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"Engineer Your Life" Evaluation Report for Year 3: Executive Summary

Prepared by:

Concord Evaluation Group, LLC

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Note: Dr. Paulsen was the study director at American Institutes for Research for the work performed in Year 1 of the project.

About the Study

Background

The Bureau of Labor Statistics has predicted that employment for engineers will increase by 11 percent between 2008 and 2018, with the most growth expected in the engineering, research and development, and consulting services industries.[1] Environmental engineers are expected to see the greatest growth—estimated at 31% growth during this projection period. Starting salaries for engineers are among the highest of all college graduates and a Bachelor's degree is typically required for most entry-level positions.[2] However, many students are graduating from high school with insufficient skills to pursue such entry-level jobs in this field.[3] Moreover, US colleges and universities are enrolling an increasing number of international students (a proportion of whom will eventually return to their home country with their education and skills) and a decrease in interest among American students in some key technical fields.[4]

The need to fill these gaps and encourage students in the US to consider science, technology, engineering, and math (STEM) careers is well-documented. Recently, The President's Council of Advisors on Science and Technology issued a report in which it argued, "As the world becomes increasingly technological, the value of these national assets will be determined in no small measure by the effectiveness of science, technology, engineering, and mathematics (STEM) education in the United States (page v)."[5] The Council further states, "Moreover, there is a large interest and achievement gap among some groups in STEM, and African Americans, Hispanics, Native Americans, and women are seriously underrepresented in many STEM fields. This limits their participation in many well-paid, high-growth professions and deprives the Nation of the full benefit of their talents and perspectives (page vi)."[6]

Males vastly outnumber females in undergraduate engineering programs. In 2007, men earned 81% of the Bachelor's degrees awarded in engineering and according to the National Science Board at the National Science Foundation, "…women's share of Bachelor's degrees in computer sciences, mathematics, and engineering has declined in recent years."[7]

Therefore, in an effort to prepare female high school students for a college curriculum and achieve gender parity in the engineering industry, WGBH has developed an initiative entitled, *Engineer Your Life* (EYL). The initiative is targeted toward female high school students, career

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[1] Bureau of Labor Statistics (2010). *Occupational Outlook Handbook, 2010-2011 Edition: Engineers.* Available online at http://www.bls.gov/opub/ted/2007/jun/wk4/art04.htm
[2] Ibid.
[3] Weill, S.I. (2008). High schools focus on engineering. *Industrial Engineer*, Vol. 40*(1)*, 16.
[4] Building Engineering and Science Talent (2010). *The Talent Imperative: Meeting America's challenge in science and engineering, ASAP.* Available online at http://www.bestworkforce.org/PDFdocs/BESTTalentImperativeFINAL.pdf
[5] Executive Office of the President (2010). *Report to the President: Prepare and Inspire, K-12 education in science, technology, engineering, and math (STEM) for American's future.* Available online at http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf
[6] Ibid.
[7] National Science Board, National Science Foundation (2010). *Science and Engineering Indicators: 2010.* Available online at http://www.nsf.gov/statistics/seind10/start.htm

counselors/educators, and professional engineers. It is designed to: 1) increase these target audiences' understanding of engineering, 2) inspire young women to explore engineering as a career option and 3) help adults encourage young women to investigate engineering opportunities.

Study Design

One component of this initiative involves collecting survey and other types of data to both track changes in attitudes and knowledge over time as well as to evaluate the impact of the EYL initiative. To achieve these goals, we have collected several types of data to inform WGBH's efforts. In Year 1 (2007 – 2008) American Institutes for Research (AIR) collected baseline survey data to inform the development of the EYL initiative and set the baseline to measure its effectiveness over time. In 2009, Veridian inSight collected Year 2 survey and interview data. In Year 3, Concord Evaluation Group (CEG) collected survey and interview data.[8]

Table 1 summarizes the type and frequency of data collection for the evaluation.

Table 1:

EYL Evaluation Data

Type of Data	Year 1 (2008)	Year 2 (2009)	Year 3 (2010)
Survey of career counselors and educators	X	X	X
Survey of engineers	X	X	X
Survey of college-bound, female high-school students	X	X	X
Interviews with EYL partners		X	X

The study was designed to capture data over a period of three years from the three main cohorts of interest: professional engineers, career counselors and educators, and college-bound females.[9] The study was not designed to be a longitudinal study of the same individuals over time. Rather, the surveys will capture data from unique members of each cohort over time.

