

AC 2008-2512: INCREASING THE IMPACT OF YOUR PROGRAM THROUGH NEEDS ASSESSMENT SURVEYS

Catherine Didion, Association for Women in Science

Catherine Didion is a Senior Program Officer at the National Academy of Engineering (NAE) which is one of the three U.S. National Academies. Her portfolio is the Diversity of the Engineering Workforce program with a charge to provide staff leadership to the NAE's efforts to enhance the diversity of the engineering workforce at all levels including the diversity of those being prepared to enter the future workforce. In addition to her duties at NAE, in March of 2007 Didion became the Director of the Committee on Women in Science, Engineering, and Medicine. This is a standing committee with a new mandate to work as a focal point on gender across the three National Academies. Didion served as Executive Director for the Association for Women in Science (AWIS) for fourteen years (1990 to 2004). During tenure AWIS was awarded the U.S. Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring and she was the principle investigator for 17 government and foundation grants. Didion presented testimony before the United States Congress and U.S. federal agencies.

Didion is an internationally recognized leader and expert on issues of equity and gender in science and engineering. She has been an invited speaker on mentoring, networking, and women in science and engineering at over 200 conferences and has authored over fifty publications on women in science and engineering. She was the editor for Women in Science Column for the Journal of College Science Teaching from 1993-2002. Didion has extensive experience on Capitol Hill including staff positions at the U.S. Senate Commerce, Science, and Transportation Committee, Office of Senator Robert Packwood (R-Oregon), the Senate Computer Center, and the Senate Press Gallery. Didion's honors and awards include AAAS Fellow (2005); AWIS Fellow (2001); Drucker Foundation Fellow (2000); Texaco Management Institute Fellow (1999); Secretary of the US Air Force Inaugural Environmental Civic Leaders Tour (1996); and Certificate of Commendation and Distinguished Service, Embassy of the United States of America (1989).

Karen Peterman, Goodman Research Group, Inc.

Karen Peterman, Ph.D., is a Senior Research Associate at Goodman Research Group, Inc. Dr. Peterman manages multiple projects, ranging from a needs assessment for an upcoming television series to summative evaluations of several national outreach initiatives. She has experience designing and carrying out evaluations for a variety of funding agencies including US Department of Education, National Cancer Institute and the National Science Foundation. Dr. Peterman is currently managing a range of projects, including an evaluation for the National Academy of Engineers; a project for the Girls Get Connected Collaborative, entitled Technology at the Crossroads; an evaluation for WGBH-TV of their new television series NOVA scienceNOW; and a project for the Wildlife Conservation Society. She has expertise in embedded assessment and evaluation design, and assists in the development of proposals and evaluation plans for upcoming projects. Prior to joining GRG, Dr. Peterman consulted with Insight Research Group and assisted with a summative evaluation project at the Exploris Museum. Dr. Peterman received her Ph.D. from Duke University and was an NIH Pre-Doctoral Fellow at the Center for Developmental Science housed at the University of North Carolina, Chapel Hill

INCREASING THE IMPACT OF YOUR PROGRAM THROUGH A NEEDS ASSESSMENT SURVEY

Abstract:

The development of a Needs Assessment Survey can be a useful tool for determining the current knowledge and level of interest in potential training and activities related to engineering education. This paper explores the results from one Needs Assessment Survey for its members and how the results facilitated the ability of the organization to identify the professional development topics of most interest to their members. This then allowed the organization's leadership to use the survey results in structuring their activities for their members in their project and should increase the likelihood that the proposed projects are well received and successful.

Introduction:

