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Broadening Participation: A Report on a Series of Workshops Aimed at Building Community and Increasing the Number of Women and Minorities in Engineering Design

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Abstract

Despite some progress in increasing the numbers of women and minorities in engineering over the past 30 years, their full participation in the discipline has yet to be achieved, particularly in engineering academia. One cause is the "leaky pipeline"; even after women and minorities choose to major in engineering, they drop out at rates higher than their counterparts along all career stages (undergraduate school, graduate school, tenure-track, etc.). Their small numbers creates isolation that has the unfortunate risks of struggle, less professional success, less sense of personal belonging, and less retention. Our hypothesis is that building a community that provides networking and support, opportunities for collaboration, and professional development, will lead to greater career success, personal fulfillment and professional happiness, retention, and greater participation/contribution from women and minorities. The authors have been conducting a series of workshops aimed at broadening participation of women and other minorities within the American Society of Mechanical Engineers (ASME) Design Engineering Division (DED). This paper reports on the activities and results of the workshop series. Pre-workshop survey data indicated a clear opportunity to address the unmet needs of underrepresented groups in the ASME DED. Post-workshop survey data showed success in attendee satisfaction with feelings of inclusion and community, professional skill building, and the prospect of future workshops held by the committee. A follow-up impact assessment survey showed that the workshops have led to greater participation in DED activities, new positive connections within the DED community, and positive feelings regarding their communication/collaboration abilities, self confidence, level of comfort, feelings of inclusion, professional goals, leadership abilities, and skill sets. While these results are encouraging, the committee feels strongly that greater success in broadening the participation of underrepresented groups in engineering would be possible by sharing our strategies and successes, and learning from others with similar experience creating communities within the many engineering disciplines represented in ASEE.

Keywords

Industrial and Manufacturing Systems Engineering

Disciplines

Engineering Education | Higher Education | Industrial Engineering | Mechanical Engineering | Science and Mathematics Education

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Broadening Participation: A Report on a Series of Workshops Aimed at Building Community and Increasing the Number of Women and Minorities in Engineering Design

Dr. Katherine Fu, MIT

Kate Fu is Postdoctoral Fellow at MIT and Singapore University of Technology and Design (SUTD). In May 2012, she completed her Ph.D. in Mechanical Engineering at Carnegie Mellon University. She received her M.S. in Mechanical Engineering from Carnegie Mellon in 2009, and her B.S. in Mechanical Engineering from Brown University in 2007. Her work has focused on studying the engineering design team process through cognitive studies. Her research is now moving toward exploring analogical inspiration and building computational design tools to aid designers during the engineering design process.

Tahira N Reid, Purdue University

Dr. Tahira N. Reid is currently an Assistant Professor in the School of Mechanical Engineering at Purdue University and is the director of the Research in Engineering and Interdisciplinary Design (R.E.I.D.) Lab. Her general research interests include: product design and development; developing methods to support the decision making of engineers and designers, the use of methods from the behavioral sciences to quantify consumer and/or designer judgments and decisions; and studying the role of perception in design. Prior to Purdue, she completed a postdoctoral fellowship in the Mechanical Engineering department at Iowa State working in the Interdisciplinary Research in Sustainable (IRIS) Design Lab. In 2010, she received her Ph.D. from the University of Michigan in Design Science, with Mechanical Engineering and Psychology as her focus areas. Dr. Reid received both her BS and MS degrees in Mechanical Engineering from Rensselaer Polytechnic Institute in 2000 and 2004, respectively.

Dr. Janis P. Terpenney, Iowa State University

Dr. Janis Terpenney is the department chair and Joseph Walkup Professorship of Industrial and Manufacturing Systems Engineering at Iowa State University. She comes to ISU from Virginia Tech, where she was a professor in the Department of Mechanical Engineering and in the Department of Engineering Education and an affiliate of the Department of Industrial and Systems Engineering. Dr. Terpenney also served as a program director for the Division of Undergraduate Education at the National Science Foundation (NSF) prior to her move to ISU. She is the director of the Center for e-Design, a multi-university NSF industry/university cooperative research center (IUCRC). Her research focus is engineering design (process and methods of early design; knowledge and information in design; product families and platforms; obsolescence in products and systems; and complexity of products and systems) and design education (multidisciplinary teams; impacts of project choice and context; and the retention and success of under-represented students). She has 9 years of industry work experience with the General Electric Company (GE), including the completion of a 2-year corporate management program. Throughout her career, she has managed over \$8 million of sponsored research and is the author of 150 peer-reviewed publications. She is a member and Fellow of IIE, a member and Fellow of ASME, and a member of ASEE, INFORMS, Alpha Pi Mu, and Tau Beta Pi. She serves as an associate editor for the ASME Journal of Mechanical Design and for the Engineering Economist. She has received numerous awards for excellence in teaching, in research, and for service.

Dr. Deborah L. Thurston, University of Illinois, Urbana-Champaign

Deborah L. Thurston is a Gutsell Professor of Industrial and Enterprise Systems Engineering at the University of Illinois in Urbana-Champaign. She earned her Ph.D. from MIT, is a registered Professional Engineer, and a Fellow of the American Society of Mechanical Engineers.

Dr. Judy M. Vance, Iowa State University



Dr. Judy M. Vance is the Joseph C. and Elizabeth A. Anderlik Professor of Engineering at Iowa State University and a Faculty Fellow of the Virtual Reality Applications Center. Dr. Vance is a Fellow of the American Society of Mechanical Engineers (ASME) and past chair of the ASME Design Engineering Division. She is a former Associate Editor of the ASME Journal of Mechanical Design and an NSF CAREER award recipient. She served as department chair of Mechanical Engineering at Iowa State University from 2003 to 2006 and she spent two years at the National Science Foundation (NSF) as the Program Director for Engineering Design and Innovation. She is a past member of the NSF Engineering Directorate Advisory Committee and served as co-chair of the NSF Committee of Visitors for the Design and Manufacturing Innovation Division. In 2012 she received an Honorary Doctorate of Engineering Degree from Heriot-Watt University, Edinburgh UK. Her research focuses on investigations of the use of virtual reality in product design and manufacture.

Prof. Susan Finger, Carnegie Mellon University

Susan Finger is a Professor of Civil and Environmental Engineering at Carnegie Mellon University. She is currently on leave at the National Science Foundation in the Division of Undergraduate Education. She is also affiliated with the Institute for Complex Engineered Systems and the School of Architecture. Dr. Finger received her B.A. in Astronomy and M.A. in Operations Research from the University of Pennsylvania and her Ph.D. in Electric Power Systems through Civil Engineering from the Massachusetts Institute of Technology. She was the first program director for Design Theory and Methodology at the National Science Foundation and is a founder of the journal Research in Engineering Design. Dr. Finger's research interests include collaborative learning in design, rapid prototyping, and integration of design and manufacturing concerns.

