

Report Mixed on Participation of Under-represented Groups in STEM Workforce

The Committee on Equal Opportunities in Science and Engineering (CEOSE) recently released a report that recognized the National Science Foundation's leadership role in increasing the participation of under-represented groups, such as women, minorities, and people with disabilities, in the STEM fields. However, this report, Broadening Participation in America's Science and Engineering Workforce, recommends that certain steps (i.e., additional research into barriers) should be taken to further promote participation among these groups.

http://www.nsf.gov/news/news_summ.jsp?cntn_id=104307&org=NSF&from=news

Summit Focuses on Improving STEM Literacy

A meeting in February 2005 convened leaders from education, business, and government to "explore strategies for integrating engineering and technology methods into America's classrooms," according to ORAU, a university consortium and co-sponsor of the event. In anticipation of a shortage of scientific workers, the Strategies for Engineering Education K-16 (SEEK-16) Summit was designed to challenge stakeholders to identify concrete steps that educators can take to promote literacy in the STEM fields.

<http://www.orau.org/partners/apr05/oraunews/seek16.htm>

Catalogs of Science/Technology Websites for Women and Girls

This annotated list of women-related websites in science/technology, and the linked inventory of websites for girls (not limited to science/technology topics), is a unique, rich online resource for research and exploration of women's participation, leadership, and achievements in the STEM fields. It was compiled by Professor Joan Korenman, founding director of UMBC's Center for Women & Information Technology, which is a partner in the ESTEEM ITEST project.

http://research.umbc.edu/~korenman/wmst/links_sci.html

The FunWorks... for Careers you Never Knew Existed

The FunWorks is a one-of-a-kind digital library of STEM career exploration resources developed for and by youth ages 11-15. Over 300 young people participated in every stage of the design and launch of the site, which was developed by the Gender, Diversities & Technology Institute at Education Development Center and funded by the National Science Foundation. The FunWorks provides highly interactive, 'real world' STEM experiences and uses children's current interests and passions (e.g., music, sports) to help them explore exciting, future STEM careers.

<http://www.thefunworks.org>



For more information on diversity/equity, IT career interest, recruitment and retention, etc., please see the ITEST LRC Resource Library.

<http://itestlrc.edc.org/SPT--About.php>

About ITEST

The Information Technology Experiences for Students and Teachers (ITEST) program was established by the National Science Foundation in direct response to the concern about shortages of IT workers in the United States. The ITEST program funds projects that provide opportunities for both school-age children and teachers to build the skills and knowledge needed to advance their study and to enable them to function and contribute in a technologically rich society. The ITEST National Learning Resource Center at EDC supports, synthesizes, and disseminates the program's learnings to a wide audience.

<http://www.edc.org/itestlrc>



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NEWSLETTER

ISSUE 1, Fall 2005

This newsletter is accessible online at <http://www.edc.org/itestlrc/newsletter/issue1.htm>.

In This Issue

- Feature Story: Robotics
- Spotlight: Technology at the Crossroads
- ITEST Projects' Success Stories
- Events
- TA/Collaboration Activities
- News & Resources from and for the Field

Dear Reader:

Welcome to the first newsletter in our series, designed to share the exciting work of teachers and students participating in ITEST (Information Technology Experiences for Students and Teachers) projects across the United States. ITEST is a program of the National Science Foundation. Participating educators and young people work hand in hand with scientists and engineers on extended research projects that carry them beyond the classroom, using technology to explore topics ranging from biotechnology to environmental resource management. In this issue, we spotlight the work of five ITEST projects, highlight upcoming presentations and publications, and link to valuable resources in the field. Please join us for our upcoming online panel on "Success Strategies for Engaging Girls and Women in STEM" on September 21, 2005 @ 2pm ET.

Sincerely Yours,

Siobhan Bredin

Project Director - NSF ITEST Learning Resource Center at EDC

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FEATURE STORY: ROBOTICS

Engaging Girls in Robotics using Assistive Technology Projects

How can you entice girls to spend a week of their summer making robots and building STEM skills? This is the question that the Robotics project staff asked themselves in the spring as they planned their summer activities.

