Engineering Our Future NJ: Promoting Engineering in K-12 Schools through Professional Development, Policy Initiatives, and Partnerships

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Engineering Our Future NJ

Multi-pronged, multi-partner, statewide effort based at CIESE to promote engineering in elementary, middle, and high schools in NJ
Goal

To ensure all NJ students experience engineering, *with a focus on innovation*, as an *integral* part of their K-12 education by 2010, not merely as an elective or extracurricular activity.
Key initiatives

- Professional development
- Policy efforts
- Partnerships and capacity-building
- Promotion
- Research strand
Projected Impact

By exposing all students to K-12 engineering curricula, we hypothesize that more students will be motivated to:

- Take and succeed in STEM gatekeeper courses in middle and high school;
- Pursue engineering and other STEM-related careers.
EOFNJ Two-Phased Approach

Phase 1 - Pilot/demonstration project in 2005-06 to understand student learning of science and engineering concepts and classroom implementation issues

Phase 2 - Statewide Scale-Up (2006-08…)
Phase 2 Objectives

- Reach a critical mass of 2,000 teachers
- Influence policy to strengthen NJCCCS and assessments
- Create a statewide network to deliver PD and other support, advocate for engineering.
Professional Development

Menu of options by:

- Content
- Grade level
- Duration
- Classroom support
- Location
- Various funding sources
Curricula Currently Supported

- Engineering is Elementary
- A World in Motion
- Engineering the Future
- Building Math
- Pro/Engineer
- CIESE Online Engineering Projects
1,700 Educators Impacted

Figure 2: Total Teachers Impacted per EOFNJ Capacity-Building

- In-District Workshops
- Catalyst Grants
- Awareness Events
- Grant Programs
- Other Locations
- Conferences
- Guest Lecturer
- Stevens Workshops
Workshop Evaluations

Received highest rating on PD from 90% of participants

“The lessons were diverse and could be used in many subjects making them great interdisciplinary modules.”

“Our curriculum is in need of serious updating and this workshop has opened my eyes to the possibilities and directions...we should move.”
Partnerships for Statewide Reach

- Catalyst grants of $5,000 (TCNJ, MSU, Rowan, Princeton, Mercer)
- In-school and district-based PD
- Guest lectures at colleges of teacher education
- Host sites (Brookdale CC, ETTCs)

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Promotion: *Messages*

- De-mystify engineering and engineers; showcase girls, underrepresented groups
- Grassroots publicity/recognition for participating schools, teachers
- Create demand by parents, public → 21st century workforce skills, jobs
- Position engineering as critical educational competency to K-12 education leaders
Promotion: Vehicles

- Press releases/ local newspapers stories
- Regional stories
- Op-ed articles
- Legislator meetings
- Corporate visits
- EOFNJ newsletter
- EOFNJ website
- Conferences
Key Awareness-Building Events

- Principals & Supervisors: Why K-12 Engineering? (May 07)
- Regional outreach: Community College Event (Dec. 07)
- Guidance Counselor Event: What is Engineering and What are the Pre-Requisites? Guidance Counselor Event (April 08)
Policy Initiatives:

NJ Standards & Testing

- 2009 Standards Revision
- New K-8 Assessments
- American Diploma Project for HS

rigorous, but prescriptive coursework with little room for additional courses
Proposed New Science Standard

INNOVATION USING DESIGN AND ENGINEERING (5.5):
ALL STUDENTS WILL UNDERSTAND THE
INTERRELATIONSHIPS BETWEEN SCIENCE AND
TECHNOLOGY AND DEVELOP A CONCEPTUAL
UNDERSTANDING OF THE NATURE AND PROCESS OF
INNOVATION AND TECHNOLOGICAL
DESIGN/ENGINEERING.

Engineering
Our Future NJ

STEVENS
Institute of Technology
Research Activities

A study to determine the effectiveness of the EOFNJ program:

- Characterize overall program progress in aggregate on teachers, other stakeholders;
- Analyze impact on classroom practice, student achievement, attitudes
- Case studies with relevant information that may be generalized to other programs.
Challenges & Lessons Learned

- Time available for PD and curricular/assessment mandates limit teacher time
- Evidence of student impact and **on what proficiencies**
- A wide range of constituencies must be convinced that engineering should become a universal requirement for K-12 students (teachers, administrators, test-makers, parents, etc.).
Next Steps:

- Continue policy initiatives for standards and testing in NJ and US (science, engineering, 21st century skills)
- Deepen support for model schools, districts in NJ and disseminate nationally
- Analyze, disseminate impact on student motivation, learning of STEM, 21st Century Skills
Acknowledgements

- Verizon Communications
- National Science Foundation
- NJ Department of Education
- NJ State Treasury
- Honeywell
- Edison Venture Fund
### Percentage of Participants Who Reported Increased Use of Each Instructional Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementing the engineering design process</td>
<td>73</td>
</tr>
<tr>
<td>Integrating math, science, and technology</td>
<td>67</td>
</tr>
<tr>
<td>Assigning projects based on real world problems</td>
<td>56</td>
</tr>
<tr>
<td>Telling students about or using new technologies</td>
<td>53</td>
</tr>
<tr>
<td>Discussing STEM careers with students</td>
<td>48</td>
</tr>
<tr>
<td>Using the computer to collect and/or analyze data</td>
<td>35</td>
</tr>
<tr>
<td>Requiring students to make formal presentations</td>
<td>33</td>
</tr>
<tr>
<td>Requiring students to use presentation software</td>
<td>33</td>
</tr>
<tr>
<td>Using the Internet to collect and/or share data</td>
<td>30</td>
</tr>
<tr>
<td>Using computers to design 3D models</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: CIESE survey of EOFNJ participants, 2008

**Figure 4:** Responses from teachers when asked whether their use of the listed instructional activities had increased, decreased, or remained the same.
Teacher Perceptions of the Effect of EOFNJ Professional Development Activities on Students

<table>
<thead>
<tr>
<th>Response</th>
<th>Percent of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning more</td>
<td>41</td>
</tr>
<tr>
<td>More interested in my classes</td>
<td>33</td>
</tr>
<tr>
<td>More positive attitude about STEM subjects</td>
<td>28</td>
</tr>
<tr>
<td>More aware of STEM career options</td>
<td>20</td>
</tr>
<tr>
<td>More interested in STEM careers</td>
<td>13</td>
</tr>
<tr>
<td>Doesn't apply; my teaching has not changed</td>
<td>12</td>
</tr>
<tr>
<td>No noticeable change in my students</td>
<td>11</td>
</tr>
<tr>
<td>Less intimidated by STEM subjects</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: CIESE survey of EOFNJ participants, 2008

Figure 5: Responses from teachers when asked how students' behavior had changed as a result of the teacher's participation in EOFNJ professional development activities.

Figure 6: A middle-school student engaged in a design activity included in the science curriculum after her teacher's participation in EOFNJ activities.