Dr. Gloria J. Wiens, University of Florida

Gloria J. Wiens holds a Ph.D. in mechanical engineering from The University of Michigan, and M.S. and B.S. in mechanical engineering from Kansas State University. After receiving her Ph.D. degree in 1986, she has served on the faculty of State University of New York-Binghamton, Auburn University and University of Florida. Over the past 26 years, Professor Wiens has been conducting research in the areas of intelligent and autonomous robotic systems, and development of innovative mechanisms and controls for automation, space robotics/small satellites, manufacturing and micro-electro-mechanical systems. She has theoretical and experimental expertise in dynamics and controls of flexible multibody systems; system identification; design and control of robots using intelligent, event-driven, and physics-based modeling techniques; sensor-enabled dynamic (active) fixturing for micro/mesoscale manufacturing systems; system automation; modeling and design of MEMS devices; and design, path-planning, dynamics and control of reconfigurable, cooperative multi-robotic systems. Her research is/has been supported by Lockheed Martin Corporation, DARPA, NSF, NASA, SNL, Hammond Machinery, Inc., Harris Corporation, PhaseSpace Corp., and others. In 2010, Professor Wiens served as a National Research Council supported Senior Research Associate at the AFRL/RVSV-Kirtland AFB conducting research on small satellite telescopes integrating the design of the deployable structures (mechanisms) with the optics. Professor Wiens has held/holds numerous positions in ASME including Manufacturing Engineering Division (MED) Executive Committee Chair (1998-99) and member (1994-1999), member of Design Engineering Division's Mechanisms and Robotics Technical Committee (1991-1996, 2006-2012), associate editor for Journal on Manufacturing Science and Engineering (2004-2011), founding member of Micro/Nano-Scale Systems (MNS) Committee (2005-2012), MNS Program and Conference Chair for iDETC/CIE 2008 and 2009 respectively, Conference Micro and Nano Technologies Track chair for 2008 MSEC, member of Design Engineering Division Committee on Broadening Participation (2008-present), member of Board on Pre-College Education (1993-1996), chair of Chattahoochee Section's Honors and Awards Committee (1989-1990), chair of the Chattahoochee Section's Minorities and Women Committee (1992-1994), organizer of The 1st Annual ASME Manufacturing Engineering Division's Student Manufacturing Design Competition (1995), chair (1992) and co-chair (1990) of the Student Mechanism Competition Committee (1989-1990 and 1991-1992), and Newsletter Editor for the Production Engineering Division (1990-1992).



In addition, Professor Wiens has served on numerous other panels, committees, U.S.A. delegations and boards for NSF, ASME, IEEE, SME, etc. Professor Wiens has also been serving on the Board of Directors as Vice-President for the Eastern and International Regions for Pi Tau Sigma – National Mechanical Engineering Honor Society Sigma (1999-2014). In summer 2012, Professor was made a fellow of ASME.

Prof. Kazem Kazerounian, University of Connecticut

Kazem Kazerounian is the Interim Dean of the School of Engineering and Professor of Mechanical Engineering in the School of Engineering, University of Connecticut. Dr. Kazerounian's expertise is in analytical and computational kinematics and dynamics applied in diverse application fields, such as protein based nano-scale mechanical devices, optimization of mechanisms and gear systems, robotics, and human motion analysis. Additionally he has extensively studied creativity in engineering education. His professional service in ASME includes Chair of the Mechanisms and Robotics Committee, DED Executive Committee, and several ASME conferences including the general conference chair for IDETC/CIE 2002. Currently he is also a member of the ASME Strategic Planning Committee.

Prof. Janet Katherine Allen, University of Oklahoma

Janet Allen came to the University of Oklahoma in August 2009 where she and Professor Farrokh Mistree are establishing the Systems Realization Laboratory at the University of Oklahoma with a focus on engineering design. She holds the John and Mary Moore chair of Engineering and is a Professor of Industrial and Systems Engineering. Before coming to OU, she retired from the Woodruff School of Mechanical Engineering at Georgia Tech where she is Professor Emerita. The focus of Dr. Allen's research is engineering design and especially the management of uncertainty when making design decisions. Her group was among the first to suggest the use of modeling uncertainty in design, particularly in the early stages of design and to recognize the importance of statistical simulation and computer-based experimentation in design and was also among the first to demonstrate the importance of using the design of experiments in exploring regions of design space in order to create surrogate models. This is a necessary step in moving away from the costly and time-consuming method of testing designs by building prototypes and replacing physical prototypes with computer-based experiments. Using surrogate models lead to the investigation of various aspects of robust design of many different systems, especially multilevel and multiscale systems. A special focus has been on supporting collaborative decision making and design – several hierarchical procedures and game theory have been used to model collaborative design. Dr. Allen and her students study/have studied energy systems, mechanical systems, materials, and design methods and have published over 200 papers in journals, conference proceedings and edited books. She is a Fellow of ASME, a Senior Member of AIAA and an Honorary Member of the Mechanical Engineering Honor Society Pi Tau Sigma.

Kathy Jacobson

Kathy Jacobson, an ASME Fellow, has 30 years of industrial experience specializing in applying Design for Manufacturing and Affordability in the early product design phases. She has held positions with General Electric and Lockheed Martin in the areas of manufacturing engineering, systems engineering, finance, and conceptual design. She earned her B.S. in Engineering from UCLA. Kathy was a Girl Scout leader for thirteen years and is involved with developing STEM opportunities for girls in her GS council. She also volunteers with the Science Olympiad program at a local middle school and organizes state-wide Science Olympiad coaching workshops.

**AC 2013 - 6781: BROADENING PARTICIPATION: A REPORT ON A
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Abstract

Despite some progress in increasing the numbers of women and minorities in engineering over the past 30 years, their full participation in the discipline has yet to be achieved, particularly in engineering academia. One cause is the "leaky pipeline"; even after women and minorities choose to major in engineering, they drop out at rates higher than their counterparts along all career stages (undergraduate school, graduate school, tenure-track, etc.). Their small numbers creates isolation that has the unfortunate risks of struggle, less professional success, less sense of personal belonging, and less retention. Our hypothesis is that building a community that provides networking and support, opportunities for collaboration, and professional development, will lead to greater career success, personal fulfillment and professional happiness, retention, and greater participation/contribution from women and minorities. The authors have been conducting a series of workshops aimed at broadening participation of women and other minorities within the American Society of Mechanical Engineers (ASME) Design Engineering Division (DED). This paper reports on the activities and results of the workshop series. Pre-workshop survey data indicated a clear opportunity to address the unmet needs of underrepresented groups in the ASME DED. Post-workshop survey data showed success in attendee satisfaction with feelings of inclusion and community, professional skill building, and the prospect of future workshops held by the committee. A follow-up impact assessment survey showed that the workshops have led to greater participation in DED activities, new positive connections within the DED community, and positive feelings regarding their communication/collaboration abilities, self confidence, level of comfort, feelings of inclusion, professional goals, leadership abilities, and skill sets. While these results are encouraging, the committee feels strongly that greater success in broadening the participation of underrepresented groups in engineering would be possible by sharing our strategies and successes, and learning from others with similar experience creating communities within the many engineering disciplines represented in ASEE.

Introduction

The goal of the Broadening Participation committee is to develop, implement and oversee new and existing activities aimed at broadening the participation of women and underrepresented minorities in the activities of the Design Engineering Division of the American Society of Mechanical Engineers. The committee was formed in the fall of 2008 by seven founding members, and has since grown to ten members, with interest from even more wanting to join and make a difference. The efforts of the committee toward broadening the participation of women and underrepresented minorities have involved a number of activities, the largest of which has been the annual workshops held at the American Society of Mechanical Engineers International Design Engineering Technical Conferences (ASME IDETC).

This paper provides a detailed report on workshop activities, including a description of each workshop topic, as well as activities that were conducted within each workshop. In addition, the results of survey assessments are presented and analyzed.

Four workshops have been held to date, all occurring the day prior to the annual ASME IDETC meeting. Participation has been by application. The workshop topics were selected based on their usefulness to the professional development for the target audience. The first was on Negotiation Strategies, the second on Networking Skills and Strategies, the third on Navigating and Leading Change, and the fourth on Communicating Technical Ideas. Each workshop was conducted by a professional consultant, supported by funds provided by ASME. The National Science Foundation (NSF) provided funding for the participation of graduate students and postdocs.

The ASME IDETC attracts up to 1100 attendees from all over the world. The proportion of majority-to-minority and male-to-female attendees at the conference reflects the overall low representation of minorities and women in the mechanical engineering profession. Workshop attendees develop crucial skills to help them negotiate, network, navigate and lead change, and communicate. In addition, connecting attendees within the design community early in their careers, will give them opportunities to support each other throughout their careers. Our hypothesis is that building a community that provides networking and support, opportunities for collaboration, and professional development, will lead to greater career success, personal fulfillment and professional happiness, retention, and greater participation/contribution from women and minorities, as suggested in the literature.

Literature Review

Although the disadvantages that women and minorities face in society, and specifically in the fields of science and engineering, may be largely imperceptible to those more privileged members of well-represented groups [1], it is evident there remain significant disadvantages for these underrepresented groups. In this paper, we focus on the status of underrepresented groups in academia, though the impact of these disadvantages reaches far beyond. While there have been significant increases in the participation of women and minorities in science and engineering, degree attainment and careers in academia in the last 40 years [2, 3], it remains far from equitable among all groups. The 2011 Engineering by the Numbers report [4] in the ASEE Profiles of Engineering and Engineering Technology Colleges states that in 2011:

For women:

- Only 18.4 % of bachelor's degrees in engineering are earned by women [4], down from 20% in 2001[5]
- 22.6% of master's degrees in engineering were earned by women [4], essentially unchanged since 2001[5]
- 21.8% of doctoral degrees in engineering were earned by women [4], up from 16.8% in 2001[5]
- Women make up only 13.8% of tenured and tenure track faculty in engineering [4], up from 9.2% a decade ago

For minorities:

- The percentage of African American students earning degrees in engineering is 4% [4], while African Americans make up 12.6% of the U.S. population [6]

- The percentage of Hispanic students earning bachelor's degrees in engineering is 8.5% [4], while 16.4% of the U.S. population is Hispanic [6]
- Minority faculty numbers have remained virtually stagnant for the past 10 years, with 2.5% of faculty comprised of African Americans and 3.7% comprised of Hispanic persons [4]; 27.6% of the U.S. population is not white/Caucasian [6]
- The percentage of Asian Americans attaining faculty jobs and engineering degrees at all levels continues to steadily increase [4]

In sum, the percentages of women and underrepresented minorities in engineering academia are low, and growth rates are slow, if not stagnant. As the 2007 NAE Beyond Bias and Barriers report stated, "It is not lack of talent, but unintentional biases and outmoded institutional structures that are hindering the access and advancement of women [and minorities]. Neither our academic institutions nor our nation can afford such underuse of precious human capital in science and engineering. The time to take action is now." [7]

Our efforts over the past 4 years have been in line with the goals and activities of many groups doing research and activism on inclusion, participation, and retention of underrepresented groups [8-26]. One such program, NSF ADVANCE Institutional Transformation (IT) program [6-16] focuses on methods to achieve institutional change. Bilimoria and Liang report on the results of this program, and assert that in order to be effective, efforts must be wide-ranging, wide-reaching, and simultaneous, including activities such as "awareness creation, skill building, empowerment, leadership development, process improvements, new policy creation, and structural changes" [27]. A key component of NSF ADVANCE IT is the research-driven approach, which involves tracking inclusion factors, evaluating effectiveness of efforts, and the improvement of data collection and analysis of these efforts [28] to affect institutional change. Many professional workshops aimed at supporting careers for women in engineering have been held, most notably those sponsored by the Society of Women Engineers [29]. A National Academy of Engineering report cites the need for such workshops at the high school and middle school levels as well [30]. However, there does not appear to be literature documenting a quantitative assessment of the impact of these programs. We share the same goals and similar approaches to increasing participation, while working within a professional organization at the individual level rather than the institutional level.

In organizing and providing workshop and networking activities for members of underrepresented groups in the ASME DED community, we facilitate professional development and skill building, increased self-esteem and empowerment, a sense of mutual support from members at all levels within the community, opportunities and connections for mentorship, and building awareness of the inequalities that still exist in our community and beyond. The remainder of the paper describes the four workshops, workshop execution methods, data collection methods, a summary of our findings, and plans for future work.

Workshop Topics

2009 Workshop: Effective Negotiation Skills

This workshop was the inaugural event of the committee on the Broadening Participation Committee of the ASME, held at the ASME IDETC in San Diego, CA on August 30, 2009. The workshop was designed to provide professional development activities and to teach negotiation and conflict resolution strategies, as well as to provide a forum for networking with supportive researchers in their field.

Two half-day parallel sessions were conducted; one focused on developing negotiation skills (led by Barbara Butterfield and Jane Tucker) and one focused on networking activities. The negotiation workshop included a variety of situations and skills that are common in academic environments, including faculty strategic persuasion and decision skills for: competitive offers, committee service, salary increases, research space, etc. Tactics that have proven to be effective were covered along with flexible, outcomes-focused negotiation models. An active-participation approach was followed in learning and honing negotiation skills with exercises, activities, and case studies.

The half-day networking workshop was intended to foster a variety of long-term relationships including: research collaborations, mentoring, and affinity group building around common interests/concerns associated with the challenges for under-represented groups in the ASME DED community. These networking activities were led by the organizing committee, all of whom are leaders in research, active contributors nationally to professional societies, have prior experience organizing and/or hosting workshops, and are predominantly from underrepresented groups, with three members who have served as Program Directors at NSF. Also, several members have held administrative leadership positions.

2010 Workshop: Networking Skills and Strategies

The workshop on Networking Skills and Strategies was designed to provide faculty members and graduate students with professional development activities and to give them the opportunity and know-how to make connections with an international network of supportive researchers in their field. This workshop was held at the ASME IDETC in Montreal, QC on August 15, 2010. The half-day workshop involved both presentations and interactive time. The workshop, led by Carolyn J. Emerson and Valerie J. Davidson, began with practice in informal networking among small groups, and practice giving introductions of colleagues that participants had just met. Participants learned about effectiveness, clarity, and establishing credibility when communicating, with an emphasis on self-advocacy. Tips for effective networking were explored and explained with personal examples in small group discussions, followed by the development of individual personal action items for networking at the conference, at the office, and in the community. A networking event concluded the workshop.

2011 Workshop: Navigating and Leading Change

The workshop on Navigating and Leading Change was designed to provide participants with tools to drive transformation and manage change in their personal life as well as with teams and entire organizations. This workshop was held at the ASME IDETC in Washington, D.C. on August 28, 2011.

In the workshop, led by Cindy Zook, participants explored the five-element systems model, a simple, yet powerful model that represents the ideal, full, "healthy" life cycle of an individual, team, project or organization. The dynamics of the model operate at multiple levels simultaneously - on the personal, relational, team, project, organization, and even societal levels. Participants began to identify their own style or tendency and began to understand how, as leaders, to manage that dynamic. This will enable participants to leverage their strengths and work on areas that challenge their style in the context of change. This formed the basis of a life cycle model that was used to guide participants in specific techniques for navigating and leading change in their lives and organizations. A networking event concluded the workshop.