These data provide a "snapshot" of attitudes, knowledge and beliefs among key audiences at three points in time: before the EYL initiative was launched, the year of its launch, and one year after EYL was launched.

Study Limitations

The samples were not randomly selected from the populations of interest. Such a randomized study design was impractical for this project as no comprehensive list of academically-prepared

[8] All three years of data collected were conducted under the direction of Dr. Paulsen, who left AIR in 2008 to start Veridian inSight. In 2010, Veridian inSight's name was changed to Concord Evaluation Group.

[9] Throughout this document we use the terms "college-bound, high school females", "academically-prepared girls" and "students" interchangeably. We make distinctions when necessary.

students exists. Instead, we identified the populations of interest and reached out to as many members of these groups as possible, with the goal of reaching out to all members of a given cohort. Our recruitment strategies are described below. After making the initial contact with members of the target cohorts, individuals self-selected into the study. Because random sampling was not practical for this study and because the sample is self-selected, generalizing the findings to the populations represented is a challenge.

Another limitation of the study is that we have not tracked survey respondents by name, so we cannot know definitively whether some individuals responded to the surveys more than once, or more than one year in a row. This was a limitation we were prepared to accept when we designed the study; we chose to administer the surveys anonymously, in part, to protect the identity of minor students. We also chose this design to encourage candor and honesty among adults in the survey. To address this limitation, we have reviewed all IP addresses for survey respondents to flag cases where we may have received duplicate respondents. In cases where there appears to be duplicate respondents, we have deleted them. Also, to avoid violating assumptions of independence among observations from year to year, we have eliminated from our analyses data from respondents who indicated that they had previously responded to the survey.

Despite these limitations, we should note that (as described below) our samples were diverse in all three years. We achieved a wide range of respondents and the proportions of individuals from key demographic categories mirrors the target population characteristics well. Moreover, as we will discuss below, our study findings reflect trends that have been found in other recent studies.

Therefore, we are confident that despite the limitations described here, the study findings are valid and worthy of discussion.

Study Instruments

The purpose of the surveys was to gather data regarding target users' attitudes and knowledge about engineering as a career for girls, as well as users' behavior and self-reported behavioral intentions with respect to choosing engineering as a career (girls) or encouraging girls to choose engineering as a career (career counselors, engineers). The purpose of the partner interviews was to learn how effectively the initiative has been implemented and provide formative data to WGBH regarding potential ways to continuously improve the initiative and its perceived impact.

Study Participants

To date, the study sample has included counselors, educators, engineers, and college-bound female students from all regions of the United States and a small sample from Canada, Mexico, and the US Virgin Islands. The total number of participants is summarized in Table 2 below. We should note that the samples are independent from Year 1 to Year 2; in other words, we only included individuals in Year 2 who had *not* responded to the survey in Year 1.

Table 2:

Number of Study Participants[10]

Target Population	Year 1 Sample Size	Year 2 Sample Size	Year 3 Sample Size
Counselors and educators	147	171	177
Engineers	401	411	375
College-bound, female students	1,824[11]	707	617
EYL partners	N/A	10	7

We recruited survey respondents through contacts at relevant organizations and associations as well as the EYL website. Individuals who received the recruitment advertisements circulated the information via listserv postings, electronic bulletin boards, word-of-mouth, flyers and emails to all of their members. The following is a list of groups that assisted in the recruitment process:

> **Engineers:** Society of Women Engineers (SWE), American Society of Civil Engineers (ASCE), Women in Engineering Programs and Advocate Networks (WEPAN), IEEE, Deans of engineering schools
>
> **Career Counselors and Educators:** National Association for College Admission Counseling (NACAC), American School Counselor Association (ASCA), Computer Science Educators Association
>
> **College-bound, female high school students:** National Association for College Admission Counseling (NACAC), Educators Domain, National Girls Collaborative Project, Girl Scouts, Aerospace Scholars Program, GEAR UP, afterschool programs, Computer Science Educators Association

In addition, we distributed recruitment text via email to individuals who previously visited WGBH at college fairs. Also, we targeted college-bound, female high school students by posting advertisements on the "facebook" social networking website and various teen / student online forums. We targeted counselors and engineers by posting advertisements on the LinkedIn professional networking website.