Having done this work for five years, they knew that the Lego kits lend themselves to vehicles. "But," noted Angel dos Santos of the Robotics ITEST project, "when you make cars, you're losing kids, especially girls. And we wanted something that held universal appeal."

The Challenge of Recruiting and Retaining Girls in STEM/IT

Attracting girls and women to STEM and IT programs poses a challenge for many if not all ITEST and similar projects. Increasing the participation of girls and

women in the STEM and IT fields, and thereby expanding the talent pool of people pursuing STEM and IT careers, is a major priority for the ITEST Program. And, according to the targets that they set, the project teams often struggle to engage as many or more girls as boys in their activities.

Recently, an ITEST project team posted a message to the ITEST online community seeking help with recruiting enough girls to meet their target. Several projects responded with their ideas, experiences, and resources. The story of how one of these projects, **Robotics: Fundamentals of Information Technology and Engineering**, interpreted and addressed their own specific recruitment and retention issues follows.

The Robotics Project: The Making of an Inclusive, Rigorous Program

Based at Northeastern University and in partnership with TechBoston, a department of the Boston Public Schools, Robotics is a comprehensive project-for teach-

ers and students-led by **Randal August**, **Principal Investigator** and Assistant Professor in Computer Engineering Technology. The team includes **Angel dos Santos**, Program Director of TechBoston Middle School Initiatives; **Morgan Hynes** of the Center for Engineering Educational Outreach (CEEEO) at Tufts University; and **Emmanuel Mason**, Professor of Counseling and Applied Psychology at Northeastern University and the project's internal evaluator. They observed, says Angel, that "All across the state, schools are struggling to cover the technology/engineering content of the Massachusetts State Curriculum Frameworks because of lack of materials, professional development, and curriculum. The robotics program we had been running for five years was being implemented in a variety of ways. There was some very rich programming going on in some classrooms, yet in others it was the carrot for students (i.e., if you finish this other work, you get to 'play' robotics). About 25 percent of the MCAS (Massachusetts Comprehensive Assessment System) test is on science and engineering, to which the students may never have been exposed. So, we thought we could marry this robotics program to middle school technology/engineering frameworks."



Amber and Kearns demonstrate the Power Lifter 2005 - a robot designed to increase the "mobility of elderly people who need aid reaching things in high places."

They pitched this idea to NSF's ITEST Program, and the resulting award gave TechBoston and Northeastern University the support to do this work, which they wanted to do anyway: provide teacher training around integrating an innovative robotics curriculum into STEM courses in the Boston Public Schools and in other racially diverse and economically disadvantaged Massachusetts school districts. Their project targets ninety STEM teachers in grades seven and eight, each of whom receive summer professional development and followup support in leading year-long afterschool robotics programs.

Randal, a presenter for the Engaging Girls and Women in STEM webcast, emphasized that "improving teacher engineering and technical knowledge and awareness of gender and minority issues in STEM are our project goals... We have worked hard to come up with a balanced and consistent program of teacher education and child enrichment to foster STEM education. Our success in reaching the students is really driven by the success of the teacher training."

The Robotics project, Randal explained, consists of two parts: "1) The summer program—one week of intensive teacher training followed by one week of practicum when teachers work with students, and 2) the afterschool program—initiated by the teachers with our support. The teacher training and the practicum, which gives the participating teachers an opportunity to perfect their knowledge, allow them to refine their delivery of the material. The enthusiasm and engagement of these teachers during the first week of training (and practiced the second week) will drive the success in the second part of our project, the afterschool program."

The summer program, recently concluded, covered design, programming, and assessment—and stretched the teachers' command of engineering and technology. One of the teachers reflected, "It's been a long time (over ten years) since I have built a device. It was challenging. It was good working with sensors, ports, and all the other parts of getting the device to do what we had planned." Another teacher commented, "I loved this day! I can't wait 'till tomorrow!" then confessed, "however, there were moments-like when taking the 'pre-test'—it could/was embarrassing to not know answers to questions I know our kids should know answers to." For another teacher, "The assessment piece was thought-provoking."

