# Action on Diversity: A Content Analysis of ASEE Conference Papers, 2015–2016

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## 1. Introduction

In recent years, the American Society of Engineering Education (ASEE) has made several attempts to advance efforts that promote diversity and inclusion in the engineering education community. Part of these efforts have included creating a Diversity Committee in 2011; declaring 2014-2015 as the Year of ACTION on Diversity; and establishing the Best Diversity Paper Award in 2015. Prior to these actions, diversity efforts were primarily relegated to a few divisions: International Division, Minority in Engineering Division, Two-year College Division, Women in Engineering Division, and Pre-College Engineering Education Division; each of which is recognized by ASEE for having made a "specific commitment" to diversity (American Society for Engineering Education, 2017). Appropriately, the charge of the Diversity Committee is to encourage additional divisions to get more involved in featuring diversity and inclusion in their work. To assist ASEE in this effort, the purpose of this paper is to investigate the ways in which members of ASEE have recently addressed diversity by conducting a qualitative content analysis of papers published in the proceedings of the annual conference. Further, to assist community members who wish to contribute to this conversation during future conferences, our research asks the following questions: (RQ1) What are the common profiles of diversity-related conference papers published in ASEE? (RQ2) In what ways can additional member divisions help expand this profile?

Through answering these questions, the results of this study will: provide an overview of the ways in which ASEE is currently discussing and addressing diversity in engineering; highlight ways in which additional member divisions can be involved; summarize the ways in which demographics are included (or not included) in these efforts; and inform future efforts of ASEE members.

## 2. Framework

To answer these questions, we combined intersectionality (Crenshaw, 1991) and the AERA Standards for Reporting on Empirical Social Science Research (2006) to frame our analysis of over 150 conference publications from ASEE. Together, these frameworks enabled a systematic decomposition of each paper and, subsequently, a critical examination of how aspects of diversity are acknowledged and discussed throughout.

Intersectional theory discusses how multiple identities—such as race, class, gender, among others—intersect to create a new identity whose experience is different from the sum of its parts (Crenshaw, 1991). The Year of ACTION in Diversity has positioned underrepresented groups (i.e., women and minorities) at the forefront of recent studies in engineering education. The distinct challenges faced by these groups point to the need for more comprehensive studies that can lead to identifying best practices in engineering education. Intersectionality provides a basis for our research (Crenshaw, 1991), emphasizing the need to critically analyze how scholarship from ASEE positions multiple aspects of diversity. Because individuals exist at the intersections of class, race, gender, etc., it is important that we have strategies to address the unique realities of those intersections as we make efforts to advance diversity.

In order to characterize the different forms of scholarship addressing issues of diversity, we used the AERA Standards for Reporting to identify the various sections of a publication that warranted analysis. As per the AERA standards, essential components of a research publication should include a problem formulation often described through a purpose statement or research question, descriptions of the design which would include the methods and tools employed to collect the data, the units of study which could be defined by a thorough description of a population, and evidence- supported generalizations or implications. While the focus of this standard is to expose what a quality paper should contain, through its arguments it gives the reader a clear idea of the essential components of an empirical research publication ("Standards for Reporting on Empirical Social Science Research in AERA Publications," 2006).

## 3. **Methods and Analysis**

Methodical reviews, such as systematic literature reviews and content analyses, have been previously recommended for the field of engineering education as a way of "Lowering the barrier for both researchers and practitioners to access the literature, enabling more objective critique of past efforts, identifying gaps, and proposing new directions for research" (Borrego, Foster, & Froyd, 2014, p. 47). A previous systematic literature review conducted by Pawley, Schimpf, & Nelson (2016) studied how the *Journal of Engineering Education* addressed topics of gender in engineering. Such an effort has not yet been done in order to determine the ways the ASEE community addresses diversity. Inspired by Pawley et al. (2016), we addressed our research questions by conducting a qualitative content analysis of over 150 diversity-related publications in ASEE from the 2015 and 2016 conferences. We chose a qualitative content analysis as our research method because our goal was to show the different interpretations and connotations related to studying diversity in engineering (Kohlbacher, 2006), as opposed to counting the use of specific operationalizations of diversity or research methods. These years were selected because they coincide with the Year of ACTION in Diversity declared by ASEE and subsequent creation of the Best Diversity Paper Award.