We also contacted Technology Student Association regional coordinators, student delegation contacts, and State Technology Education Association high school regional contacts in nearly all 50 states, as well as high school technology education and engineering departments as identified through the ITEA networking lists to recruit counselors and students.

[10] In Years 2 and 3, we asked respondents whether they had previously participated in the EYL survey in Year 1. Only a handful of respondents responded affirmatively. These respondents were not included in data analyses, to avoid violating statistical assumptions of independence of the observations across the years.

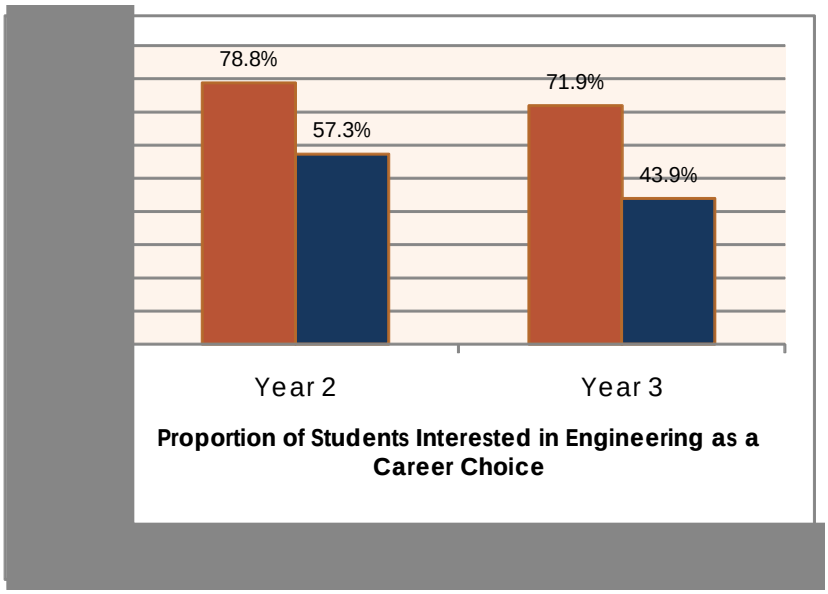
[11] We cannot explain the significant difference in sample sizes for the student population. As with any study recruitment effort that relies on Web traffic to deliver messages to members of the target population, it is likely that the invitation was simply seen by more students in Year 1 than in Years 2 or 3.

Summary

This study provides evidence that the EYL initiative has had a positive impact on the students, counselors, educators, engineers and outreach partners who have participated in it. EYL has helped educate participants about what the field of engineering is like, the potential impact of engineering on society, and how to prepare for a career in engineering. By providing resources for student mentors, such as educators, counselors, and engineers, and by providing resources directly to students, EYL has helped to encourage academically-prepared, female students to consider a career in engineering.

For the second year in a row, there is evidence that EYL has encouraged college-bound, high school females to consider engineering as an attractive career option and has taught them how to prepare for it.

This study found that although many students in Year 2 and 3 were interested in engineering (many more than in the baseline year of the study), students who had been exposed to EYL resources (such as the website, video profiles, posters, or career fairs) were *significantly more likely* to report that they wanted to be engineers than students in Years 2 and 3 who were unfamiliar with EYL (see Figure).



In fact, for the second year in a row, engineering was the most frequently chosen career option among *all* students, but especially for students who had been exposed to EYL.

Most of the students who viewed the EYL website indicated that the website helped them learn more about engineering (95.3% in Year 2 and 91.7% in Year 3). Most students also indicated that the website made them more interested in engineering as a career (87.9% in Year 2 and 77.8% in Year 3) and inspired them to take an engineering class in college (75.5% in Year 2 and 77.8% in Year 3).

EYL has helped female students to see engineering as an opportunity to do the kind of work they are most interested in: work that enables them to be creative and to help society.

When we asked students to tell us the most important factors in a career, students across all three years told us they wanted to (1) have fun, (2) have time for family and friends as well as work and (3) be successful, and (4) contribute to society or make a difference in people's lives. For example, roughly half of the students across all three years said they would be "very interested"

or "interested" in designing life saving medical devices for patients with heart disease and in teaching communities to make their drinking water safe.

Students who had been exposed to EYL resources were more likely to understand that engineering careers could meet their needs. For example, we found that students in Years 2 and 3 who were familiar with EYL were *significantly more likely* than those students who were unfamiliar with EYL to believe that the following skills were important to engineers:

- Imagination and creativity
- "People" skills
- Public speaking skills

Moreover, we found that students in Years 2 and 3 who were familiar with EYL were *significantly more likely* than students who were unfamiliar with EYL to believe that engineering offered them the opportunity to (1) think creatively, (2) make a difference in people's lives, and (3) work in lots of different settings.