Putting the teachers in students' shoes at the same time as they are asked to think about how they will implement the curriculum in their classroom is a dynamic common to all the comprehensive projects. Throughout this program, the Robotics team worked to effectively facilitate the learning experiences of the teachers—who, in turn, will facilitate student learning—supporting both their content knowledge and pedagogical skill development.

Presenters: Siobhan Bredin & Joyce Malyn-Smith, LRC; Mike Haney, National Science Foundation; Alisha Sparks & Mark Terranova, ESTEEM; Lucinda Sanders, IMMEX Fayette Consortium; Michele Masucci, BITS

International Women & ICT (Information and Communication Technology) Symposium

June 13-15, 2005 - Baltimore, MD

(Hosted by Center for Women & Technology at UMBC, Pls of the ESTEEM ITEST project)

Presenters: Siobhan Bredin & Sarita Nair, LRC

TA / COLLABORATION ACTIVITIES

Upcoming:

Success Strategies for Engaging Girls and Women in STEM [September 21, 2005, 2pm EST]

The purpose of the event will be to hear the latest in both research and practice on the topic and share what ITEST projects (especially those with a specific focus on working with girls and women) are doing to address some of the obstacles and stereotypes around the engagement and achievement of women in STEM, and IT specifically. The online audience will include ITEST projects, equity and STEM researchers, STEM industry professionals, educators of all levels, legislators, and the media. To join this webcast, please contact itestinfo@edc.org.

Marketing & Publicity [IdeaBrief, Volume 3, October 2005]

The purpose of this event is to help projects continue or start thinking about how to share their work with others. Project staff will have the opportunity to discuss marketing strategies and reflect on what works, and what doesn't work; what's unique about this project; who are the target audiences; what message needs to be communicated; and what are the goals to be achieved?

Recruiting and Retaining Diverse Participants [IdeaBrief, Volume 4, October 2005]

ITEST projects engage an amazing diversity of students and teachers across the country. There are projects working with Native American students in the rural Pacific Northwest and Alaska, others offering successful programming to urban African American students, Latino students, and their families, and still others recruiting students from low-income areas of the Midwest. What can projects learn from each other about recruiting and retaining diverse participants? The LRC will produce an IdeaBrief publication summarizing ITEST projects' strategies, including forging creative community partnerships, for reaching and serving their audiences.

For more information about the ITEST LRC TA/Collaboration materials, visit the Publications page of our website.

<http://www.edc.org/itestlrc/publications.htm>

Visit the ITEST LRC News & Events page for more information about conferences and ITEST-related activities.

<http://www.edc.org/itestlrc/ITESTNews&Events.htm>

Recent:

Accessibility: Creating Inclusive Learning Environments [IdeaBrief, Volume 2, August 2005]

"An inclusive program is one that welcomes and accommodates everybody... Access is a continuum. There is no such thing as an accessibility seal of approval that you get if you make a specified list of improvements to your facility and program. It's a way of thinking, an attitude—an approach to decision making that uses accessibility and inclusion as a filter."

http://www.edc.org/itestlrc/Materials/IdeaBriefv2_Accessibility.pdf

New Skills, New Experiences - The Future of Learning: Highlights of the ITEST 2005 Symposium

"You don't have to teach people intellectual curiosity—you have to keep it from being beaten out of them," Dr. Kaye Howe asserted. She posited that a reawakening needs to take place that would embrace the profound importance of personally motivated learners. For her, "the emphasis on informal learning is critical."

<http://www.edc.org/itestlrc/Materials/Symposium05.pdf>

Evaluation Peer Exchange

Again, for the second year, ITEST project staff and evaluators participated in a lively online exchange of evaluation instruments and resources. Leslie Goodyear, ITEST LRC core team member, facilitated this exchange and is currently developing a reference table that will document the various aspects of this work (i.e., changes in attitude toward IT) that ITEST projects are seeking to measure. For a growing collection of evaluation resources, visit the ITEST LRC Resource Library:

<http://itestlrc.edc.org/SPT--BrowseResources.php?ParentId=181>

From the archives:

Active Learning in the Information Age: Integrating IT Skill Development into STEM Curricula [Information Brief, Volume 1, July 2004]

"Educators develop curricula that facilitates the discovery of key academic principles in the students' environment and community so that learning is truly relevant and contextual. With STEM learning rooted in student inquiry, technology tools can be harnessed to further exploration, experimentation, and communication."

http://www.edc.org/itestlrc/Materials/ITEST_InfoBrief.pdf

From the ESITA team

The **Environmental Science Information Technology Activities (ESITA)** program provides inner-city students, grades 9-10, with extra-curricular, academically rigorous activities in environmental education. The activities are field-based experiences using sophisticated information technologies. This project is based in Oakland, Richmond, and Sacramento, California.