### 3.1. Data Collection

Our sample is comprised of conference publications from the years 2015 and 2016 that fell into three publication categories. In addition to focusing on publications nominated for the Best Diversity Paper Award, we focused on publications from the Minority in Engineering Division (MIND) and Women in Engineering Division (WIED). We selected MIND and WIED based on their long-standing commitment to diversity. This decision was also informed by the dichotomous approach to broadening participation (i.e., emphasizing women & minorities as different groups) traditionally taken by the field of engineering. Focusing on these two divisions simultaneously provided an opportunity to explore the implications of such an approach with regard to intersectionality. We recognize other divisions may contain diversity-related publications that did not meet our inclusion criteria. However, we believe our analysis captures how the community as a whole typically handles this topic. The complete list of publications analyzed is located in Appendix A.

### 3.2. Data Analysis

Using the AERA Standard for Reporting (2006), Pawley et al (2016), and Intersectionality (Crenshaw, 1991) we developed a preliminary codebook that contained various relevant descriptors of each paper. Specifically, our analysis focused on the following aspects: (1) ASEE division; (2) paper type (i.e., research, practice or theory); (3) study rationale; (4) demographic of interest; (5) organizational status of demographic of interest; (6) data source; (7) framework or theory; (8) research questions; and (9) implications & recommendations. While some categories include child codes, through our initial refinement of the codebook we found that not all parent codes could be sub-coded into specific codes. Therefore, we coded the phrase in the publications that addressed the component we were looking for and subsequently summarized the general findings.

Table 1. Codebook

| **Category** | **Operationalization** | **Codes** |
|---|---|---|
| Publication Type | The type of publication submitted | Program Overview |
| | | Program Assessment |
| | | Literature Review |
| | | Research |
| | | Others |
| Organizational Status | The organizational status of the group under study for the paper | Faculty |
| | | K-12 |
| | | Undergraduate |
| | | Graduate |
| | | Industry |
| | | Other |
| Theoretical Frameworks | For research publications, the theoretical framework used (if any) for the study | |
| Data Sources | The type of data source used in the publication | Quantitative |
| | | Qualitative |
| Demographics | The demographics being studied in the publication | First Generation College |
| | | Gender |
| | | LGBTQ |
| | | Racial/Ethnic Minorities |
| | | Other |
| Implications | The recommendations the authors concluded as a result of the work | |
| Research Questions & Purpose | The question or purpose the publication intends to discuss | |
| Study Rationale | The reason for the authors pursuing the work | New Theory |
| | | Country's Changing Demographic |
| | | Workforce |
| | | Underrepresentation |
| | | Retention |
| | | Gender Differences |
| | | Other |

To complete the content analysis, a single author reviewed and coded each conference paper after our research team co-developed and refined a codebook. We performed an initial round of

coding with two randomly selected articles (one from each division), which helped us further refine the codebook and determine the granularity of analysis we would pursue. Our final codebook is described in Table 1. Each author was assigned an equal number of randomly assigned publications to code, and periodic reviews were used to revise codes or discuss exemplary and/or ambiguous cases. This was done to minimize discrepancies in how each researcher was applying the agreed upon codes.

## 4. Results and Discussion

This section will discuss the multiple ways members of ASEE can contribute to the efforts of the Diversity Committee. We will specifically review the categories as shown in Table 1.

### 4.1. Publication Type

We began our analyses by classifying our publication samples using the categories listed in table 1. The most prevalent categories were (in descending order) research, program overview, program assessment, literature review, and panel summary. Other was used for anything that did not correspond in the previous descriptions. Table 2 gives examples of each type of publication as found in our publication sample.

