate them to continue their education. In addition, the presenter has participated in various STEM related outreach conferences and meetings, by holding workshops for female students. In each of these outreach activities various hands-on projects have been used that will be displayed in this poster presentation.

Each of the projects includes topics that are not covered in everyday high-school curriculum (and most of the time they are also new to the undergraduate students involved). Furthermore, the projects are designed to spark student curiosity, to stimulate student inquiry, to get them to get "their hands dirty" with math, and to inspire them to want to learn more. In addition, the projects demonstrate that math is fun, interesting, and has many applications in other fields.

Some of the projects that will be discussed in this presentation include:
- [1] Graphs, Hamiltonian Circuit, 3 Edge-Coloring
    - o Hands-on project: making Origami 3-colored Buckyball
- [2, 6] Using GeoGebra software to explore and discover some of the most interesting and mind-blowing modern Geometry Theorems, such as: Nine-Point Circle Theorem, Pascal's Mystic Hexagram, Napoleon's Theorem, Feuerbach's Theorem, etc.
- [1, 7] The Two-Color Map Theorem, Origami and Two-colorability, The Four-Color Map Theorem, Coloring on other surfaces, graph coloring
    - o Hands-on project: coloring on other surfaces: sphere, Mobius band, and torus
- [3] Platonic and Archimedean Solids
    - o Hands-on project: making a truncated tetrahedron ornament
- [4] Origami Geometry
    - o Hands-on project: making various art designs using GeoGebra

In addition, feedback from the participants about these projects will be shared. Moreover, it will be discussed how these hands-on projects affected the students' perception of math, and which of these projects was most "likeable" and why.

Reference:

[1] Hull, T. 2013. *Project Origami: Activities for Exploring Mathematics.* Boca Raton: CRC Press.

[2] Hvidsen, M. 2005. *Geometry with Geometry Explorer*^{TM}, New York: McGraw-Hill.

[3] Sutton, D. 2005. *Platonic and Archimedean solids*. Wooden Brooks.

[4] V. Vasilevska, C. Wagner, *Winning High School Women's Heart and Minds*, Focus, Vol. 31, No. 3 (June/July 2011), 23–24.

[5] Vasilevska, V. *Math-Origami, GeoGebra, and Art*. (Submitted)

[6] Venema, G. 2013. *Exploring Advanced Euclidian Geometry with GeoGebra*. Mathematical Association of America, Inc.

[7] Wilson, R. 2002. *Four Colors Suffice: How the map problem was solved*, Princeton University Press.

[8] http://www.uvu.edu/math/mgr/