2012 Workshop: Communicating Technical Ideas

The goal of the workshop on Communicating Technical Ideas was to provide participants with specific strategies and tools to help them as researchers and engineers become more confident and effective communicators. This workshop was held at the ASME IDETC in Chicago, IL on August 12, 2012.

The workshop, led by Dan Agan, consisted of presentation and active participation. There was a total of one hour of working session(s) built into the agenda. All workshop participants received a free download of the companion guide on creating PowerPoint presentations, and the Panthera proprietary communications tools: the Communications Planning Worksheet, the Message Triangle, and the Storyboard Worksheet (for planning PowerPoint visuals). A networking event concluded the workshop.

Workshop Execution Methods

The methods described below were employed in the execution of all four workshops, including descriptions of the recruitment and selection processes for participants, funding information, and assessment and evaluation methods.

Recruitment and Selection

Because our goal is to attract participants from underrepresented groups into our research community, we focused our recruitment efforts on them. Each year, we actively sent email to Mechanical Engineering Department Chairs asking them to identify graduate students and Post-Doctoral Fellows from our target groups who would benefit from attendance at the workshop and the IDETC conference. We also sent out broader calls through the mailing lists for the ASME DED. The organizing committee also actively recruited through our own networks. Due to the desired interactive nature of the workshops, the attendance at all of the workshops was limited to approximately 35-45 people.

In addition to information on current position and/or progress towards completion of their degrees, education, gender, age, and ethnic background, the application requested a short essay response on research interests, long-term career goals, and benefits anticipated as a participant in the workshop. There were no required or expected areas of experience or knowledge or expertise. The applications were reviewed by the organizing committee who strove to achieve a diverse set of attendees. Our initial goal was for women, minorities and other under-represented groups to comprise at least 70% of the attendees. In the selection process, we strove to achieve a diverse set of graduate students, junior faculty, senior faculty, and administrators from underrepresented groups, as well as others.

Funding

The ASME DED supported these workshops annually, with between \$5,000 and \$10,000 for each of the four years, which covered the costs of expert workshop leaders, as well as the costs of materials and refreshments for the workshop. Two NSF grants, ENG-0948057 in 2009, and ENG-1138615 in 2011, also defrayed a portion of travel costs for graduate students and postdocs from U.S. institutions for all four workshops.

Assessment and Evaluation

In order to evaluate the effects of the workshop activities, pre- and a post-conference assessment questionnaires were requested of participants each year.

The pre-workshop questionnaire was distributed electronically prior to the workshop. The questionnaire attempted to determine the participants' current level of interaction with peers in both research collaborations and professional development. The questions explored mentoring experiences, both informal and formal, involvement in professional development activities, and existing collaborations, with a focus on activities related to the ASME DED. The post-workshop questionnaire was distributed and collected at the conclusion of each workshop. The questions focused on the participants' impression of the success of the workshop and ideas for improvement for future workshops. Finally, a follow-up impact assessment questionnaire was distributed in the Fall of 2012 to participants from all four years, which asked questions regarding how the workshop(s) and interaction within the community have affected self confidence, professional development, leadership, and career aspirations.

The workshop attendance demographics by career, gender, and race/ethnicity are presented in Figures 1-3. For all four years, the majority of participants were PhD students, with the second largest group being faculty members. For all four years, the participants were principally female. The proportion of males was increased in 2012 with the logic that greater awareness in less marginalized or more privileged groups of the population is important to changing the status quo. Unfortunately, race/ethnicity data was not collected for years 2009 and 2010. For 2011 and 2012, the majority of participants were of the demographic group white/Caucasian, with Asian as the second most represented demographic.

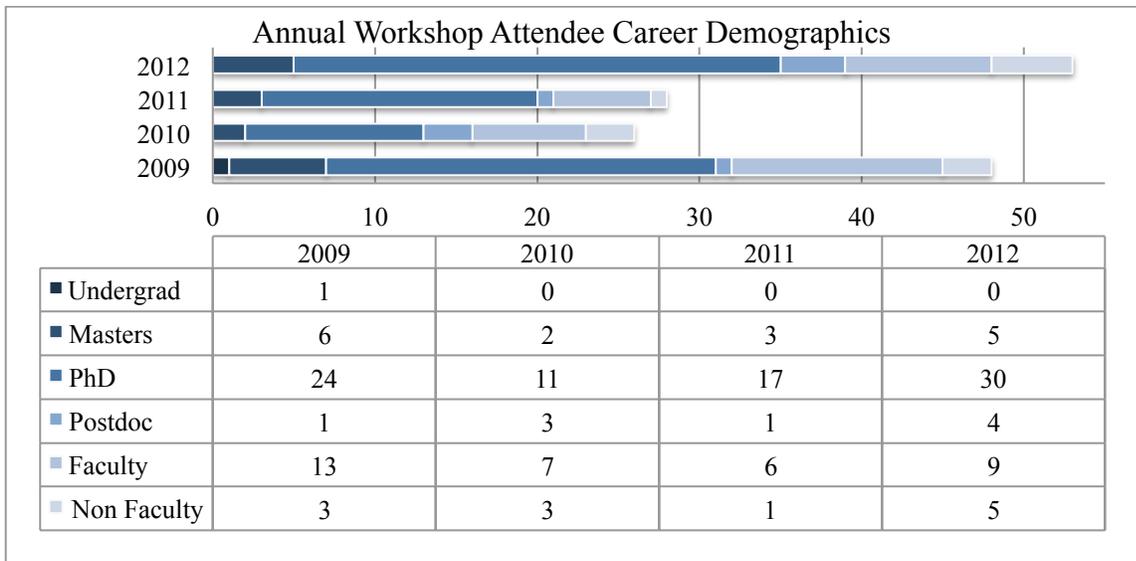


Figure 1: Annual Workshop Attendee Career Demographics

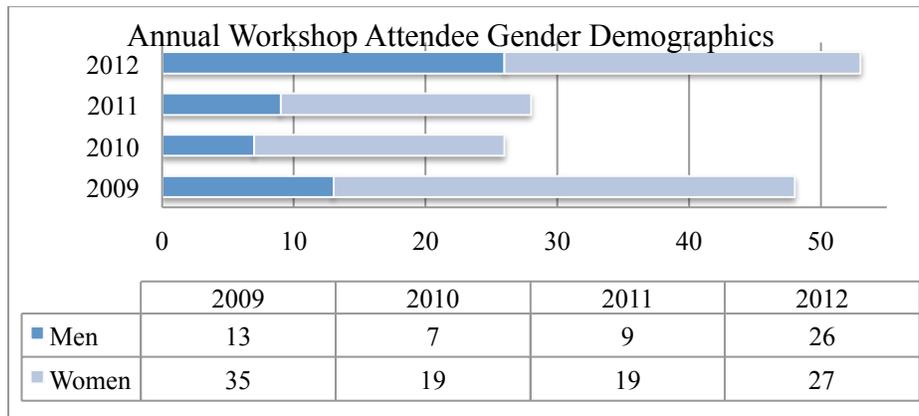
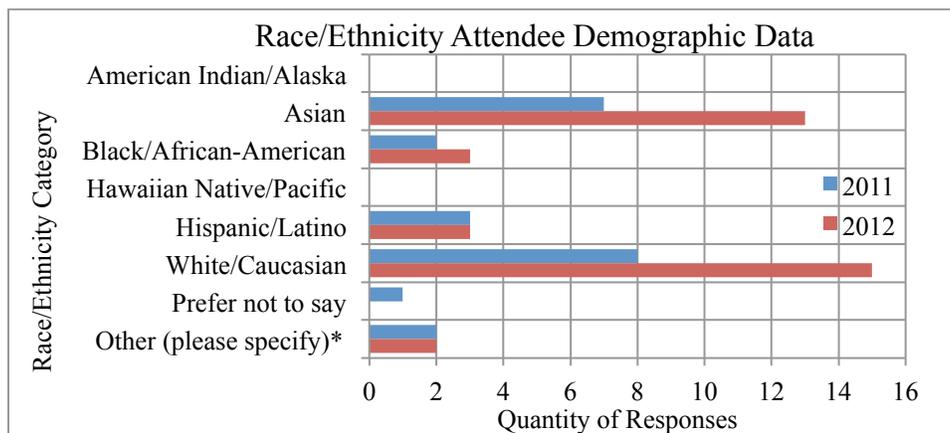


Figure 2: Annual Workshop Attendee Gender Demographics



*All "Other" responses were in the category: "Middle Eastern"

Figure 3: 2011 and 2012 Workshop Attendee Race/Ethnicity Demographics

Pre-Workshop Survey

The committee did not begin to collect year-to-year comparable pre-workshop data sets until 2011. Thus, the pre-workshop survey results only portray information on attendees from years 2011 and 2012. The total number of attendees was 28 in 2011 and 53 in 2012, but the data described in Figures 4-6 includes only a portion of these attendees who consented to complete the survey, 23 attendees in 2011 and 35 attendees in 2012. Figure 4 displays the attendee level of involvement in the DED activities. Involvement is relatively high for conference attendance and presentation, but much lower for leadership and outreach activities.

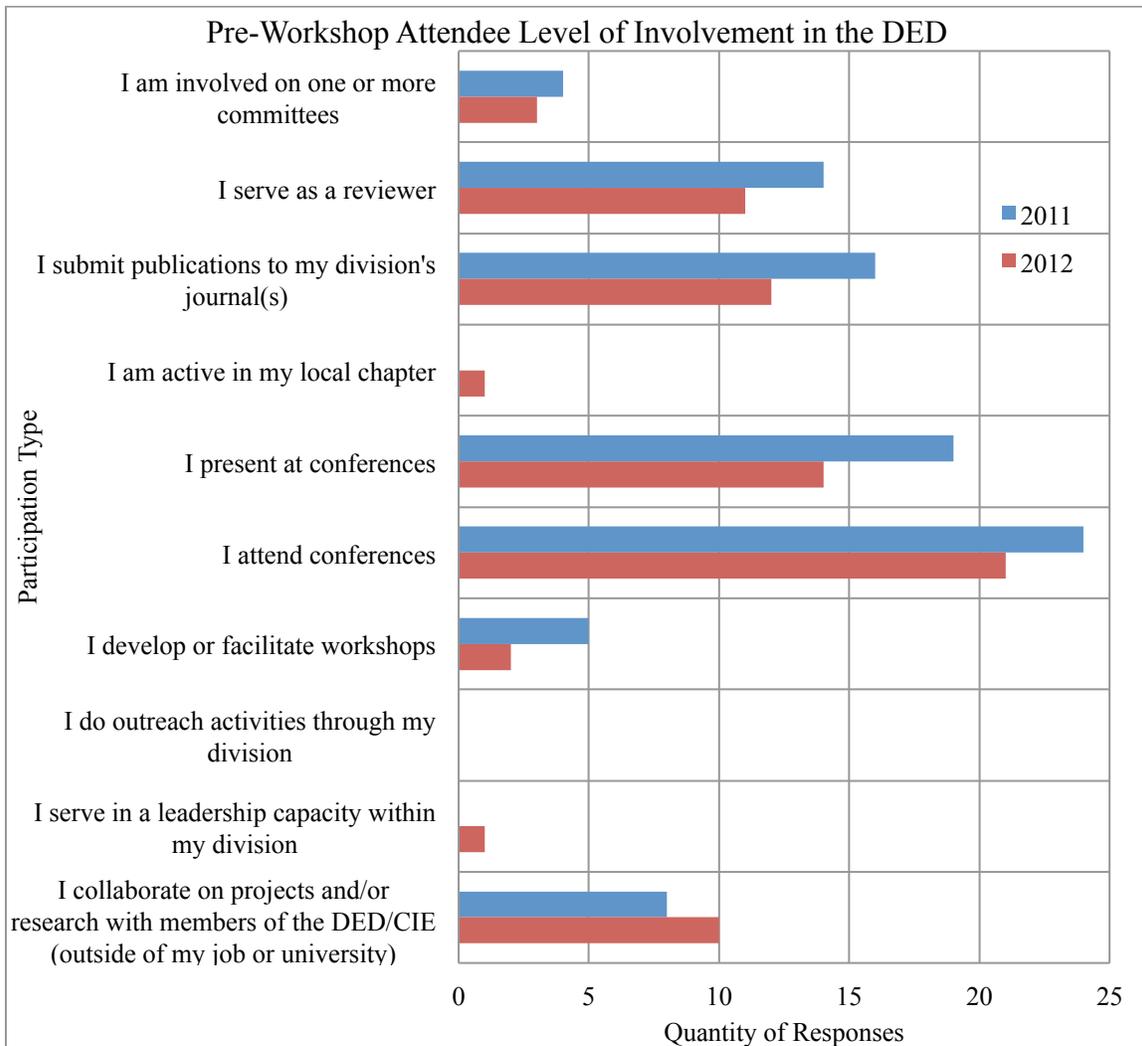


Figure 4: 2011 and 2012 Pre-Workshop Participation Level in DED of Workshop Attendees

Figure 5 displays the attendees' impressions about their level of connection within with the DED community (i.e. how "well-networked" they felt). The majority of attendees responded that they felt they were not "well-networked" within the DED in 2011 and 2012, with most feeling either moderately or not well networked.

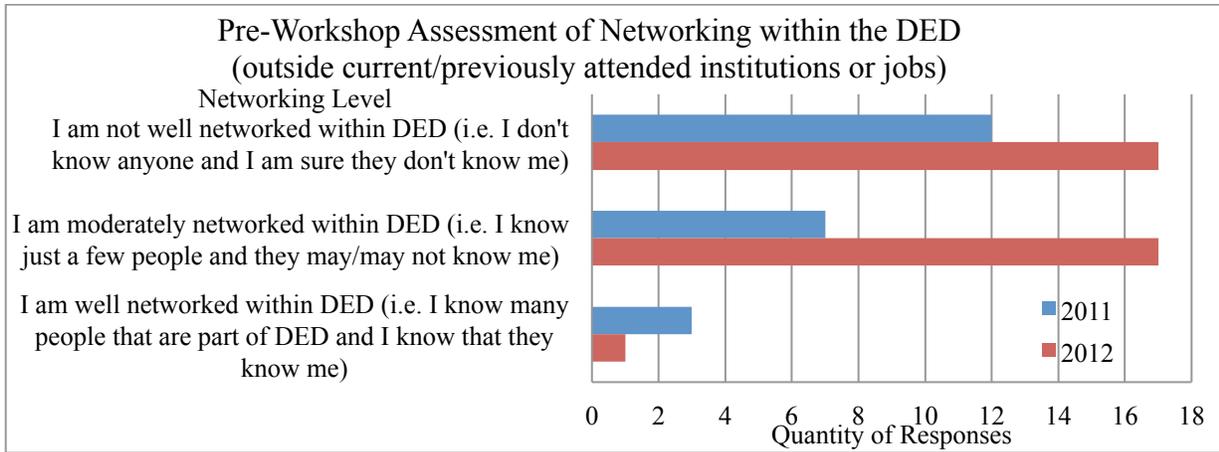


Figure 5: 2011 and 2012 Pre-Workshop Assessment of Attendees' Networking within DED

Figure 6 shows the assessment of attendees' feelings about how well networked they are in a broader community of underrepresented people. Blue hues indicate positive responses, while red hues indicate negative responses, with the darkness of the color indicating the intensity of the feeling, and white indicates neutrality. Generally, in 2011 and 2012, more attendees felt neutral to negative that they have opportunities to interact, collaborate, socialize, or do outreach activities with other women and/or minorities in their field.

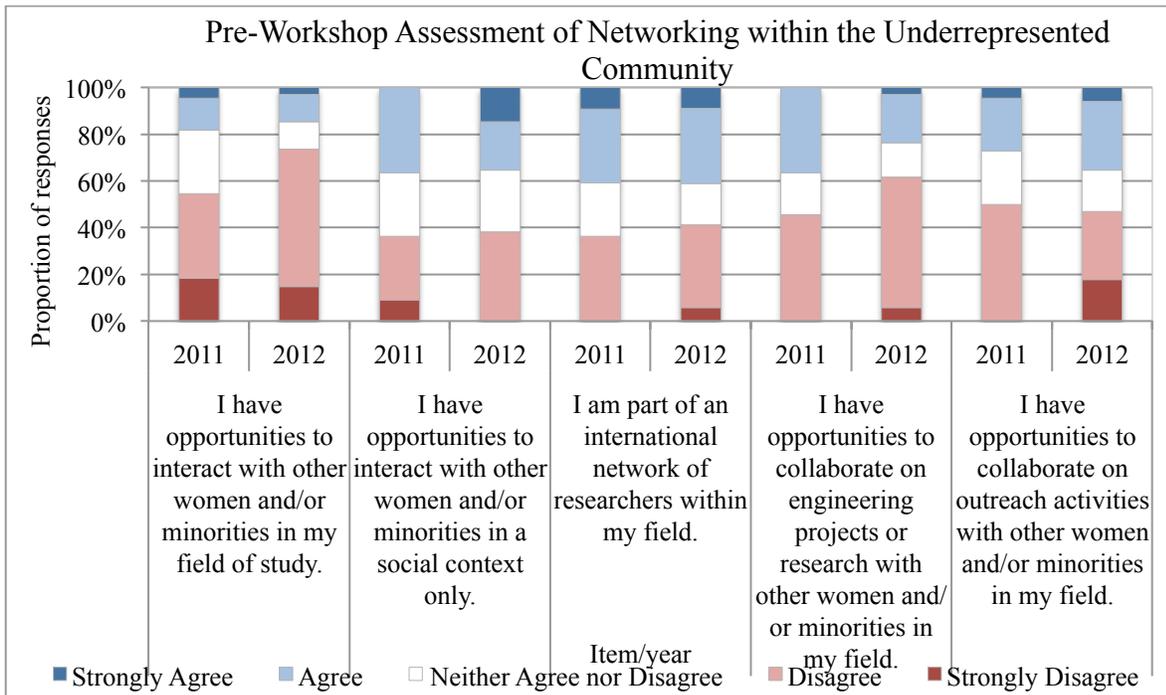


Figure 6: 2011 and 2012 Pre-Workshop Assessment of Attendees' Networking within the Underrepresented Community

Figures 4-6 illustrate that members of underrepresented groups are not participating as actively as they could be in leadership activities within the DED; they do not feel well connected or networked within the DED; and they do not feel well connected to one another.

Post-Workshop Survey

The post-workshop surveys were administered at the completion of the workshops and served to gather data on what the attendees experienced during the workshop. Similar questions were asked in each of the four years of workshops. Figures 7 and 8 present responses to questions regarding feelings of connectedness, skill acquisition, professional development, and feelings about future workshops. The number of respondents for each year is as follows: 2009 – 45 respondents, 2010 – 25 respondents, 2011 – 23 respondents, 2012 – 45 respondents. As in Figure 6, blue hues indicate positive responses, while red hues indicate negative responses, with the darkness of the color indicating the intensity of the feeling, and white indicates neutrality.

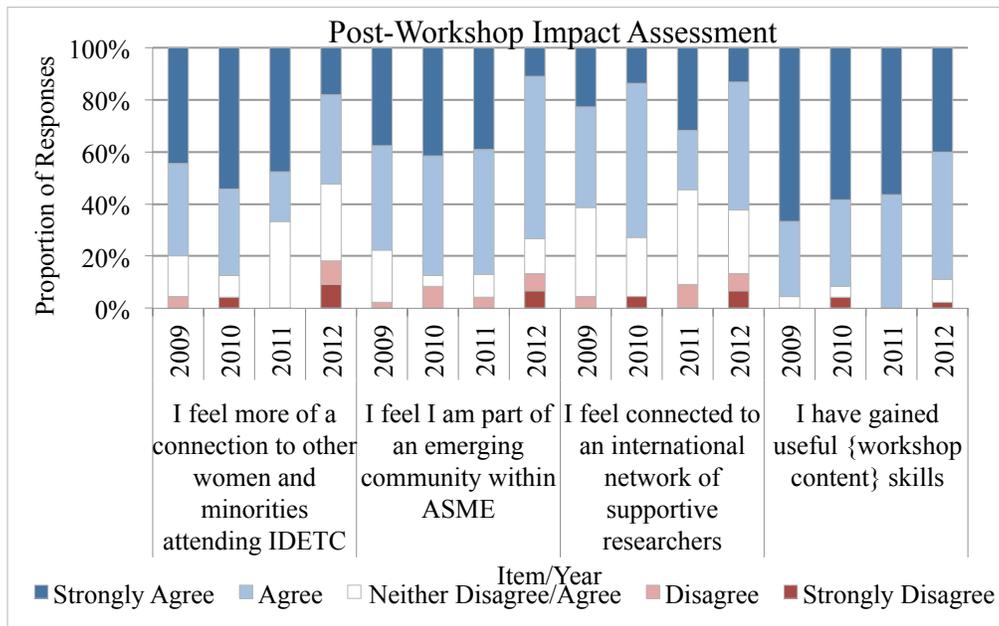


Figure 7: Post-Workshop Impact Assessment, Connectedness and Skill Acquisition

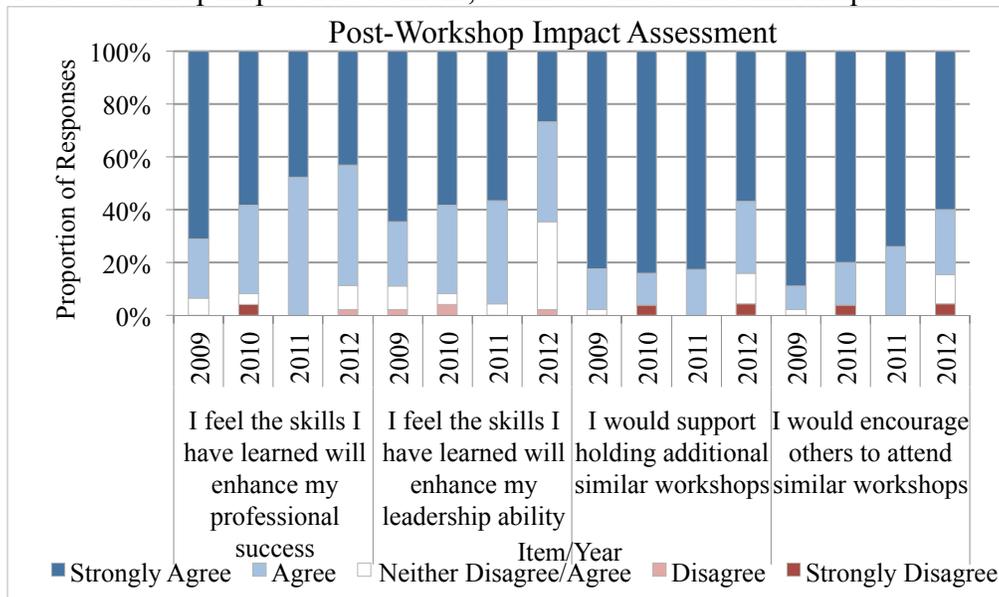


Figure 8: Post-Workshop Impact Assessment, Professional Development and Future Workshop

The majority of attendees had positive or strongly positive feelings that their involvement in the workshop led them to feel more connected to other women and minorities at the conference, to feel more part of a community within ASME and internationally, to feel that they had gained useful skills to enhance their success and leadership professionally, and to support future workshops and encourage others to attend.

2012 Follow-Up Impact Assessment Survey

This section details the results of the 2012 follow-up impact assessment survey, which had 20 respondents. In line with the distributions of attendance demographics for each year, the respondents to this survey are majority female, and white/Caucasian or Asian, and at the graduate level in their career.

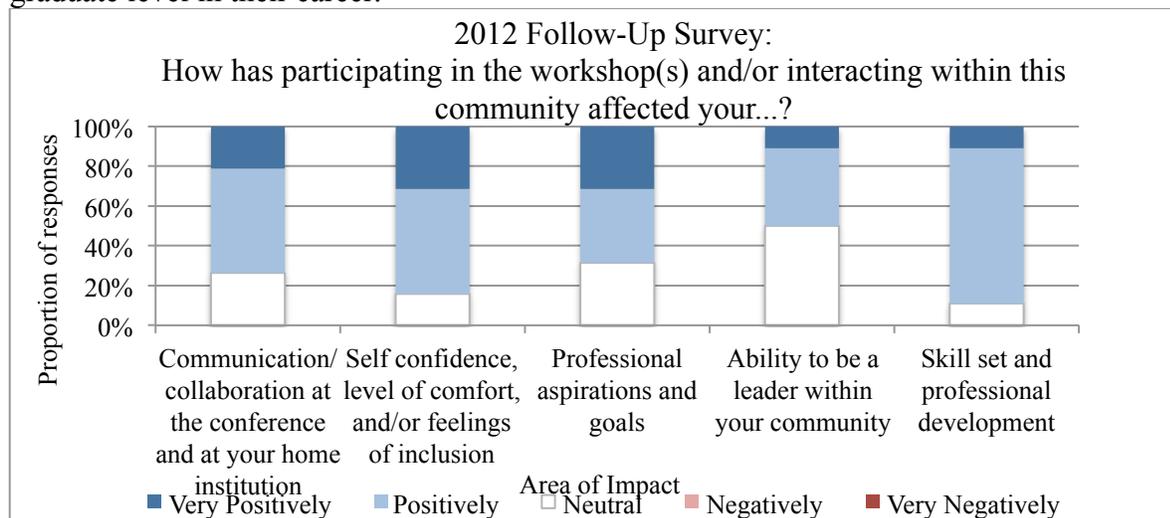


Figure 9: 2012 Follow-Up Impact Assessment Survey Reported Effects of Workshop/Community Participation on Different Areas of Professional Life

Figure 9 displays the results from the 2012 follow-up impact assessment survey of series of questions regarding how the participation in the workshop(s) and/or interaction within the broadening participation community has affected different aspects of the attendees' professional growth. The aspects include communication/collaboration, self-confidence, level of comfort, feelings of inclusion, professional goals, leadership abilities, and skill set. All responses were positive, with the level of agreement varying with the question. Overall, the workshop participants feel that the workshops have had a positive effect on their professional lives.

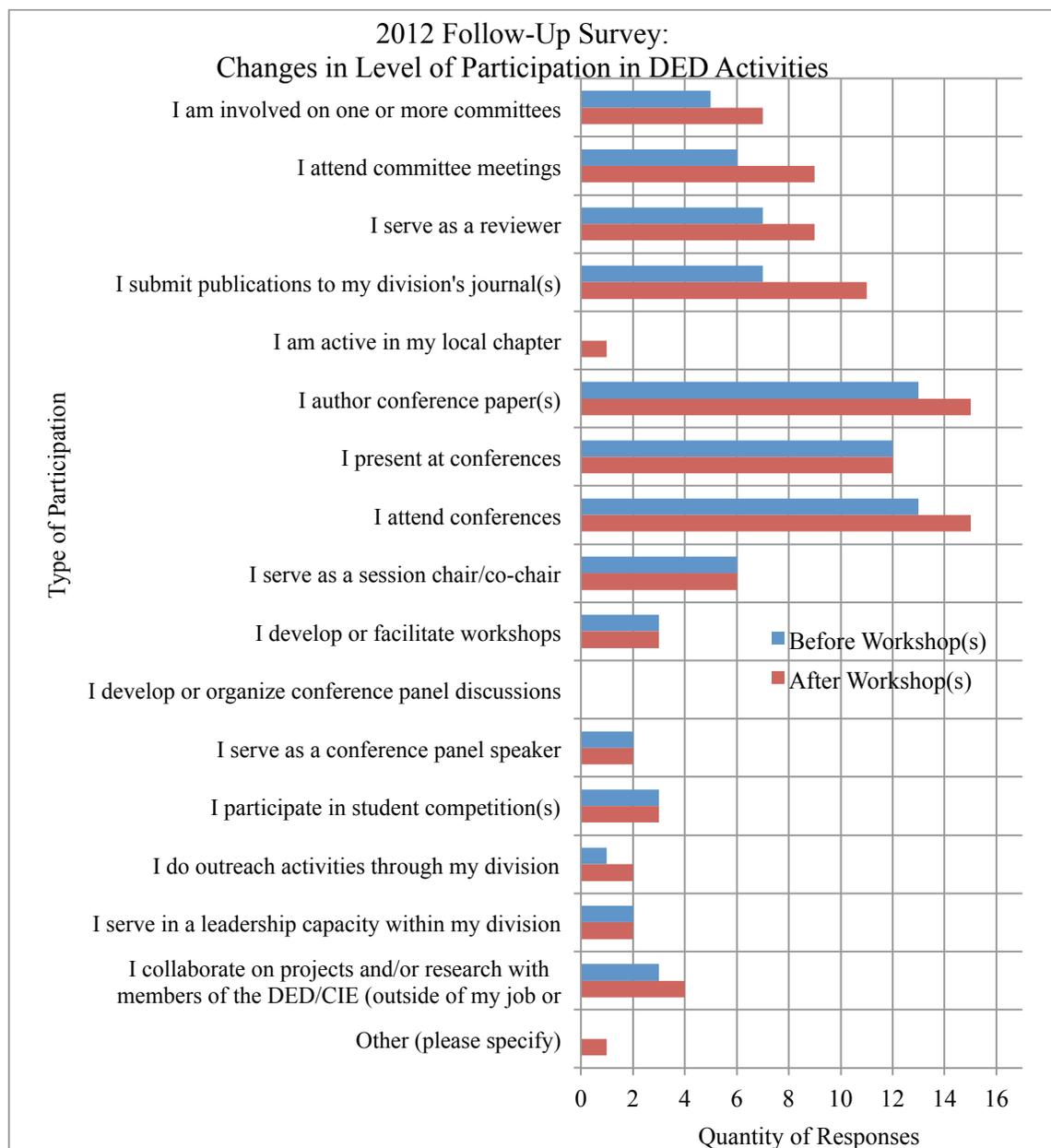


Figure 10: 2012 Follow-Up Impact Assessment Survey Respondent Changes in Level of Participation in DED Activities Before and After Attending Workshops

Figure 10 shows the comparison of amount/type of participation in DED activities that attendees had before and after attending the workshop(s). In all cases, the “after” state of participation has either matched or exceeded the “before” state of participation in DED activities. While we have not been able to collect longitudinal data for individual attendees to track their participation, professional development, and career advancement, self-reported activities have improved.

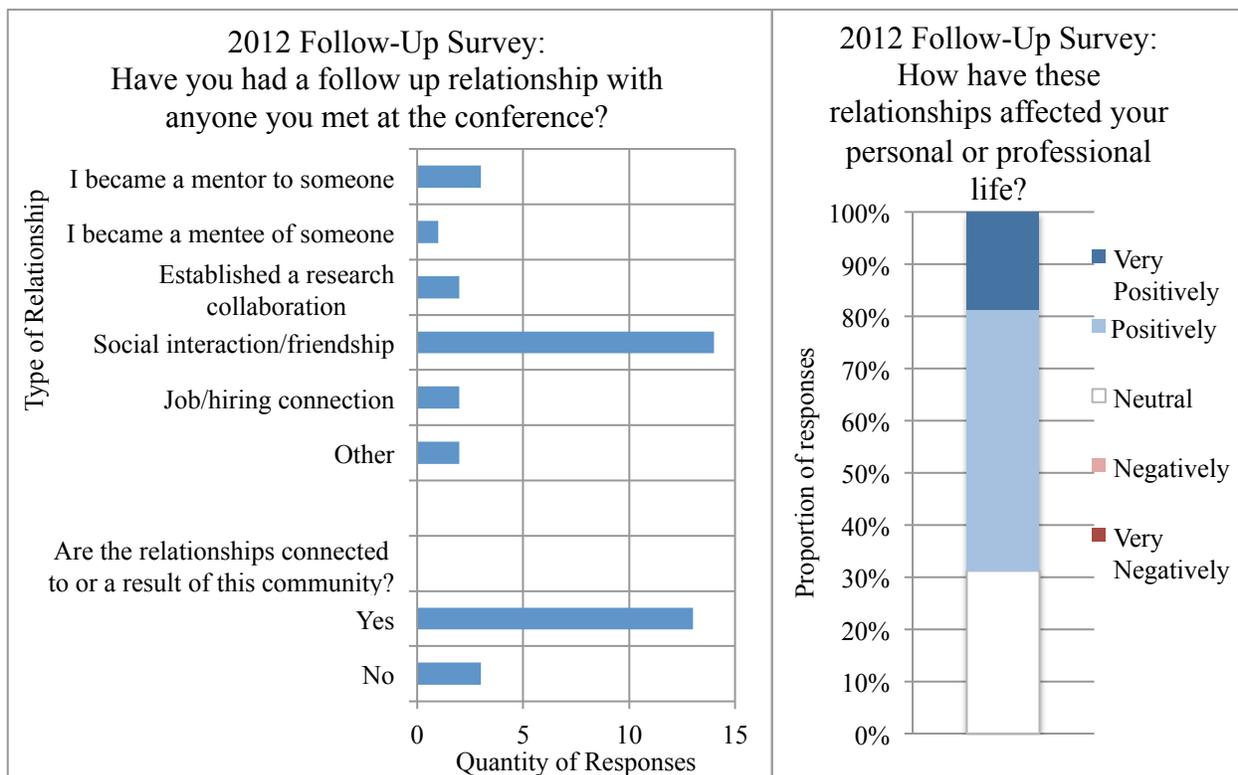


Figure 11: 2012 Follow-Up Impact Assessment Survey Respondent Development of New Relationships at IDETC and Impact on Personal/Professional Life

Finally, in Figure 11, the results from the 2012 follow-up impact assessment survey regarding the attendees' forging of new relationships at the conference, and the impact of those relationships on the attendees' lives are presented. The majority of new relationships were informal (social interactions or friendships) and were connected to or a result of the broadening participation community. The impact of all new relationships were reported to be very positive, positive, or neutral. The activities of the committee have directly affected attendees' feelings about their level of connectedness within the ASME DED community, and this has affected the majority of the attendees' professional and/or personal lives in positive way.

Summary

The pre-workshop survey data clearly indicates need and desire for the fulfillment of the mission of the broadening participation committee – to broaden the participation of underrepresented groups in the activities of the ASME DED. Attendees noted their lack of participation in leadership activities in the DED, and their lack of connections within the DED community and within a broader group of underrepresented groups in the wider research community. Post-workshop survey results collected directly after each workshop indicated positive feelings from the attendees regarding their connectedness within DED, their professional development, and the prospect of similar future workshops. The follow-up impact assessment survey indicated that attendance and participation in at least one of the workshops led to self-reported greater participation in DED activities, new positive connections within the DED community, and positive feelings regarding their communication/collaboration abilities, self confidence, level of comfort, feelings of inclusion, professional goals, leadership abilities, and skill sets.

Conclusions and Future Work

Involvement in professional organizations provides avenues for career advancement and inclusion in a professional community that can have a very positive effect on a career. The networking that occurs within professional organizations has the potential to result in a rich pool of mentors and advisors. Because these mentors come from different organizations and institutions, they can provide unique advice on career issues. This is particularly important for members of underrepresented groups. Often, members of professional organizations are asked to provide recommendation letters and evaluation letters for members of their community. In addition, many awards are given by professional organizations and active participation in the community exposes potential nominees to the process. Finally, volunteering for leadership opportunities in a professional organization gives an individual the opportunity to explore leadership and develop skills that may not be available within their existing work organization.

We feel that there is a balance between limiting participation in our activities to members of underrepresented groups only, and including those who are not members of underrepresented groups to increase awareness, inclusion, knowledge, and connection among all people in our community. Looking forward, we will likely increase our percentage of participants from underrepresented groups to at least 80%, to ensure the opportunities we provide are in line with our mission more fully. In addition, in the future, we hope to include more faculty and industry participants to broaden the perspectives represented and to expand the reach of our impact beyond mainly graduate students.

The results of our efforts so far are encouraging. We will continue to offer professional development workshops, seeking continued support of the ASME DED Executive Committee and the National Science Foundation. We will also reach out to other groups who are working within their own professional organizations to affect change and build communities of minority and women professionals. There is much we can learn from each other.

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