BUILD IT Underwater Robotics
Scale Up & Partnership Opportunities

National Girls Collaborative Project
Center for Innovation in Engineering and Science Education (CIESE) at
Stevens Institute of Technology
Oct. 14, 2008
Goals for Meeting

- Introduction of CIESE, Background, Capabilities
- Overview of BUILD IT Project (Current & Future Possibilities)
- Opportunities for Expansion/Scale-Up
- NGCP and Member Institutions Share Programming Models, Implementation Needs, Capabilities
- Identify Synergies and Next Steps
Who is CIESE?

- @Stevens Institute of Technology, Hoboken, NJ
- K-12 Focus on STEM disciplines
- Formal education settings
- Teacher professional development
- Curriculum development (use of cyber resources, real time data in K-12 science and mathematics)
- Educational research on student STEM learning
Who is CIESE?

• Large-scale, national, statewide programs
  – 8,000 teachers in 3 states w/3 community colleges
  – 250 faculty at 41 community colleges in 21 states
• Focus on K-12 engineering → 2,000 teachers in NJ, standards revisions, learning research
• Bridging research and education (e.g., SAGE, BUILD IT)
What is BUILD IT?

• 3 year ITEST program (*NSF ESI-0624709*)
• 36 diverse middle and high schools
• ROV Curriculum = LEGO robotics in underwater environment w/wire guided switches
• NXT Curriculum = adds controller design and programming
• Extension Activities = Autonomous Underwater Vehicles

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Why Underwater Robotics?

• Presents unique, complex design challenges (e.g., buoyancy, control in 3-D)
• LEGO enables rapid prototyping, testing, redesign
• Exposure to concepts like propulsion, drag, buoyancy and stability, gearing, torque, speed, and thrust
Why LEGO$s$?

- Familiarity
- Ease of use and durability
- Variety of pieces
- Rapid construction and redesign
  - “Tweak friendly”
- Fewer components required to create start-up kit
Project Challenge

• Using LEGO and related components, create an underwater ROV (remotely operated vehicle) that will be able to pick up weighted wiffle balls and deposit them in a bin.
Task 1 – Straight Line Challenge

• Use a single motor to build a vehicle that can travel the diameter of the pool on the surface as quickly as possible; optimize gearing to achieve best propeller speed.
Task 2 – Figure Eight Challenge

• Use a second motor to enable steering; maneuver on surface to complete a slalom course around two buoys in shortest time.
Task 3 – Submerge Challenge

• Use a third motor and other materials to control the vehicle's buoyancy in order to descend and rise vertically in water.
Task 4 – Grabber Challenge

• Design a motorized mechanical manipulator which can grasp specified objects; build an electrical control system which uses 4 switches to control 4 motors; each switch must have 3 positions (forward, backward, off).
Task 5 – Final Challenge

- Produce a vehicle that can retrieve the greatest number of objects from the bottom of the pool within a specified period of time.
- Objects must be deposited in bins at various depths in the water to score points.
## Key Concepts, Skills

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Girls in BUILD IT (observational)...

- LEGO provides low project entry threshold—engineering design less intimidating
- Girls less wedded to poor designs than boys; more willing to adopt/adapt designs and learn from others what works well
- Girls’ attention to detail in the design, programming
Research Questions

• Student learning of core concepts
• Knowledge about, attitudes toward engineering
• Impact of pedagogical strategies embedded in the curriculum, including hands-on learning and group work
• Gender differences in above
ITEST

- STEM learning and motivation as they lead to STEM workforce development, participation and improvement.
- Emphasizes design, implement, and synthesize components of DRL Cycle
- How motivation relates to preparation and participation.
- LOI ~ February; Full proposal ~ mid-April
ITEST

• Improving STEM workforce and building students’ capacity to participate in it
• Grades K-12, all areas of the STEM workforce, emphasis on technology-related areas
• Capturing and establishing reliable knowledge base about dispositions toward and knowledge about STEM workforce skills among U.S. students
ITEST Products

• Strategies that encourage K-12 students to be intellectually prepared for careers in information technology and STEM fields and to consider careers in those fields.

• Strategies that equip teachers (and providers) with resources to ensure students consider and are prepared for STEM workforce.

• Research tools and findings to build knowledge base about approaches, models, and interventions with K-12 aged children and teachers that are most likely to increase US capacity in the STEM workforce, including ICT fields.
Scale Up Projects

• Implement and test models about preparing students for information technology or the STEM workforce in a large-scale setting such as a state or national level based on evidence of demonstrated success.

• Especially interested in projects that target students who are underserved and underrepresented in STEM ICT-intensive careers, including those residing in rural and economically disadvantaged communities.
Scale Up Projects

• Evidence from previous projects or related theoretical and empirical evidence…
• Provide new evidence of the feasibility or impact of implementing the models on a broader scale
• Address question of whether models and programs that have proven effective locally can be extended to wider implementation
Scale Up Projects

- Enactment of interventions whose efficacy has already been established in new contexts (to produce) positive impacts in larger, more diverse populations
- May involve scaling up ideas (broaden original conceptual focus) or scope of implementation (obtain quantitative change in the number and types of people involved...), or both
- Provide systematic evidence that the proposed innovation would broaden (it) to new settings.
Info on NGCP Program Models

- Direct services to girls or turnkey trainer or ??
- Middle school or high school grades or both?
- Duration of programs: < 30 or > 30 hours?
- Equipment (see equipment list)
- Fee-based or grant funded or both?
- STEM background of leaders/instructors?
- Ability to do data collection? How?
- Key elements of successful programs?
- Important NGCP/partner research questions?
Next Steps

• Synthesize, summarize
• Gather additional information
• E-mail distribution list
• Work toward proposal development

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