Table 2. Distribution of Publication Categories by Division

| **Publication Type** | Example |
|---|---|
| Research | "This study aimed at answering the research question: "How do Alaska Native students participating in ANSEP describe the program's role at motivating them to take advanced mathematics and science courses in high school?" (Yatchmeneff, 2015, p. 2) |
| Program Overview | "To address the pressing need for high school engineering design training, particularly for young people from underserved minority populations, we have created the HYPOTHEkids (Hk) Maker Lab, a six-week summer program in which high school students from underserved communities are introduced to biomedical engineering (BME) and biodesign." (Kyle, Sattler, Zhao, & Kovich, 2016, p. 2) |
| Program Assessment | "The goal of this work is to determine if the structure of iFEAT facilitated participant learning and satisfaction. We will analyze the program structure with respect to program content, pace, and climate. With the information learned, we remark on implementable changes for program improvement." (Horstman, Mai, Li, & Bhargava, 2015, p. 3) |
| Literature Review | "This literature review will discuss the engineer of 2020 attributes as discussed in historical and contemporary literature related to African Americans/Blacks, with a focus on males and precollege informal learning contexts." (Tolbert & Cardella, 2016, p. 2) |
| Panel Summary | "This panel brings together a group of men with diverse backgrounds and experiences to discuss their perspectives and offer practical skills for men to effectively serve as advocates for gender equity." (Genalo et al., 2015, p. 3) |

### 4.2. Publication Rationale

The majority of the rationales provided for these publications were focused on recruitment and retention of diverse groups. Asides from this rationale, many of the arguments targeted the underrepresentation of diverse groups in engineering, the nation's changing demographic, pursuing further understanding of gender differences, and the lack of diversity in the workforce. Publications often discussed more than one of the rationales previously listed, specifically when it came to arguing against underrepresentation.

We discuss less traditional rationales as a way of showing that not all work undergoing for the purpose of diversity has to be focused towards the reasons typically used. One particular publication had the objective of "increase transparency in the salary equity study process" by "providing an inclusive framework for faculty and administrators in the form of a collaborative committee" (Marchetti & Bailey, 2016). Another interesting example coincided with "increasing minority participation in pursuing advanced degrees in STEM" by "scientific literacy in sustainable energy and the energy-water nexus" (Castillo, Cabrera-Rios, Persans, & DeYoe, 2016). One publication combined its main objectives to promote the value of STEM and teamwork and, as a side effect, engage participants in more regular physical activity through the development of wearable fitness trackers (Harriger, Harriger, Flynn, & Flynn, 2015). Lastly, the rationale behind another work was to determine how the discourse within engineering shapes the public discussion and perceptions regarding the concept of engineering (Brewer, Sochacka, & Walther, 2015). The variety of rationales behind the publications studied show us that in order to contribute to these divisions, the focus can often be combined and go beyond the idea of diversity as a demographic itself.

### 4.3. Publication Research Questions & Purpose

When analyzing the research questions and purposes in the publications analyzed we were able to group the majority of the works into four broad categories: characteristics of diverse people, recruitment and retention interventions, academic institutional policy research, and how to 'teach engineering'.

The first and most common purpose was to research the *characteristics of diverse people*, be it by gender, race, or some combination of the demographics described in section 4.3. Some examples of the specific questions being asked around these characteristics of diverse people are: which factors enable minorities' success, how do specific demographics perform in teamwork scenarios, and how can we recruit diverse groups. Some specific examples of nontraditional questions asked within this category are the "relationships between student characteristics and entrepreneurship education (curricular and co-curricular) choices" (Celis & Huang-Saad, 2015), as well as how does socio-economic status play a role in course performance (Agrawal, Stevenson, & Gloster, 2016).

A second category of the research questions and purposes stated was the role of interventions for recruitment and/or retention. These publications described the goals and execution of these interventions as well as a subsequent assessment of these interventions and the participants involved. Some examples of the questions asked in this category are "What effect does NSBE membership have on graduation rates at the university?" (Whalin, Pagán-Trinidad, Villanueva, &

Pittman, 2016) and the role of co-curricular science and engineering centric activities and whether participation in such affects the course enrollment choices of its participants (Gonzalez & Millunchick, 2016).

Within this category of *interventions*, we were able to find a myriad of publications regarding the mentoring experiences of diverse groups. Publications regarding mentoring discussed understanding the perspectives of those involved in the mentoring experience (Mondisa, Brown, & Adams, 2015) and how this process strengthens their identity (Smith & Paretti, 2015), the context in which this mentoring is taking place and the role of such mentoring in career socialization (Rajan et al., 2015).

