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Seeking Teachers for Underwater Robotics PD Program

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Seeking Teachers for Underwater Robotics PD Program

By Beth McGrath and Jason Sayres

A new hybrid training model for an underwater robotics project is being developed, and ITEEA members will contribute to its development.

Introduction

With funding from the National Science Foundation (NSF), ITEEA members will contribute to the development of a hybrid professional development program designed to facilitate the scale-up of an innovative underwater robotics curriculum.

WaterBotics™ is an underwater robotics curriculum that targets students in middle and high school classrooms as well as participants in informal learning environments such as summer camps and after-school programs. The curriculum provides hands-on experience with a variety of concepts in physical science, engineering, and information technology and gives students valuable exposure to other 21st century skills, such as problem-solving, teamwork, creativity, and innovation. External evaluation has demonstrated increased student learning of science and engineering concepts as well as increased interest in engineering careers by students who have participated in WaterBotics™.

Originally developed by Stevens Institute of Technology through an NSF Innovative Technology Experiences for Students and Teachers (ITEST) grant in 2006-10, the WaterBotics™ curriculum is being disseminated through four hub sites around the country (in Ohio, Texas, Illinois, and Kentucky) that are delivering face-to-face turnkey training institutes for formal and informal educators. In addition, through a partnership with ITEEA, a hybrid training program—which includes a full-day face-to-face workshop and several online modules—will be developed, pilot-tested, and disseminated. The hub site dissemination as well as the partnership with ITEEA is part of a five-year NSF ITEST Scale-Up grant.

Twenty ITEEA teachers will be selected through a competitive application process to participate in pilot-testing the hybrid professional development institute, implementing the curriculum, and providing feedback about the training and support. Pairs of teachers from a single school are preferred; each will receive a $500 stipend and reimbursement of the ITEEA annual conference registration fee, and the pair will receive a classroom kit of equipment valued at approximately $3,500.

The WaterBotics™ Approach

Designers of the WaterBotics™ curriculum have three key goals: to engage and interest diverse students in science and engineering; to increase student learning of key science and engineering knowledge and skills; and to increase student awareness and interest of engineering careers. The challenge-based curriculum design, the choice of materials, and the career-awareness activities were devised with these three goals in mind.

Curriculum

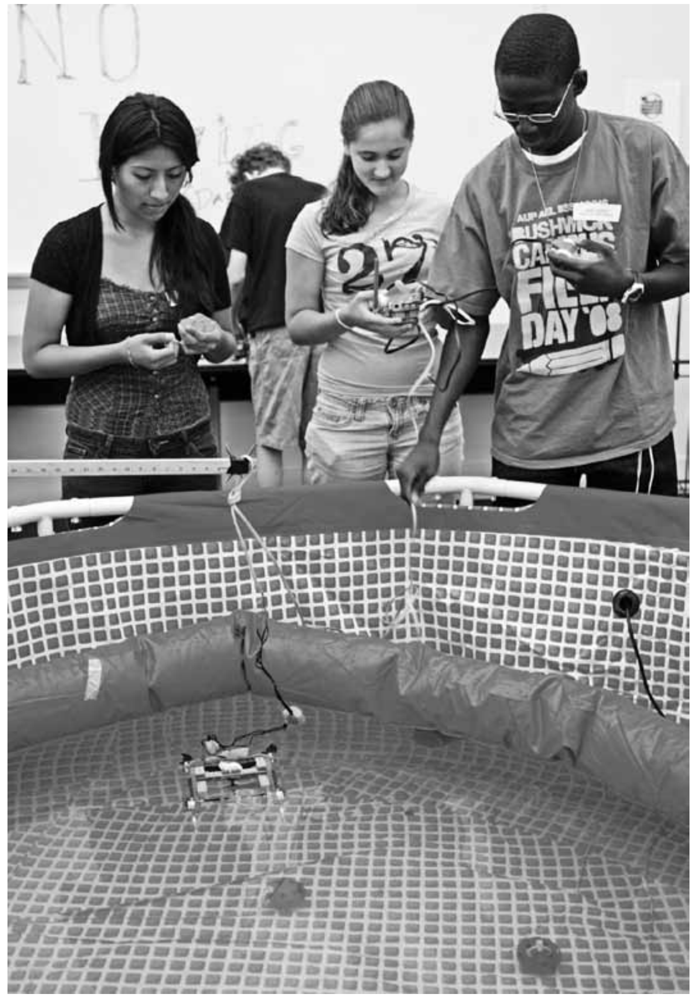
A 25-hour science and engineering curriculum has been developed and used by formal and informal educators across the country in Grades 7-12 technology education, science, and programming classes. Key concepts covered in the curriculum include physical science, engineering, and information technology concepts such as propulsion, buoyancy, stability, Newton's laws, inertia, torque, building durable structures, gearing, decision-branching, and looping, as well as 21st century skills such as problem-solving, teamwork, and innovation. The curriculum is based on an iterative design philosophy where students work in teams to complete a series of increasingly demanding challenges implemented in an 8-foot diameter pool or smaller testing area, resulting in a complex, fully-capable underwater robot:

1. **Straight-Line Challenge**: Use a single motor to build a robot that can float on the surface of the water and move back and forth in a straight line.
2. **Figure 8 Challenge**: With an additional motor, redesign the robot so that it can navigate around and through a pair of buoys.
3. **Vertical Challenge**: Given a third motor, enable the robot to navigate around and through the pair of buoys while under the water.
4. **Final Challenge**: With an optional fourth motor, combine the experiences from the previous challenges to create a robot that can dive under the water, pick up objects such as wiffle balls, and transport them to submerged bins of various sizes.