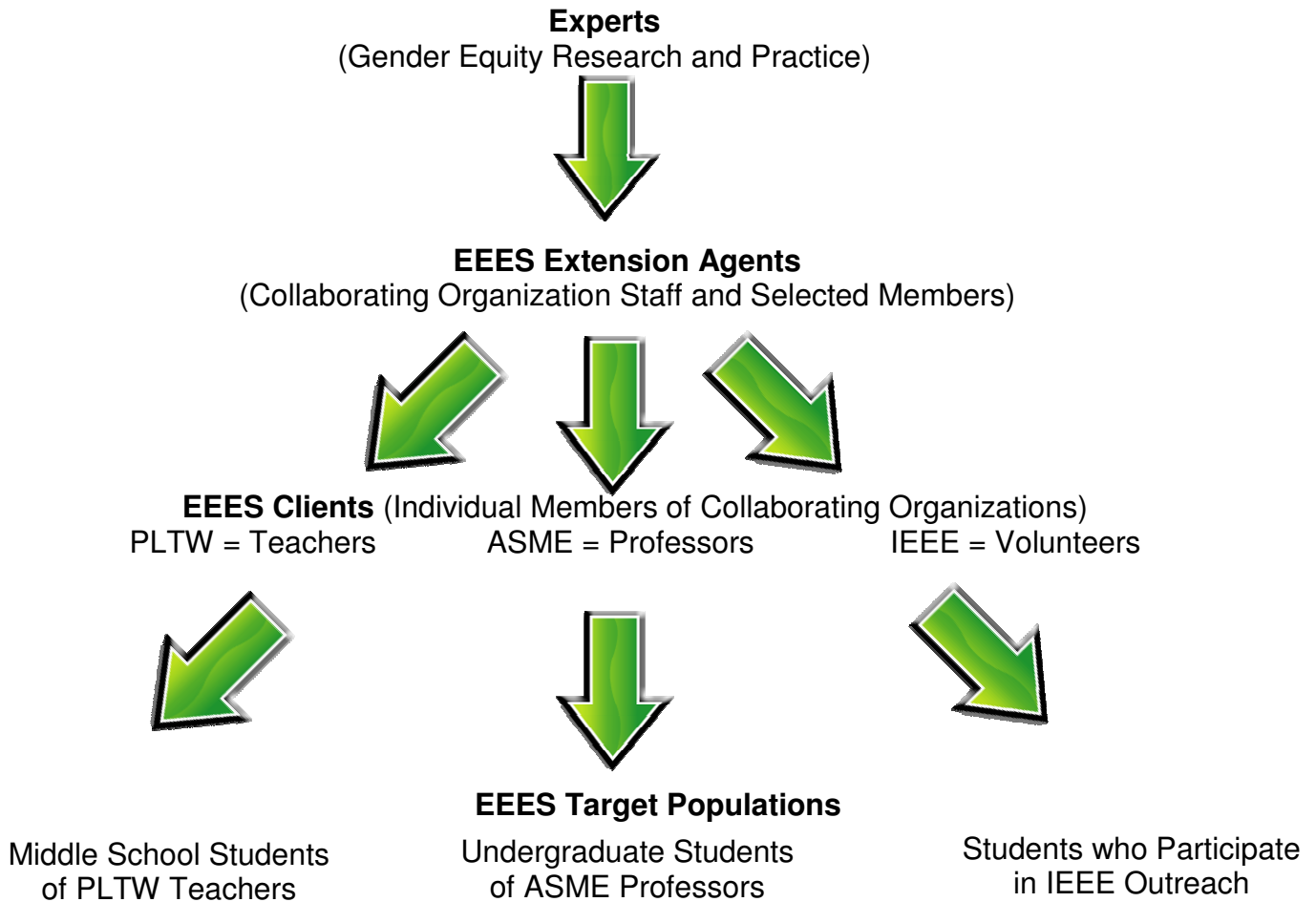
The National Academy of Engineering's Center for the Advancement of Scholarship on Engineering Education (CASEE) received a grant from the National Science Foundation (NSF) in 2005 to create the Engineering Equity Extension Service (EEES). The goal of EEES is to provide national extension services to the pre-engineering and engineering communities by bringing together

- expertise in gender studies,
- the research base on science and engineering education, and
- practical skills in project management.

This project was funded, in part, to address the shortage of American students pursuing a career in engineering. While it is true that engineers today must be equipped with the skills needed to work in a global environment, it is also true that the United States is contributing fewer engineers to this environment than ever before. This project aims to correct this trend by making engineering more accessible and interesting to a wider range of students.

As part of this effort, CASEE is partnering with three national engineering organizations: American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronics Engineering (IEEE), and Project Lead the Way (PLTW). Each organization is working with CASEE to create train-the-trainer programs to help accomplish the overall project goal.

The EEES Train the Trainer Model



The Goodman Research Group, Inc. (GRG) was engaged to provide evaluation for the project and conducted the Needs Assessment Survey described in this paper. Starting in 2006 Needs Assessment Surveys of members of the three organizations in the EEES project were created in order to identify the professional development topics of most interest to the members of each organization. The members included end-users of professional development activities as well as those who would serve as the “trainers” to be supported by EEES.

The Needs Assessment Surveys were developed so that they would provide the organizations useful data on members’ current interests and ranking of potential topics and activities that their EEES project was considering, and thereby help the organizations in structuring their activities on gender equity to be most effective in reaching their members. Survey respondents rated the importance of several issues in the field of

engineering today, including

- Items related to the importance of increasing K-12 students' exposure to and interest in engineering,
- Effective techniques for teaching engineering to different types of learners (including females and other groups who do not typically pursue engineering), and
- Creating the engineering workforce of tomorrow.