A third broad category for research questions focused specifically on studying *academic institutional policies*. Some examples of the questions being asked in these publications aimed at understanding which diversity-related policies worked and why (Beddoes, Schimpf, & Pawley, 2015; Camargo, Wood, & Layne, 2015), and how can institutional policy better support diverse groups (Turrentine, 2015). It is important to note that many of the publications related to policy focused on fomenting a diverse faculty, specifically in STEM.

The fourth type of research purposes examined the process of "teaching engineering." While most of the publications in this category focused on strategies for teaching specific engineering concepts, some exemplary cases stood out. Examples of the questions and purposes in this category are understanding the instructional strategies used to foster empathy (Gray, de Cresce El Debs, Exter, & Krause, 2016), discussion on the execution and results of a problem based learning course (McCullough, 2015), and exploring the disposition of faculty to use student-centered learning strategies and whether this varied by gender (Ross et al., 2016).

Outside of these four categories, we found purposes that may not have directly aligned with them but asked important diversity questions. For example, understanding why women leave the engineering workforce (VanAntwerp & Wilson, 2015), how to improve the experiences of transfer students from community colleges into 4-year institutions (Pieri et al., 2015), and strategies for dual-career couples searching for employment in academia (Ciston et al., 2015).

### 4.4. Publication Demographics

The overwhelming majority of publications in our sample studied demographics via two main groups: gender-based groups and racial and ethnic minorities. Other categories that were less present were first generation college students and LGBTQA+ communities. While some publications focused on specific intersections of demographics and organizational statuses such as pre-college black males (Tolbert & Cardella, 2016) or first generation Latinas in engineering (Verdin, Godwin, & Morazes, 2015), other publications targeted a blanket group of underrepresented groups in STEM such as women and minorities (Agili, Morales, Null, Smith, & Vidalis, 2015).

Many of the publications in the gender-focused group specifically targeted females with different organizational statuses. One particular study evaluated the parental influence of a female student's decision to major in engineering (Madjar, Huey, & Shor, 2016). Another interesting paper was a panel discussion hosted by men for an intended audience of men regarding practical

skills on how to serve as advocates for gender equity (Genalo et al., 2015). In the ethnic/racial minority sections, most publications focused on Latinos/Hispanics and/or African Americans. In our publication sample, only two publications discussed Native Americans and Alaskan Natives and none discussed Pacific Islanders. Regarding the LGBTQA+ demographic, only two of the publications in our sample indicated working with this population. One of these studies discussed heterosexist mappings of technical/social dualism in engineering (Leyva, Massa, & Battey, 2016) and the other studied the experiences of LGBT professionals in the STEM workplace (Cech, 2015).

Many of the publications in our sample did not target a specific target demographic. Conversely, they were scoped to members of a course, an after-school intervention, an online community of people with disabilities, academic faculty, or a whole grade (e.g., 8$^{th}$ grade students) in K-12. These examples show us that a contribution to these divisions does not have to be limited to the traditional ideas of underrepresented groups.

### 4.5. Publication Organizational Status

A significant majority of the publications in our sample focused on undergraduate students, followed by faculty, and K-12 students. A smaller number of works concentrated on graduate students, industry, and other populations. Some work was directed at multiple organization status—such as Jacobs et al. (2016), which included "a mix of ages ranging between high school students and professors in mid-career." Other work did not target an organizational status but instead the field of engineering education as a whole, such as Svyantek (2016), which asks the question "Where is disability expressed (at all) within engineering education itself?" When interpreting these findings, it is important to note that other divisions in ASEE are designated spaces for specific populations such as K-12, Industry, and Graduate Studies and thus other potential places to pursue diversity efforts in these specific group asides from MIND and WIED.

### 4.6. Publication Data Source

When looking at the types of data sources used by the studies in our sample, we noticed a roughly equal split of qualitative and quantitative data. Among the quantitative data sources, the most common data collection tool utilized was surveys administered either in the classroom, online or at an intervention. These surveys most often contained a Likert-type Scale and measured different aspects of student performance, such as self-efficacy and grit, or used questions from preexisting surveys such as mentor evaluation forms. Other forms of quantitative information came from archival data from school records such as retention rates, completion rates, representation information, job placement rates, as well was individual student performance (in the forms of GPA, SAT and ACT scores, among others).

Qualitative data came from a larger variety of sources. The most typical data collection tool used was interviews in multiple forms—including semi-structured, one on one, and focus groups. Similarly, open-ended surveys were also used as a form of collecting qualitative participant responses. Some unique forms of data sources were online blogs (Jafer, 2015), online forum posts and emails (Blaser, Steele, & Burgstahler, 2015), student artifacts (Gray et al., 2016), panel proceedings (Genalo et al., 2015), and reflective journals (Brewer et al., 2015). Through these examples, we see that in order to contribute to these divisions and the conversation on diversity

we can look beyond the conventional methods of obtaining information and incorporate novel data sources.

### 4.7. Publication Frameworks

We observed a large variety of frameworks being used in our sample. While most studies used analytical frameworks to base their work, others also used worldviews and methodologies to ground their methods. Numerous identity theories were frequently discussed such as multiple identity theory, professional identity formation, ethnic identity, and mathematics identities. A specific theory that was often used is social cognitive career theory. Other motivation-focused frameworks found were self-determination theory and self-efficacy framework. In the publications that used metaphors or worldviews for their work we observed the concept of 'engineering climate' (Copeland & Natarajarathinam, 2016) being discussed, a constructivist worldview (McGee, Robinson, Bentley, & Houston, 2015), as well as a metaphor of 'bait-and-switch' (Lachney & Nieusma, 2015) as means to characterize classroom teaching strategies. In order to assist people searching for frameworks when pursuing future work, Table 3 shows some examples of how authors used frameworks in our publication sample. We have also provided a list of a subset of the frameworks used along with their respective citations that could serve as an initial selection from which to choose in Appendix B.

Table 3. Examples of Frameworks in Publication Sample

| **Framework** | **Example** |
|---|---|
| Social Cognitive Career Theory | "This research has used grounded theory and **Social Cognitive Career Theory** to understand how best to recruit and retain students." (Anderson-Rowland, 2016, p. 1) |
| Expectancy Value Theory | "The research questions were designed to examine the values that women place on STEM as a career choice, as well as a self-assessment of their capabilities and outlook for success in a STEM career. Tobin's Gender Socialization Theoretical Model and Eccles' **Expectancy Value Theory** were applied as Theoretical Platforms." (Brandt, 2015, p. 1) |
| Tinto's Model of Institutional Departure | "The '**Tinto Model of Student Retention**' provides a useful framework for discussion of academic and social integration, adopted by existing successful programs such as National Science Foundation (NSF) funded Louis Stokes Alliances for Minority Participation (LSAMP), which aims to "build productive capacity and output within institutions having significant enrollment of minority populations in STEM fields." (Christe et al., 2015, p. 2) |
| Self-Determination Theory | "I used Ryan and Deci's **self-determination theory** of motivation as the theoretical framework for my study…to decipher whether Alaska Native ANSEP Precollege students are being intrinsically or extrinsically motivated to take advanced mathematics and science courses." (Yatchmeneff, 2015, p. 2) |
| Multiple Identities | "By developing and conducting our research using **multiple identities**, we ultimately hope to improve engineering students' identification with |

| | |
|---|---|
| | engineering leading to increased motivation and retention." (Matusovich, Barry, Meyers, & Louis, 2011, p. 4-5) |

### 4.8. Publication Implications

When coding the publications for implications and/or recommendations we found that approximately two-thirds of the publications included implications in their conclusion sections. The implications we found could be split across multiple characteristics and levels of specificity. For example, "panelists recommend creating safe zones where discussions about literature related to gender bias or workshops addressing inherent biases can be conducted and discussed." (Genalo et al., 2015). Here the authors suggest clear action and specific work to be done. Other implications were broader in nature. For example, "invest in strategies to graduate more minorities in STEM and meet the growing need for workers in the field" (Long, Kitchen, & Henderson, 2015). Here, the recommendation is more general and in reference to decidedly broader themes than the example above.