*P*reliminary analysis of evaluation data indicates that participating students' understandings of the role that IT plays in the generation of scientific knowledge, as well as the nature of science in general are positively impacted through participation in the program. For example, data generated through the use of pre-post-participation surveys indicates significant changes in students' responses to statements such as, "science will give me a better understanding about worldwide problems" and "science helps me to work with others to find answers."

http://www.edc.org/itestlrc/itestprojects/esita_ca.htm

EVENTS

ITEST Events

We look forward to welcoming the new Cohort 3 ITEST projects in October! As with the current projects, these range in location from Hawaii to the Bronx and in content area from understanding the acoustic behaviors of whales and dolphins to investigating how the physics of light and the technology of solid-state electronics meet in devices.

SAVE THE DATE: 3rd Annual ITEST Summit
February 7-9, 2006 in Washington, DC
 Details coming soon

Conferences

Upcoming:

Association of Science and Technology Centers (ASTC)
October 15-18, 2005 - Richmond, VA
 ITEST Session Sunday, October 16 2:15-3:30: Student-Focused Learning in STEM and IT: The ITEST Experience

From the USCT team

The ITEST project, **Understanding the Science Connected to Technology (USCT)**, targets information technology experiences in a comprehensive training program and professional support system for students and teachers in science, technology, engineering and mathematics. This project is based in Fargo, North Dakota.

*S*ome of our students are displaying data using box/whisker plotting (fairly specialized data graphing) as part of their River Watch data interpretation and reporting. Also, we just completed a two-day Arc 9 training for our school teams, and we have a couple teens (first time users) who surpass most adults with their new Arc View skills.

One ITEST school will be piloting this school year a dual credit option in environmental science centering around our river watch and NSF activities. The students will receive both high school credit and college credit thanks to the leadership of faculty consultant, Dr. Dan Svedarsky from the University of Minnesota-Crookston Campus.

http://www.edc.org/itestlrc/itestprojects/USCT_nd.htm

Session leader: Dan Calvert, Co-Principal Investigator/Program Coordinator, Oregon Museum of Science and Industry, Bend.
Presenters: Lucinda Sanders, IMMEX Fayette Consortium; Patricia Cogley, Youthlink; Alisha Sparks, ESTEEM; Bonnie Styles, MuseumTech; Siobhan Bredin, LRC

American Evaluation Association (AEA)
October 26-29, 2005 - Toronto, Ontario, Canada
Session Leader: Leslie Goodyear, LRC

Presenters: Gerald Knezek, DAMSALS²; Helen Cagampang, Marine Biotech; Shannan McNair, DAPCEP

Recent:

Alliance for Technology Access Institute 2005
July 28, 2005 - Seekonk, MA
Presenter: Tony Streit, LRC

ISTE National Educational Computing Conference (NECC)
ITEST Poster Sessions
June 29, 2005 - Philadelphia, PA

Spotlight on Strategies for Engaging Girls

"To have a real impression and have an effect, our research shows that engaging the emotions is critical for successful learning," says **Claudia Morrell of the ESTEEM ITEST project**. She is Principal Investigator of the Enhancing Science and Technology Education and Exploration Mentoring project, a partnership of the University of Maryland-Baltimore County's Center for Women and Information Technology, the Shriver Center, and the Chabot Space and Science Center. This youth-based project is implementing and testing Chabot's TechBridge curriculum in six middle schools, through an after-school program, weekend fieldtrips, and a four-week summer program.

Claudia, a presenter for the Engaging Girls and Women in STEM webcast, reflected on their strategies for engaging girls, and the research, collaborations, and experiences that they have drawn on:

"We borrowed a lot for the experiences from the Chabot Space and Science Center (Oakland, California) that developed the original curriculum. But we have added elements from our own Computer Mania Day as well, including keeping things moving (not too much time at one time on one project), providing for lots of learning styles, and having fun.

The hands-on curriculum, which is also diverse (not always computer-based) is very important. Girls (and boys) enjoy engaging quickly with the technology and exploring the software and hardware without fear of breaking it. They get a lot of encouragement, which is necessary to overcome the negative messages they may have experienced earlier. But we find that this encouragement is less necessary as the program progresses and they gain confidence.

The informal mentoring is also important between the girls and the female undergraduate and graduate students that support them. The girls see the students tackle the tough challenges fearlessly, break things and laugh, and cheer when they have success. The college students are there when needed but can also stand back and let the girls succeed and fail on their own. Both outcomes are seen as positive learning experiences and celebrated for the students' willingness to try."

http://www.edc.org/itestlrc/itestprojects/ESTEEM_md.htm

Creating a Learning Environment that Works for Teachers and Students

In this project, Angel elaborated, they provide the curriculum, "but we also give the teachers the pedagogy." This encompasses considerations including "How do you recruit and retain girls, if you're running this as an afterschool program? How do you get under-represented groups? How do you secure the involvement of administrators, parents, and the community?"

She continued, "Working in an afterschool environment is totally different from in-school. How do you build teamwork among students? How do you put together an afterschool program where you can build a rigorous program?" Moreover, "How do you do evaluation? Does the robot have to work for the student to be successful?"

Angel reported that they did a lot of work upfront to address these issues; for example, they developed an assessment of content learning. They also did a lot of research, finding that "girls and students of color are especially interested in collaborative projects that benefit others. Girls only like technology if it's a useful tool. They want to use PowerPoint, say, to do a really good Social Studies project. They are less interested in 'tinkering' with technology."

As part of their research, they reviewed the Massachusetts State Curriculum Frameworks for Science and Technology/Engineering. Angel emphasized that they wanted to address the standards "in as genuine a way as possible." Since the technology/engineering framework for middle school requires students to be able to identify examples of adaptive or assistive devices, they realized that making the projects themselves about building assistive technology would be the ideal way to both meet the standard and offer an inviting, inclusive learning opportunity: "We felt that an assistive device was something that would help them to be more empathetic, and that would be compelling too."

As it turned out, the students conducted plenty of their own research online about assistive technology and thought about their families in this context (i.e., a grandmother who had a hip replacement). They either improved on a device or invented their own. Angel reflected, "We felt like we nailed it—not just the girls

were excited, but everyone got into it." Ironically, she notes, "many of the wheelchair-based projects in their final form actually looked like cars!"

Collaborating Your Way to Good Ideas and Solutions

Building an inclusive program, it seems, rests substantially on building good relationships, and the Robotics team worked hard in collaboration with the teachers to reach the representation—approximately 40 percent of the 54 students were girls—that they achieved.

One of the project staff's recruitment strategies was to leverage the existing relationships between teachers and students. Teachers who signed up for the program were supposed to recruit their own students, with 50 percent of them being female. Angel observed, "The teachers that complied with this brought at least 50 percent girls to the practicum. Some teachers had an even higher percentage. The girls in these groups also tended to be more engaged by the program. Rather than just speaking in classrooms, I would ask teachers to personally recommend students. Then you can follow-up with students individually. This makes students feel really wanted and special."

Another recruitment strategy was to ask any and every parent, teacher, administrator, etc. that they spoke with to refer their daughters, nieces, neighbors, and friends' children. The most effective approach, Angel emphasized, is to "get on the phone." She advocates using your network to spread the word, especially since some folks may be connected with all-female organizations (i.e., afterschool program, camp, church group).

Retaining the students', especially girls', interest is the next critical piece after recruitment. To support the teachers on this front, the Robotics team brought in a curriculum developer, Morgan Hynes, from CEO at Tufts. He helped come up with the idea for assistive technology projects, joining Angel in research prior to the program design, and writing and piloting the curriculum in classrooms. Further, he led several sessions during the summer program to support the professional development around the new curriculum.