Most students who used the EYL website indicated that the website helped them understand what they should do if they wanted to become engineers (79.2% in Year 2 and 75.0% in Year 3).

Engineers, Counselors, and Coalition Partners Reported that EYL has Helped them to Encourage Young Women to Choose Engineering

Coalition partners reported that EYL offers them a useful resource that enables them to more effectively reach out to their target audiences.

> We've actually modified most everything of what we do in our college that's a visual handout…And with everything we create we say we 'EYL-it.' We turn EYL into a verb. Everything we do is EYL, from six foot by four foot posters to digital screen monitors to handouts.
> *—Coalition Partner*

Coalition partners reported that EYL's emphasis on engineering as a philanthropic and creative field has changed the way they represent engineering careers to girls. As reported in Year 2, EYL coalition members reported that they use a wide cross-section of EYL materials to supplement or structure their own programs and enhance their own messaging. Moreover, members reported that the way EYL represented engineering has been effective in reaching their target audiences.

> We did a survey of our girls, and before (showing the EYL videos), out of 64, only three (3) said that they were even interested in being an engineer. But by the end of it, 24 said they'd really be interested in pursuing engineering, and 50 said they would take an engineering class in high school.
> *—Coalition Partner*

In terms of specific resources, members reported that the EYL video profiles were overwhelmingly well-received by students. Partners believed that the videos effectively challenged stereotypes of engineering careers and changed many girls' perception of engineering.

One partner at the university level reported an increase in female enrollment that was, in part, attributed to their use of EYL resources:

"We have seen an increase in the number of students coming in to CU Boulder. It's gone up a couple percent from two years ago to last year, and a couple more percentage points from last year to this year. We're pretty sure that (EYL) had something to do with it." —University of Colorado at Boulder

The EYL website has helped counselors and educators to learn more about engineering and how to prepare young women to pursue it.

> I am thrilled to discover this website and plan to incorporate it into my science curriculum next year. I encourage all my students to look at engineering as an option and love all the resources you have provided.
> *—High school science teacher*

Educators in Years 2 and 3 reported that they had used the EYL website, video profiles, brochures, posters and postcards with female students to educate them about the field of engineering. In Year 3, we found that respondents who were familiar with EYL reported they were *significantly more knowledgeable* about engineering career opportunities than respondents who were unfamiliar with EYL.

However, we did not observe any other significant relationships between EYL users and non-users with respect to an understanding of the academic preparation required for engineering, engineering job characteristics, or skills required. Both EYL users and non-users reported they were knowledgeable about these factors.

Respondents did report that the EYL website had a positive impact on them. We asked the respondents who used the EYL website to report how much the website changed their own level of interest in the field of engineering, if at all. More than half reported that it made them more interested in engineering (52.2% in Year 2 and 54.8% in Year 3). Most of the respondents also self-reported that the website did a good job of helping them understand what they should do to prepare high school girls to become engineers (96% in Year 2 and 97% in Year 3).

Most respondents (95.7% in Year 2 and 100% in Year 3) reported that the website did a good job of showing what life and work are like for different engineers. All respondents (100%) reported that the website helps to teach kids about engineering, that it helps kids understand that an engineering career is achievable, and that it does a successful job of introducing high school girls to young women engineers.

All respondents (100%) reported that they would visit the website again and recommend the website to others, including other counselors and students.

Engineers who used EYL resources were actively participating in outreach activities and the EYL resources helped educate them on effective messages for students.

Across both Years 2 and 3, this study found that engineers who were familiar with EYL were *significantly more likely* than engineers who were unfamiliar with EYL to report participating in (1) guest lectures at high schools, (2) career fairs, (3) engineering summer camps, and (4) outreach programs. In Year 3, engineers who used EYL resources were also more likely than

non-EYL users to participate in (1) mentoring programs, (2) career exploration days, (3) Engineering Week, (4) school events, and (5) Girl Scouts.

In Year 3, engineers who were familiar with EYL were *significantly more likely* believe that one of the most important aspects of engineering is that "engineers make a difference in the world." Engineers who were *familiar* with EYL were also significantly more likely to downplay the following career aspects as less important:

- Studying to be an engineer is very difficult.
- Math and science are extremely important to be successful in engineering.
- Engineering is a challenging and demanding field.