The results of the Needs Assessment Surveys indicate several common themes were found across organizations and as well as differences in responses based on race, gender, and sector of employment (academia, industry, etc.) of respondent. This paper will focus on one of the organizations in the EEES project, PLTW, its survey results, on how survey results have been used to inform programming decisions made by the organization, and the implications for embedding gender equity into existing programs in engineering organizations.

Project Lead The Way (PLTW) Needs Assessment Survey Results

Project Lead The Way (PLTW) is a not-for-profit organization that promotes pre-engineering courses for middle and high school students. PLTW forms partnerships with public schools, higher education institutions and the private sector to increase the quantity and quality of engineers and engineering technologists graduating from the U.S. educational system. PLTW curriculum was first introduced to 12 New York State high schools in 1997. Currently PLTW courses are offered in over 2,000 schools in 50 states and the District of Columbia. PLTW has developed a high school program for engineering that is a four year sequence of courses which, when combined with traditional mathematics and science courses in high school, introduces students to the scope, rigor, and discipline of engineering prior to entering college.

In the fall of 2006 the PLTW Needs Assessment Survey was hosted on a web site for three weeks. An email and two follow-up emails were sent during this period to a listserv of approximately 4,000 members. A total of 1,067 members responded to the survey.

Table 1 presents the demographic profile of the PLTW respondents who completed the survey. As you can see from the table below, the majority of the survey respondents were male and white. Most of respondents were teachers (89%) and there was a large range of teaching experience.

Survey respondents were given eight topics and were asked to rate the extent to which they thought each topic was an important issue to the field of engineering on a scale of 1 (Not at All) to 5 (Extremely). The ratings of these topics are below in Table 2 and are listed by order of rated importance.

Table 1
Demographic Profile of PLTW Survey Respondents

	%	
	Respondents	
Gender	Male	82%
	Female	18%
Race/Ethnicity	African American	4%
	American Indian	<1%
	Asian	2%
	Hispanic	3%
	Native Hawaiian/Pacific Islander	<1%
	White	88%
Current Position	Teacher	89%
	Counselor	<1%
	Professor	9%
	Other	5%
Number of Years Teaching	Less than 5 years	32%
	6-15 years	28%
	16-25 years	22%
	26-35 years	14%
	36-45 years	2%

N=1,067 for each category with the exception of Number of Years Teaching (N=1,045)
 Those who responded “Other” to the question about Current Position included mostly administrators.

Table 2
PLTW Members’ Ratings of Issues to the Field of Engineering

	Not at All 1	A Little 2	Somewhat 3	Very 4	Extremely 5
Increasing the number of American engineering students mean=4.58	<1%	<1%	6%	28%	65%
Creating the engineering workforce of tomorrow mean=4.53	<1%	<1%	5%	35%	59%
Exposure of K-12 students to engineering mean=4.47	0%	1%	6%	38%	55%
Increasing K-12 students’ interest in engineering mean=4.46	0%	1%	6%	39%	54%
The need to improve engineering education mean=4.42	<1%	<1%	10%	35%	54%
Retention of undergraduate engineering students mean=4.26	<1%	1%	14%	42%	43%
The need for more women in engineering mean=4.19	1%	3%	16%	36%	44%
The need for more racial/ethnic diversity in engineering mean=3.87	3%	5%	26%	34%	32%

N=1,067

From Table 2 one can discern the following:

- On average five of the eight items rated were considered to be a 4 (Very) to a 5 (Extremely Important) to the field;
- The topics of “retention of undergraduate engineering students” and “the need for more women in engineering” were rated as 4s (Very important) on average; and
- “The need for more racial/ethnic diversity in engineering” topic was rated on average as a 3 (somewhat) to a 4 (Very important).

The Goodman Research Group (GRG) then analyzed these responses based on respondents’ gender and race and determined the following:

- PLTW survey respondents who identified themselves as belonging to underrepresented racial and ethnic groups rated every topic as a more important issue when compared to the survey respondents from racial and ethnic groups that are not underrepresented. Five of these differences were statistically significant including “the need for more women in engineering” and “the need for more racial/ethnic diversity in engineering.” This is displayed in Table 3.
- Male and female survey respondents rated the eight topics similarly overall. However, women rated “the need for more women in engineering” and “the need for a more racial/ethnic diversity in engineering” as more important issues at a statistically significant level. This is shown in Table 4.