In teams of three to five, students work through these challenges, each of which culminates in either a competition or a showcase.

Materials

To closely simulate the engineering design process, particularly the aspects of rapid prototyping, redesign, and optimization, the LEGO® MINDSTORMS® system was selected as the robotics platform. A distinctive feature of this underwater robotics curriculum is the use of LEGO® materials, which provide ease of use, likelihood of familiarity by many



Students test their robot during a WaterBotics™ summer camp.

students, fewer consumables, and lower long-term costs. In addition, the MINDSTORMS® software delivers a simple and easy-to-learn programming environment.

A classroom kit containing all the materials necessary for implementation of the curriculum, including five MINDSTORMS® base sets, three supplementary parts kits, the MINDSTORMS® NXT-G programming software, motors with extra connecting cables, rechargeable batteries, propellers, and an 8-foot diameter pool, will be provided to all teacher pairs selected for this pilot. Many schools have most of the LEGO® materials available from other robotics programs and competitions, and a supplemental kit is available for those schools.

Professional development enables educators to develop confidence with underwater robots.

Engineering Career Awareness

To provide participants with an increased awareness of engineering careers, several resources have been integrated into the curriculum. These include descriptions of specific types of engineering careers that are related to the activities in WaterBotics™; frequent references to these careers throughout the curriculum; surveys and assessments to help students associate those careers to the work they are doing; videos highlighting related engineering careers and featuring interviews with both female and male engineers; and links on the project website to external resources, such as websites focused on women in engineering.

Professional Development Model

The current training and support program for formal and informal educators consists of five days of face-to-face professional development in which teams of teachers work in groups to meet each of the four challenges. In the process, they become familiar with the curriculum, the materials, the programming, and the assessments, as well as the ways they will implement the curriculum in their own classrooms or informal education environments. They also bolster their own knowledge and skills of concepts such as buoyancy and gears, as well as their programming mastery. To supplement the face-to-face training, the curriculum includes additional science and programming lessons; engineering design process resources; engineering career resources; complete guides for equipment acquisition and preparation; highly detailed lesson plans; embedded assessments and surveys; and online videos, screencasts, and simulations. The online materials are available for "just-in-time" learning for both teachers and students.

To make the curriculum more accessible to experienced technology education and engineering teachers and those who may have participated in other robotics curricula and/or competitions, the next phase of our program will focus on developing a hybrid teacher-professional-development program with the help of ITEEA and partner teachers.

Partnership to Develop a Hybrid Approach

The "hybrid" training model will be a combination of in-person, hands-on instruction and online modules designed to provide educators experienced with LEGO® robotics with the familiarity with the WaterBotics™ curriculum they will need to be successful in implementing it in the classroom. The goal is to maximize the flexibility of the professional development in order to increase the number of teachers who, though they may not be connected with a training site, will nevertheless be able to receive training and may then implement the project in their classrooms.

A full-day, face-to-face session will concentrate on those topics that are best addressed with hands-on activities and

Online tools and resources are a significant component of the hybrid training.

the guidance and supervision of a live instructor. Therefore, most of the day will be spent on the construction and testing of robots for the challenges, as well as lessons and activities covering the most important science concepts.

Following the full-day workshop, partners will participate in 8-12 hours of online, supported professional development. These online modules will consist primarily of programming content, with the goal of helping educators get accustomed to the NXT—the "brains" of the MINDSTORMS® system—and its sensors, as well as the NXT-G software environment and programming language. Additionally, these modules will advise educators in the planning of their implementations, covering topics such as equipment preparation, room and pool set up, connections to state and national curriculum standards, project customization, and timing and scheduling.

Each of the online modules will consist of two parts. In the first half, educators will be expected to spend about one to two hours working "asynchronously" with self-paced instructional materials in a variety of formats, such as written guides, images, videos, screencasts, simulations, and programs. In the second half of the module, a live web conference will be held, using software such as WebEx™ or Adobe® Connect™. This session will provide pilot educators with an opportunity to ask questions and discuss the content they had previously studied in the first half of the module.

The goal of the pilot is to understand the training and support needs for robotics-experienced educators to become familiar with the WaterBotics™ curriculum and effectively deliver it in their classrooms. Beyond the face-to-face workshop and online modules, online support in the form of one-to-one email correspondence, listservs, discussion boards, and additional follow-up web conferences will be provided. Pilot educators will be responsible for providing feedback on the professional development, ensuring completion of student assessments and recommendations for improvement.

Teacher Benefits and Commitments

Twenty teachers will be accepted into the 2012 WaterBotics™ hybrid training pilot program to assist in the development of a blended-model professional development program for technology education and engineering teachers in middle and secondary school. Before applying, teachers should be prepared to:

- Complete seven hours of professional development (face-to-face workshop to be held March 14, 2012 in Long Beach, CA and four online modules to be completed by June 2012).
- Implement the curriculum, taking a total of 20-25 hours, with at least 20 students during the 2012-13 school year.
- Complete all professional development evaluation surveys and student evaluations.
- Complete a post-implementation survey.

In return, each teacher will receive:

- A $500 completion stipend.
- Reimbursement of ITEEA registration for participation in the preconference WaterBotics™ workshop.
- Each pair of teachers will receive an equipment kit for implementation of the curriculum, valued at approximately $3500.

Next Steps

To learn more about WaterBotics™, as well as the teacher benefits and commitments, please visit www.waterbotics.org/iteea. Applications will be due by January 15, 2012, and teachers will be selected by February 15, 2012.

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