Education Overview

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Education Thrust Leader

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K-12 Outreach Coordinator

NSF Year Nine Site Visit
April 22 - 23, 2009
Gordon-CenSSIS Education Team

- S McKnight, NU
  - Education Thrust Leader

- K Hicks, NU
  - Partnership and Education Services Coordinator

- M Ruane, BU
  - Education Thrust Co-Leader

- R Rodriguez-Solis and S Cruz-Pol, UPRM
  - Education Thrust Co-leaders

- B Yazici, RPI
  - Education Thrust Co-leader

- C Duggan, NU
  - K-12 Outreach Coordinator

- Paula Leventman
  - Gordon-CenSSIS Evaluator and Diversity Coordinator
Curricular Innovations: CenSSIS Education Works at All Levels

- Engineering Profession
  - Continuing Ed.
    - Grad. SSI Topics
    - “Distributed University”
    - Upper-class Intro to SSI, Undergrad Research
    - Fresh Hi-Tech Tools&Toys, CenSSIS Scholars

- K-12 Outreach
- MGH
- MSKCC
- INL
- BU
- RPI
- LLNL
- WHOI
- UPRM
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WHOI

LLNL
CenSSIS Mentors New Professors, New Courses, New Research

- **Purnima Ratilal, NU**
  - ONR Young Investigator, 2007
  - ASA Lindsay Award, 2006
  - Special Topics: “Acoustics and Sensing”

- **Richard Radke, RPI**
  - NSF CAREER Award, 2003
  - ECSE 4969/6969: “Computer Vision and Graphics for Digital Arts”
  - ECSE 4540: “Introduction to Image Processing”

- **Edwin Marengo, NU**
  - NSF CAREER Award, 2008
  - Special Topics: “Inverse Scattering”
  - Special Topics: “Physical Signal Processing and Imaging”
“Distributed University” Creates Expanded Opportunities for Students

- Provosts’ agreement (2001): students can take courses at any partner university based on tuition at home university

- 76 cross-university course registrations since program inception
  - Boston-area CenSSIS courses (including Gordon Fellows courses)
  - ECSE-6963: Cell and Tissue Image Analysis (Roysam) Voice-annotated PowerPoint with “E-Office hour” F’02, F’03, F’04, F’06, F’08
Gordon Program: A New Program to Create Technology Change Agents

- MS degree or Graduate Certificate in Engineering Leadership – 1 Year Program
- Challenge Project
- Leadership Course and Scientific Foundations Course
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Fresh Hi-Tech Tools&Toys CenSSIS Scholars

K-12 Outreach

NU RPI MGH LLNL MSKCC WHOI INL UPRM BU
High-Tech Tools and Toys Lab: An SSI Discovery Lab for Freshmen Year

- In place at all four universities
- Tool for K-12 and CC outreach
- New ALERT-themed modules
- CCLI Proposal for dissemination submitted in Jan ‘09
Subsurface Shape in Opaque Gelatin
Subsurface Object Imaged
Gordon-CenSSIS NU RA/TA Heidy Sierra Gil from UPRM working in the NU HTT&TL
HTT&TL Color-Sorting Project Connects C++ Programming with Engineering
Student Reaction to HTT&TL Has Been Consistently Enthusiastic

- **2002: GE1102 2QH “Introduction to Computing”**
  - “I loved the hand-on part of the course because it’s very rewarding to see your programs doing something ‘real’.”
  - “Best course experience I’ve had so far …”
  - “Would you recommend a friend to take this course in the HTT&TL?”: 100% = Yes.

- **2008: GEU111 4QH “Computation & Problem Solving”**
  - Prof. Stephen McKnight recipient of COE “Outstanding Teacher of First-Year Engineering Students Award”
### Comparative HTT&TL Survey Shows Advantage Over “Chalk-and-Talk”

<table>
<thead>
<tr>
<th>Questions Posed</th>
<th>HTT&amp;TL Sections*</th>
<th>Non-HTT&amp;TL Sections*</th>
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<tbody>
<tr>
<td>Overall, how much do you feel you learned?</td>
<td>3.1</td>
<td>2.4</td>
</tr>
<tr>
<td>How effective do you feel course was in teaching you problem-solving techniques?</td>
<td>3.4</td>
<td>2.6</td>
</tr>
<tr>
<td>How effective do you feel course was in teaching you about computer usage and programming?</td>
<td>3.3</td>
<td>2.6</td>
</tr>
<tr>
<td>How effective do you feel that course was in teaching you about engineering?</td>
<td>3.6</td>
<td>2.4</td>
</tr>
<tr>
<td>How useful did you find the [HTT&amp;TL] as a preparation for the [programming] course you are taking now?</td>
<td>2.7</td>
<td>2.2</td>
</tr>
<tr>
<td>How enjoyable did you find course?</td>
<td>4.6</td>
<td>2.6</td>
</tr>
</tbody>
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*5=High, 1=Low
HTT&TL Initiatives: A Plan for Dissemination

- Course, Curriculum, and Laboratory Improvements (CCLI) Proposal, (NU/BU Joint Proposal, Jan ’09)
  - HTT&TL for beginning programming courses
  - New portable, less-expensive labs
  - New pedagogy
  - New partners
    - Freshman instructors at NU, BU
    - Middlesex and Northern Essex CC’s

- NU Freshman “Gateway” instructors develop classroom HTT&TL projects
“Introduction to Subsurface Sensing and Imaging Courses”

Upper-class technical elective offered at NU since 2002, BU and RPI since 2003, UPRM since 2008

- **NU: ECE1467 “Intro to SSI”**
  - Team-taught: D. Brooks, C. DiMarzio in first three years
    - D. Brooks, E. Miller in 2006 and E. Marengo in 2008

- **BU: SC500 “Intro to SSI”**
  - Prof. Bahaa Saleh
  - Cross-listed graduate/undergraduate course

- **RPI: ECSE4963 “Intro to SSI,”**
  - Team-taught: Prof. Roysam and Prof. Thomenius, Chief Technologist for Bioimaging at GE Global Research Center

- **UPRM: Shawn Hunt, F’08: “Intro to SSI”**

A New Textbook: A Major Goal For Year 9
Undergraduate Research Paths

- CenSSIS supported research
- Volunteers / CenSSIS Scholars
- Capstone / Honors Adjuncts
- REU / LSAMP / AAMU
Gordon-CenSSIS Scholars Program Identifies and Mentors Promising Young Engineers

- Incoming freshmen receive $1000 book vouchers
- 217 participants since 2002
- Continuing Scholars as mentors
- Broadly representative
  - 50% women, 30% minority
- Active in HTT&T Lab, seminars, field trips, research, K-12 outreach, REU Program
Gordon-CenSSIS Scholar and SLC President, Sarah Brown has been involved with Gordon-CenSSIS since her freshman year.
Rick Moore, MGH / Gordon Program Collaborator, meeting with an NU Capstone Group in February of 2009
Undergraduate Research Programs Motivate Graduate Study
Networking with other students, ERC management, and Industry Partners

- Impacts student experience by feedback to ERC management
- Exposure to multi-institutional organizations and collaboration between diverse populations
- Gordon-CenSSIS SLC reps hosted the Student Retreat at the 2007 NSF Annual Meeting
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Institutions:
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“Scientists and engineers working in partnerships with local teachers represent an essential new force that will be required for effective science education reform... But to be effective, we scientists must first be willing to be educated about the opportunities and problems in our schools. This means that we must approach this problem with a humility that reflects how little most of us really understand about how children learn, as well as our respect for the tremendous energy, devotion, and skill required to be a successful K-12 teacher in today's schools.”

- Bruce Alberts, Former President, National Academy of Sciences
Moving Beyond Awareness: Building a Sustainable ERC K-12 Education Program

**Leadership** committed to education outreach

**Recognition** for faculty and students engaged in education outreach

Strong **partnerships** with teachers, school districts and Community Colleges

**Programs** that meet our partner’s needs

- Raise student achievement
- Support rigorous advanced coursework
- Improve STEM teaching
Goal: “Strengthening the skills of 250,000 current teachers through summer institute training programs...” (Rising Above the Gathering Storm)

- Provide participants with an extended research/design experience
- Develop leadership skills of participants
- Share best practices
- Build connections to the classroom
- 58 teachers to date (over 7000 students) have spent their summers working at Northeastern University.
RET – Changing Classroom Practice

- I now truly understand the importance of higher learning and the incorporation of "real life" application.”

- “I now place more focus on inquiry and thus my students are participating in a more question-driven curriculum.”

- “My research in soil remediation has added to my content knowledge about soils and earth science directly benefiting my students “

- “I try to work engineering into my curriculum more often than I used to”

- Responses from 2008 participants on what impact participation in the RET program had on how and what they taught.
Partnerships with Community Colleges: 
Building the Pipeline

- Create a sustainable STEM partnership between NEU STEM departments and Community College

- Summer Research Opportunities - Provide Community College faculty and Students access to REU and RET opportunities.

- Replicate Northeastern University’s Summer Bridge Program at interested Community Colleges and develop a Transfer Bridge Program for Community College students transitioning to Northeastern University.

- Expand academic mentoring and support. Identify promising practices and provide professional development opportunities for all partners.
Young Scholars Program – Starting Early

- Offers future scientists and engineers a unique opportunity for hands-on experience while still in high school

- 88 students since 2004, almost 90% have moved on to major in STEM fields
K-12 Outreach by Undergraduates

- Participation in Science Fairs, Regional and National Competitions
- Volunteer in middle and high school classrooms
- UPRM Pre-College Engineering Program
- High Tech Tools and Toys Lab used for K-12 Outreach at BU, NU, RPI and UPRM
An unique collaboration among five private universities, the City of Boston, and the Boston Public Schools to help close the achievement gap through coordinated services.

- Academic Support for Schools
- Quality Extended Learning Opportunities
- Health and Wellness Programs
- Parent and Community Engagement
CenSSIS Leverages Over 15 Years of NEU Experience and Innovation in K-12 Education
- ERC vision inspires students at all levels
- Sustained involvement with students – many program synergies
- Outreach to bring students into pipeline
- Dissemination of educational innovations