The Robotics team also worked closely with Rachelle Reisberg, Director of the Women in Engineering Program at Northeastern.

She was "invaluable," Angel said—"connecting us with people in her field." In addition, she led a workshop on the Engineering Design Process with the teachers. Angel reflected, "Typically, as educators we often design programs or activities oriented to boys... Rachelle led an activity designed for girls—writing up directions about how to make a bead necklace—which was compelling, and eye-opening for all of us."



Zarina and Dianna demonstrate their robot designed to assist "people who are in wheelchairs that can't grip or hold things."

One of the teacher participants commented, "Rachelle's presentation was super... I'm wondering about using her mini-lesson in our programs. Can we integrate them into the current lessons?"

This collaboration with Rachelle even extended to sharing program time. While the Robotics team debriefed with the teachers following the joint teacher and student morning sessions, her group facilitated an afternoon program for the students. Angel found the activities to be a "great fit in terms of content and pedagogy."

This total package of program design, content, and community served to engage girls, boys, and their teachers this summer on the Northeastern campus. And, at least for one of the girls, her experience creating an assistive technology device was tantalizing enough to get her thinking about doing more robotics. At the end of the program, Deborah, a 7th grader, asked "Can I come back next year?" This is the kind of response that may portend the changing face of engineering, math, science, and technology.

http://www.edc.org/itestlrc/itestprojects/Robotics_ma.htm

Related Resources

Upcoming event: Engaging Girls and Women in STEM [Webcast & conference call, Wed., Sept. 21 at 2pm EST]
<http://www.edc.org/itestlrc/webcastSep21st.htm>

ITEST LRC Publications on Equity/Diversity and Participant Recruitment/Retention
<http://www.edc.org/itestlrc/publications.htm>

Equity/Diversity resources, ITEST LRC Resource Library
<http://itestlrc.edc.org/SPT--BrowseResources.php?ParentId=193>

Recruitment/Retention resources, ITEST LRC Resource Library
<http://itestlrc.edc.org/SPT--BrowseResources.php?ParentId=191>

SPOTLIGHT: TECHNOLOGY AT THE CROSSROADS

LRC staff had the opportunity to visit the Technology at the Crossroads ITEST project—hosted at Simmons College in Boston—this summer. A partnership between the Girls Get Connected Collaborative and Simmons, the three-week summer camp was for middle school students from the Boston Public Schools. These students worked in small groups with science teachers to conduct environmental research for use by the City of Boston Parks Department, which is working with the Urban Ecology Institute to count the number of street trees in Boston.



Students in the Technology at the Crossroads program participated in the Greater Boston Urban Forest Inventory in collaboration with the Urban Ecology Institute.

Students accessed, measured and recorded various descriptors about each tree using ArcGIS in Boston's Fenway area, which will be compiled into a central database, to aid in the maintenance of Boston's Urban Forest.

"At the beginning of the week, the students told us that they thought all trees were the same and by the end of

the three-week camp, the students could identify 25 tree species," commented **Dr. Deborah Muscella, Principal Investigator** of the project. They utilized a variety of technologies in their investigations, including Geographic Information Systems (GIS), Geographic Positioning Systems (GPS) and HTML programming. "We were amazed at how quickly the students caught onto using the various technologies," **Dr. Richard Gumey, Co-PI** for the project and an Assistant Chemistry Professor at Simmons, told us. Each team was led by a science teacher from one of the schools, who will continue to work with the students throughout the school year.

When LRC staff visited on just the third day of the summer program, it was clear that the young people were already learning and applying so much—about trees, about online and library research, about using GPS technology to report findings on trees that will actually be used by the City of Boston Parks Department, and about working collaboratively as a member of a team. We observed students posing questions, making observations, collecting, and analyzing and interpreting data. We saw each team planning their work in the lab, then going out into the Fens park nextdoor to the college filled with enthusiasm about applying and expanding their new knowledge.

http://www.edc.org/itestlrc/itestprojects/Crossroad_ma.htm