Table 3
Mean Ratings of Issues in the Field Today, by Racial/Ethnic Representation in the Field of Engineering

	Underrepresented Groups (N=80)	Non- Underrepresented Groups (N=987)
Increasing the number of American engineering students	4.59	4.58
Creating the engineering workforce of tomorrow	4.65	4.52
The need to improve engineering education	4.67	4.37*
Increasing K-12 students’ interest in engineering	4.60	4.45*
Retention of undergraduate engineering students	4.39	4.25
Exposure of K-12 students to engineering	4.61	4.46*
The need for more women in engineering	4.60	4.41**
The need for more racial/ethnic diversity in engineering	4.47	3.82**

*p<05; **p<.01

Table 4
Mean Ratings of Issues in the Field Today, by Gender

	Males (N=877)	Females (N=190)
Increasing the number of American engineering students	4.58	4.57
Creating the engineering workforce of tomorrow	4.53	4.52
The need to improve engineering education	4.67	4.37
Increasing K-12 students' interest in engineering	4.45	4.48
Retention of undergraduate engineering students	4.25	4.31
Exposure of K-12 students to engineering	4.48	4.45**
The need for more women in engineering	4.42	4.40**
The need for more racial/ethnic diversity in engineering	3.79	4.22

**p<.01

The Needs Assessment Survey then asked the respondents to select the one issue that the respondent felt was “the most important issue to the field of engineering.” As you can see in Table 5 survey respondents were divided about which issue to choose. However, approximately one in five selected either “increasing K-12 students’ interest in engineering” or “exposure of K-12 students to engineering” as the most important issue.

Table 5
PLTW Members’ Ratings of the Most Important Issue to the Field of Engineering

	% Respondents
Increasing K-12 students' interest in engineering	22%
Exposure of K-12 students to engineering	22%
Increasing the number of American engineering students	17%
Creating the engineering workforce of tomorrow	17%
The need to improve engineering education	10%
Retention of undergraduate engineering students	5%
The need for more women in engineering	5%
The need for more racial/ethnic diversity in engineering	2%

N=1,067

The Needs Assessment Surveys were designed so that the organizations would not only get feedback on potential topics and their relative importance but also on the preferred delivery modes of training. The PLTW Needs Assessment Survey asked their respondents to rate their interest in receiving training and/or attending a workshop that featured a specific topic. Fifteen topics were provided and the ratings are on a five point scale of 1 (Not at All) to 5 (Extremely). Results of the PLTW respondents’ preferences are provided in Table 6 in order of preference. One can note that following from this table:

- The first choice for training was on “ways to improve engineering education.”
- The topics focused specifically on girls – “effective techniques for getting girls interested in engineering” and “effective retention strategies for keeping girls in engineering programs” were rated third and fifth overall.

- The topics of least interest to these survey respondents were “research on student learning” (rated 15th) and “mentoring skills” (rated 14th) on average.

Table 6
PLTW Members’ Interest in Training/Workshop Topics

	Not at All 1	A Little 2	Somewhat 3	Very 4	Extremely 5
Ways to improve engineering education mean=4.06	2%	3%	16%	44%	35%
Keys to successful implementation programs mean=3.86	2%	7%	21%	43%	27%
Effective techniques for getting girls interested in engineering mean=3.82	3%	7%	23%	38%	29%
Engineering content for K-12 students (curricular and extracurricular) mean=3.79	2%	6%	27%	41%	24%
Effective retention strategies for keeping girls in engineering programs mean=3.78	4%	8%	24%	38%	28%
Skill assessment in hands-on learning mean=3.58	5%	8%	28%	41%	18%
Pedagogy related to effective engineering instruction mean=3.57	5%	8%	29%	40%	18%
Effective techniques for getting ethnically diverse students interested in engineering mean=3.46	6%	12%	31%	33%	18%
Effective retention strategies for keeping ethnically diverse students in engineering programs mean=3.43	6%	13%	31%	31%	19%
Group organization and project teams mean=3.41	6%	11%	34%	35%	14%
Creating an effective teaching climate mean=3.26	8%	16%	32%	30%	14%
Instruction techniques for different types of learners mean=3.22	8%	15%	36%	28%	13%
Effective curricular characteristics for different types of learners mean=3.17	8%	16%	38%	27%	11%
Mentoring skills mean=2.99	9%	20%	40%	24%	7%
Research on student learning mean=2.85	12%	23%	39%	19%	7%

N=1,067

Goodman Research Group, Inc. (GRG) investigated this data using a series of independent-sample t tests to determine if there were differences in topics by group.

- Women were more interested than men in several of the topics and they reported a greater interest at a statistically significant level in eight of the fifteen topics. Six of these eight topics focused on learning to reach and teach different types of learners. This included, but was not limited to topics on girls and ethnically diverse students.

- Survey respondents from underrepresented groups rated their interest in ALL of the fifteen topics at a higher level when compared to the rest of the respondents. These differences were statistically significant in ten out of fifteen topics and including topics on reaching and teaching girls and ethnically diverse students.

One week into the survey collection, an open ended question was added that allowed respondents to share any thoughts they had on the survey and its contents. Of the 725 respondents during this period, 139 (19%) did provide feedback. Examples of the responses give on the open ended question include:

- “Let’s get students, in general, involved with engineering, and not focus on diversity. You can’t have equality and excellence at the same time. Why don’t we just focus on the excellence part because it seems much more capable than equality.”
- “I think this is a politically correct stunt. I want [competent] engineers, irregardless (sic) of gender or race.”
- “I am a female PLTW teacher with a degree in mechanical engineering. I teach MANY white males that are VERY interested in engineering. We seem to focus way too much on recruiting women and minorities that are not interested at all. Too many times my white, male students are left out of the loop and miss opportunities when they are the ones who deserve the [opportunities] and would work the hardest.”

The open ended comments were then coded by GRG. The largest group of respondents (19%) felt that PLTW should not be focused on increasing diversity in engineering. Several respondents provided other topics which they felt would be a more appropriate topic including:

- The need for increasing technology in the classroom;
- The need for increased salaries for engineers; and
- Recruitment of all students for engineering regardless or race or gender.

Post Needs Assessment Survey - Activities Developed by Project Lead the Way (PLTW)

After the results from the Need Assessment Survey were reviewed, Project Lead The Way has focused its efforts on the following activities:

- Review of current PLTW curriculum using research on gender inclusion. Currently reviews of three units (one middle school level and two high school level) have been completed;
- Development of materials and resources that will support the training of high school guidance counselors and of PLTW master teachers on the importance of gender equity principles and their application to their work; and
- Development of EEES activities at the annual Summer Training Institutes for PLTW teachers and staff.

PLTW has used the EEES Experts and other gender equity leaders to provide training to their Master Teachers and Affiliate Professors who make up the corps of PLTW trainers. These trainers lead Summer Training Institutes (STIs) with teachers from around the country every summer. The Master Teachers and Affiliate Professors then serve as EEES Extension Agents as they integrate gender equity training into their STI. It is expected that teachers will be able to take the equitable practices they learn in their STI and use them in their classrooms to directly influence their students.

PLTW through its EEES work hosted a series of training webinars in Fall 2007 designed to help guidance counselors and other key educators understand more about the field of engineering and the need for a more diverse engineering work force. These webinars were led by EEES Experts, and it is anticipated that those who participate will then become EEES Extension Agents who use the information from the webinar to train counselors in their local area.

Conclusions:

Based on the Needs Assessment Surveys conducted by Goodman Research Group, Inc. for CASEE and its EEES project, we have noted the following:

- **The data from the PLTW Needs Assessment Survey confirm CASEE’s decision to use a “stealth approach” to deliver gender equity content to PLTW teachers while using a more explicit approach with PLTW master teachers and staff.** When asked to choose the biggest issue in their field today, members from PLTW selected a global issue such as *creating the workforce of tomorrow* rather than an issue that focused on a sub-group of engineering students such as girls. In addition, a small group of respondents from PLTW voiced opposition to a focus on diversity as demonstrated in the open ended comments shared earlier in this paper.
- These findings and anecdotal evidence from the first two project years **suggest that offerings that focus on improving engineering education without always having an explicit focus on gender equity may be better received and thus more effective than offerings with a specific focus on gender equity.**
- In addition, these data indicate that the broad topics that each organization finds most pressing often facilitate the greatest engagement of the audience. PLTW teachers believe that increasing K-12 students’ exposure to and interest in engineering are the biggest issues facing the field of engineering today. By using these as overarching themes, EEES activities have been able to reach a large audience of PLTW members who might not have initially engaged in a more narrowly defined effort to reach only female students.

Acknowledgements

The authors gratefully acknowledge the support provided by the National Science Foundation under grant HRD-0533520. The views expressed are those of the authors and may not reflect the views of the sponsoring agency.