Engineers who were familiar with EYL prior to completing the survey were significantly more likely to believe that there were barriers to women entering the engineering profession than engineers who were unfamiliar with EYL. Engineers in Years 2 and 3 who were familiar with EYL were also significantly more likely to believe that young women were unaware of what engineers do than engineers who were unfamiliar with EYL. Engineers in Year 2 familiar with EYL were more likely to believe that there is a lack of visible role models for young women than engineers who were unfamiliar with EYL. In Year 3, engineers who were familiar with EYL were more likely to believe that college counselors do not do enough to encourage women to enter the industry than were engineers who were unfamiliar with EYL.

In Year 2, engineers who were familiar with EYL were significantly more likely than engineers who were unfamiliar with EYL to report that "engineering is rewarding." In Year 3, engineers familiar with EYL were more likely than other engineers to report that engineering offers variety in terms of career tracks.

Engineers reported that the EYL website is realistic, useful, and educational.

Among the engineers who reviewed the website, almost all of the engineers (96.1% in Year 2 and 100% in Year 3) reported that the website did a good job of showing what life and work were like for engineers. Most (88.3% in Year 2 and 97.9% in Year 3) also reported that the website helped them to feel more comfortable helping to prepare high school girls for becoming engineers.

> EYL is fabulous. If everyone used this in their school curriculum and outreach programs, we'd have more girls considering engineering as a career.
> *—Professional Engineer*

Almost all of the engineers (97.1% in Year 2 and 100% in Year 3) reported that the website helped kids learn about engineering and did a successful job of introducing high school girls to female engineers. All of the engineers (100%) reported that the website helped kids understand that an engineering career is achievable.

All of engineers (100%) indicated that they would recommend the website to a student who is interested in learning more about engineering. Almost all of the engineers (97.1% in Year 2 and 100% in Year 3) reported that they would recommend the website to a colleague.

Opportunities Remain to Address the Need for More Engineering Students

Although the current funding period for EYL has ended, there appear to be additional opportunities for EYL, or a program like EYL, to address the need for more US-based talent in the field of engineering. [12,13,14,15]

The majority of the counselors/educators across all three years of data collection reported that they perceived both educational and non-educational barriers to entry for women into the profession. Most counselors/educators reported that educational factors were a barrier to entry into the field of engineering for women, especially the lack of engineering classes and program offerings in many schools and the lack of encouragement for girls to take the prerequisite classes. More than one-third of the counselors "strongly agreed" or "agreed" that boys were generally more encouraged to pursue engineering than girls. More than half of the counselors reported that there were several non-educational barriers to women entering the field of engineering, including a lack of female role models, women being unaware of what engineers do, the masculine image associated with engineering, and aversion to working in a male-dominated environment.

The majority of engineers also reported that there were barriers that prevented women from entering into engineering. The most commonly reported barrier was young women's lack of familiarity with the engineering industry. Other key barriers included: a lack of visible role models, the perception of having to work in a male-dominated environment and being the "lone female," and the masculine image of engineering. In fact, we asked the engineers whether they had any male or female engineers as role models when they were in school or starting their career. Very few respondents reported having a female role engineer as a role model (14.5% in Year 1, 21.9% in Year 2, 17.6% in Year 3). Meanwhile, 66% of respondents in Years 1 and 2 and 63% of respondents in Year 3 reported that they had a male engineer as a role model.

Thus, there remain opportunities for programs based on the EYL model to continue to reach out and educate students, counselors, educators, and engineers about the field.

[12] Bureau of Labor Statistics (2010). *Occupational Outlook Handbook, 2010-2011 Edition: Engineers.* Available online at http://www.bls.gov/opub/ted/2007/jun/wk4/art04.htm
[13] Weill, S.I. (2008). High schools focus on engineering. *Industrial Engineer*, Vol. 40*(1)*, 16.
[14] Building Engineering and Science Talent (2010). *The Talent Imperative: Meeting America's challenge in science and engineering, ASAP.* Available online at http://www.bestworkforce.org/PDFdocs/BESTTalentImperativeFINAL.pdf
[15] Executive Office of the President (2010). *Report to the President: Prepare and Inspire, K-12 education in science, technology, engineering, and math (STEM) for American's future.* Available online at http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf