

Engineering Our Future New Jersey: Guidance Counselors Mission Critical

Dawna Schultz, Stevens Institute of Technology

Susan Metz, Stevens Institute of Technology

Susan Lowes, Columbia University

Beth McGrath, Stevens Institute of Technology

Mercedes McKay, Stevens Institute of Technology

Abstract

A key objective of a statewide initiative to infuse engineering into all K-12 schools' curricula is to provide and disseminate accurate information about engineers and engineering to critical stakeholders. Guidance counselors are a primary source of career information for students and therefore, a key partner in the *Engineering Our Future NJ* mission. Survey data from a guidance counselor event held in April 2008, *Encouraging Students towards STEM and IT Careers*, revealed that a majority of guidance counselors hold misconceptions or suffer from a lack of information about engineers and engineering. This paper analyzes the self-reported data and suggests strategies to cultivate better partnerships with this important constituency.

Introduction

In the last 50 years, more than half of America's sustained economic growth was fueled by engineers, scientists and advanced-degree technologists, a mere 5% of America's 132 million-person workforce¹. Also, the science & engineering job market in the U.S. grew by 4.2% over the last 20 years, but U.S. degrees awarded in these fields grew by only 1.5% during the same period.² An 11% increase in the U.S. engineering workforce—or 160,000 new engineering jobs will be created by 2016, in addition to retirements among as many as a third of the engineering workforce.² It is clear that the U.S. needs to attract more students overall, and more from all demographic groups, to engineering and science to meet the economic needs and global challenges facing the U.S.

Since 1988, the Center for Innovation in Engineering and Science Education (CIESE) at Stevens Institute of Technology has supported excellence in teaching and learning of science, technology, engineering, and mathematics (STEM) and other core subjects through innovative, research-based instructional strategies and use of novel technologies. CIESE has received more than \$30 million in funding from public agencies, corporate and private foundations, and school district sources to implement curriculum development, teacher professional development, and research programs in K-12 education.

Engineering Our Future NJ

Engineering Our Future NJ (EOFNJ) is a multi-pronged initiative designed to ensure that all students in NJ experience engineering as an integral component of their K-12

education. Building on a pilot effort, this CIESE program has: reached a critical mass of 2,000 teachers with professional development of exemplary K-12 engineering curricula; influenced policy to strengthen educational standards and assessments; and created a statewide network of partner organizations that deliver or host K-12 engineering-focused professional development to for practicing or pre-service teachers. In addition, EOFNJ has launched an awareness-building effort to disseminate critical messages to various stakeholders including school administrators, educators and parents.

Dispelling ingrained stereotypes about engineering and broadening perspectives about the field is key to EOFNJ's success. Data shows that people have negative perceptions about engineers and engineering. According to a Harris Interactive® survey conducted on behalf of the American Association of Engineering Societies (AAES)³, people perceive that scientists more than engineers: save lives (82% vs. 14%); care about protecting the environment (77% vs. 17%); and improve the quality of our lives (71% vs. 22%). The EOFNJ awareness initiative is a direct response to these negative perceptions of engineering. A primary goal of EOFNJ, therefore, is to provide and disseminate accurate information about engineers and engineering to critical stakeholders. A key objective in achieving the EOFNJ goal of infusing engineering into mainstream K-12 education in New Jersey involves building awareness of engineering, identifying its importance to U.S. economic health, and broadening perspectives of engineering held by key constituencies who influence students' career choices. EOFNJ works to de-mystify engineering and engineers; to showcase women and underrepresented groups in engineering practice; and to highlight and acknowledge the work of participating schools and teachers in their local communities who have successfully implemented K-12 engineering curricula in their classrooms.

Encouraging Students towards STEM and IT Careers: Guidance Counselor Conference

Guidance counselors are vital stakeholders influencing the future of education in the U.S. They are a primary source of career information for students. CIESE held a special event for New Jersey guidance counselors in April 2008, *Encouraging Students towards STEM and IT Careers*, with the goal to prepare guidance counselors with both a big picture view of the economic imperative to produce more science, technology, engineering and mathematics (STEM) graduates as well as with specific examples and strategies that illustrate pathways for women and underrepresented groups to participate in engineering, science and information technology careers.

This conference was part of a major grant program, Build IT: a 3-year, \$1.2 million National Science Foundation-sponsored program to cultivate students' interest and persistence in science, engineering, and information technology through use of LEGO and NXT programming in the context of a series of underwater robotics challenges. More than 2,600 middle and high school students will be involved over three years. Middle and high school guidance counselors from *Build IT* schools were required to participate in the conference and guidance counselors from throughout the state of New Jersey were also invited to participate

The conference agenda included a blend of data and statistics about the engineering pipeline, including the underrepresentation of women and minorities in engineering, as well as personal perspectives of recent engineering graduates in a variety of non-traditional engineering positions regarding their career satisfaction and how their engineering degree prepared them for the world of work. Highlights included a female engineer who serves as a process engineer in a candy factory; a management of technology major who advises surgeons on biomedical implants; and a mechanical engineer who has held a series of increasingly responsible positions in a multinational cosmetics company. Keynote speaker Virginia Ruesterholz, President of Verizon Telecom, a chemical engineer, described engineering as “the liberal arts degree of the 21st century,” stating that it prepares one to be successful in any field. The full agenda can be viewed at: http://www.stevens.edu/ciese/buildit/guidance_symposium_2008.html.

Conference Evaluation

A formative evaluation of the conference was conducted by asking participants to complete a pre-survey when they registered and a post-survey at the end of the day. The pre-survey (see Figure 1) focused on gaining a better understanding of how counselors acquired information about STEM careers, what if anything the school did to interest underrepresented groups in STEM careers, and what help they could use to obtain more information about STEM careers. The post-survey (see Figure 2) focused on the content and organization of the conference, what counselors learned that they had not known before, and what they might do differently as a result of participating in the conference.

Forty-five of those who attended the CIESE Guidance Counselor professional development day returned a pre-survey, handed out at the beginning of the day, and a post-survey at the end of the day. Four returned only the pre-survey and one returned only the post-survey. All are included in the analysis.

Guidance Counselor Pre-Survey Results

More than half of the guidance counselors participating were from high schools. Attendees represented a wide range of school districts in New Jersey as indicated by their District Factor Grouping (DFG) classification, a measure that provides a means of ranking school districts in New Jersey by their socioeconomic status. DFG classifications range from “A” (lowest socioeconomic status) to “J” (highest socioeconomic status).

Time Allocation

The survey asked what percentage of their time the guidance counselors spent on their main responsibilities. Middle school guidance counselors reported that they spent most of their time counseling. Teachers from DFG A & B schools spent more time advising about high schools than teachers from FG - J schools, probably because the latter came from suburban schools with fewer high school options. See Figure 3.

Figure 1: Pre-survey

CIESE GUIDANCE COUNSELOR SURVEY

Name _____
School _____
Grade level of the students you advise _____

What **percentage of your time** do you spend on your main responsibilities as a guidance counselor?

_____ % High school advising
_____ % College advising
_____ % Career advising
_____ % Counseling
_____ % Scheduling
_____ % Discipline
_____ % Other (_____)

100 %

What would you like to spend **more time** on if you could? _____

Do you discuss their **future careers** with your students?
___ Yes ___ No
If you do, **when and where** do you do this? _____

Where do you **learn about** current Science, Technology, Engineering, and Mathematics (STEM) careers and their educational requirements?

Is your school doing anything specific to recruit **girls and/or minorities** into STEM fields?

What **help** could you use in learning about STEM careers?

Figure 2: Post-survey

CIESE GUIDANCE COUNSELOR POST-SESSION SURVEY

Name _____

School _____

On a scale of 1 to 5, with 5 the highest score, how would you **rate today's activities** in terms of the following?

	Lowest	Highest		
Organization	1	2	3	4	5
Pacing	1	2	3	4	5
New learning/content	1	2	3	4	5
Quality of speakers	1	2	3	4	5

What did you learn today that you did **not** know before?

Will you do anything **differently** in terms of advising students as a result of today's session?

Which **panel** did you like best and why?

Additional comments are welcome!

Figure 3: Average percentage of time spent on main responsibilities by type of school

Middle Schools		
	DFG A & B	DFG FG to J
Counseling	36%	44%
High school advising	13%	7%
Discipline	12%	11%
Career advising	6%	8%
Scheduling	5%	14%
College advising	1%	1%

High school guidance counselors, in contrast, reported spending much less time on counseling and discipline and much more time on scheduling. Those from DE - J schools spent more time on college advising than those from A&B schools, who spent more time career advising. See Figure 4.

Figure 4: Average percentage of time spent on main responsibilities by type of school

High Schools		
	DFG A & B	DFG DE to J
Scheduling	28%	22%
College advising	18%	23%
Career advising	17%	9%
Counseling	15%	11%
High school advising	12%	14%
Discipline	6%	2%

All guidance counselors, whether in A-B or DE-J schools, indicated that they would like to spend more time on counseling, followed by career advising and college advising.

Career Advising

Guidance counselors in high schools tended to meet with students individually for career advising, although those in A and B high schools were more likely to meet with groups than those in the other types of schools. Middle school career advising also happened in classrooms and middle school guidance counselors tended to do career counseling in group settings, particularly in A & B schools.

Where Guidance Counselors Learn About STEM Careers

Across all school types, guidance counselors learned about current STEM careers through three channels: (1) from teachers, coworkers, or school departments; (2) from professional development opportunities, such as workshops, seminars, or conferences; and (3) from media, such as the Internet, TV, news, or other print materials.

Recruiting Girls and/or Minorities to STEM Fields

Few guidance counselors reported that their schools had specific plans to recruit girls and minorities into STEM fields, with DE to J schools being just slightly more proactive than A and B schools. See Figure 5.

Figure 5: Is your school doing anything specific to recruit girls and/or minorities into STEM fields?

	DFG A and B Schools (n=23)		DFG DE to J Schools (n=23)	
	Count	Percent	Count	Percent
Yes	8	35%	9	39%

Some of the specific programs/events they reported in A and B schools to recruit girls and/or minorities were: robotics programs; Saturday academy for girls; summer enrichment programs; after school classes in STEM fields; women’s day events and career day events. In DE to J schools they reported: women in engineering elective class; science clubs; robotics design included in curriculum; summer science program; and exploratory pre-engineering and computer technology classes.

Help Guidance Counselors Need to Advise Students about STEM Careers

Guidance counselors from all categories of schools were consistent in identifying their needs to improve STEM career advising. They requested three primary areas including: attending more professional development workshops similar to *Encouraging Students towards STEM and IT Careers*; providing their students with opportunities to interact with role models, specifically undergraduate and graduate engineering students and professionals; and obtaining more resources, such as print materials and information via email or websites.

Guidance Counselor Post-Survey Results

The workshop was very highly rated, particularly in terms of the overall organization and the quality of the speakers. See Figure 6.

Figure 6: On a scale of 1 to 5, with 5 the highest, how would you rate today’s activities in terms of the following?

	1	2	3	4	5	Average	Total
Organization	0	0	1	5	40	4.8	46
Quality of speakers	0	0	0	10	36	4.8	46
Pacing	0	0	3	11	32	4.6	46
New learning/content	0	2	4	15	25	4.4	45

Almost two-thirds of the high school guidance counselors reported that they had learned things they did not know prior to the conference about the diverse career opportunities in engineering. They specifically noted that they were more knowledgeable about how an

engineering degree is a good foundation for many different careers. Other responses included the kind of skills that are important for engineers to acquire such as good problem solving skills, teamwork skills, and that students do not have to be math and science “geniuses” to succeed in engineering. See Figure 7.

Figure 7: What did you learn today that you did not know before?

	All high school (n=30)	
	Count	%
Job opportunities related to engineering	19	63%
About Stevens	8	27%
Skills for engineering related jobs	4	13%
Females & minorities in engineering field	4	13%
Ways to introduce STEM	3	10%
Resources	2	7%
Access to STEM	1	3%

The majority of middle school guidance counselors identified job opportunities related to engineering as an area unfamiliar to them prior to the conference. See Figure 8.

Figure 8: What did you learn today that you did not know before?

	All middle school (n=13)	
	Count	%
Job opportunities related to engineering	11	85%
About Stevens	3	23%
Skills for engineering related jobs	2	15%
Females & minorities in engineering field	2	15%

The panel sessions that showcased undergraduate engineering students and practicing engineers were rated by all participants as the best component of the conference. The majority of guidance counselors expressed increased confidence and enthusiasm about introducing engineering to their students. In particular, guidance counselors from Build-IT high schools stressed the importance of encouraging students to pursue engineering even though their math and science grades may not be excellent.

Overall, the day received very high marks from all the attendees, who appreciated the opportunity to learn information that they could take back to their students. While there were some differences between high school and middle school guidance counselors, and between guidance counselors in lower socioeconomic status schools (A-B) and higher socioeconomic schools (D-J), particularly in terms of their job responsibilities, there was no difference in their appreciation for what they learned during the day.

Suggested Strategies

The analysis of the guidance counselor surveys revealed specific strategies to integrate into professional development activities geared to improving career advising in STEM. The following suggested strategies are listed in order of importance:

- Dispel ingrained stereotypes and misconceptions of engineers and engineering. Focus on key messages that appeal to students.⁴
- Broaden guidance counselors' view of students who should be encouraged to pursue engineering. Reach beyond the advanced placement majority male students, to students of all demographic groups who are curious about the world around them, enjoy and do well in math and science, and desire to make the world a better place.
- Connect practicing engineers and undergraduate and graduate engineering students with guidance counselors. Engineers need to share their passion for engineering, with students, teachers and parents. Encourage and provide assistance to guidance counselors to organize a career program at their school.
- Remind guidance counselors to encourage all students to take a full complement of high school math and science courses to keep as many career options open as possible.
- Provide K-12 engineering curriculum resources to guidance counselors to share with teachers and encourage them to integrate engineering into existing math and science courses. (<http://www.stevens.edu/ciese>)
- Provide information on K-12 engineering summer camps, workshop opportunities, and other special programs for guidance counselors to share with students, especially girls and minorities.
- Provide quality print materials and Internet resources on careers in engineering so guidance counselors have this information easily accessible to share with their students.

Conclusion

Guidance counselors are a key constituency for advancing K-12 engineering within school districts and encouraging students to pursue engineering careers. They are a primary source of career information for students and have the unique opportunity to increase awareness about STEM careers with teachers, administrators, students and parents. To improve guidance counselors' ability to effectively introduce and encourage students towards STEM careers, guidance counselors report that they require: access to well-designed professional development workshops; access to role models, specifically undergraduate and graduate engineering students and professionals; and access to quality print and electronic resources.

Bibliography

1. Building Engineering & Science Talent (BEST). (2004). *The Talent Imperative: Meeting America's challenge in science and engineering*, ASAP. San Diego, CA
<http://www.bestworkforce.org/PDFdocs/BESTTalentImperativeFINAL.pdf>
2. National Science Board (NSB). (2008). *Science and Engineering Indicators 2008*. Arlington, VA: National Science Foundation.
<http://www.nsf.gov/statistics/seind08/pdf/c03.pdf>
3. Public Perceptions of Engineering Survey. (2003). Harris Interactive® survey conducted on behalf of the American Association of Engineering Societies (AAES).
<http://www.scienceblog.com/community/older/2004/4/20043879.shtml>
4. Committee on Public Understanding of Engineering Messages, National Academy of Engineering. (2008). *Changing the Conversation: Messages for Improving Public Understanding of Engineering*. National Academies Press.
http://www.nap.edu/catalog.php?record_id=12187