Geophysical Research Abstracts
Vol. 17, EGU2015-2500, 2015
EGU General Assembly 2015

WaterBotics: Pooling Students to STEM

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The STEM workforce of the future is sitting in today's K-12 classrooms, attending summer camps, and participating in after-school programs. How do we attract more youth—particularly those currently underrepresented in STEM fields such as girls and minorities—to explore the marvels of engineering and science? How do we entice them to become active participants – not merely witnesses - in the creation of solutions for our global neighborhood's greatest challenges, from environmental cleanup, to safe and efficient energy production, to improvements in healthcare?

The WaterBotics program is one vehicle that has demonstrated success in engaging young learners. This underwater robotics program is designed to provide hands-on experiences for middle and high school age youth to engineering design, information technology tools, and science concepts, and to increase awareness and interest in engineering and IT careers.
Middle and high school participants demonstrate increased enjoyment in studying science and engineering and interest in STEM careers as a result of WaterBotics. Such results can be seen from a statewide initiative that reached more than 2,600 middle and high school students in New Jersey in 2006-09 where student learning of science concepts and programming increased (McGrath et al, 2009, 2008). These findings provide the impetus to expand the WaterBotics program nationally.

The curriculum can be used either in traditional classroom settings or in after-school and summer-camp settings. This problem-based program requires teams of students to work together to design, build, test, and redesign underwater robots, or "bots" made of LEGO® and other components. Students use the NXT and LEGO Mindstorms® software to program their robots to maneuver in the water, thereby gaining valuable experience with computer programming, as well as 21st Century skills. Teams must complete a series of increasingly sophisticated challenges which culminates with a final challenge that integrates learning from the prior challenges. The nature of these challenges allows for easy adaptation to various real-world scenarios for students to engage in, such as developing a submarine for ocean floor study or designing a vehicle to explore and mine the ocean for mineral resources.

First-hand experience with WaterBotics curriculum has shown the increased engagement and excitement for STEM. Starting with a peanut butter and jelly sandwich leads to amazing discovery as students work through the engineering design process, sketching and building their LEGO robots and learning the steps to simple programs that allow their robotic creations to complete various tasks. With LEGOs being so easy to use, students can easily revise their design over and over again until it looks and works as it should. Once the students have the opportunity to test their design in the water for the first time, they are hooked. They can see that something they designed and built actually completes the task, even if it takes multiple tries, and they want to try the next challenge.