Another observation was that the implications listed varied by audience. Research implications refer to when an author concludes with a call for work in a specific area. For example, "additional qualitative research on students' progression through the typology could also prove fruitful for STEM educators to assist in planning and ordering of interventions and strategies to ensure students' success." (Long et al., 2015). These implications make clear recommendations about the need for further research based on their publication.

Practice implications were most often recommendations for educators and other stakeholders in the educational process. One example is "'Findings suggest that the interactive theater sketch can help students work on teams more productively and demonstrate increasing value for diversity." (Paguyo, Atadero, Rambo-Hernandez, & Francis, 2015).

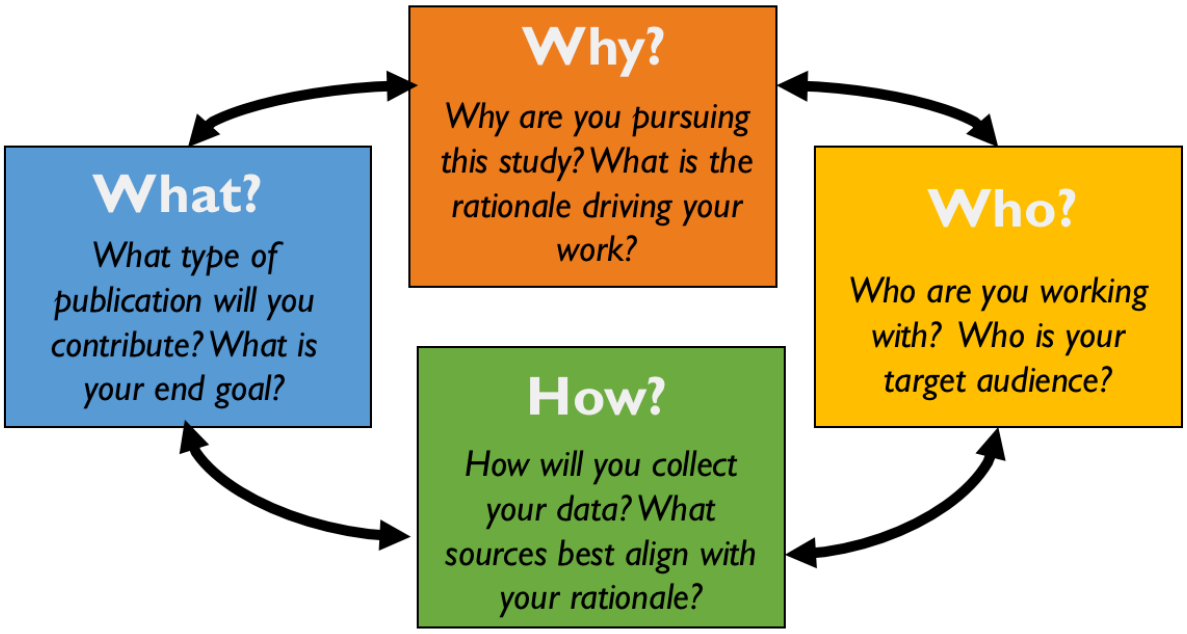
Finally, the third type of implications observed was policy implications. These implications are made to larger systems that govern or control particular areas of academic and institutional experiences. An example of this would be "'invest in building new, or deploying existing structures that facilitate women's retention and promotion in STEM in ways that incentivize international collaboration and research as part of the tenure process." (Brown, Tull, Medina, Holder, & Medina, 2015). Another way policy recommendations are made is through calls for cultural changes. Recommendations such as "'Attracting women to engineering need not be undertaken by accentuating stereotypical feminine traits and showing them how they can fit to engineering but may require also for engineering itself to be transformed." (Blosser, 2015). Another one would be "'Actively promote an egalitarian environment." (Meadows et al., 2015). This is not necessarily something that is rectified through policy but is more a call to shift the way we talk about engineering and how we view engineering culture.

## 5. Implications & Conclusions

Through this publication, we have discussed the common profiles of diversity-related ASEE publications published between 2015 and 2016. We listed the myriad of data sources, questions,

and rationales used for the body of work being pursued in this diversity in engineering education space which ultimately aims at broadening the participation of underrepresented groups in engineering. The most common profile of the publications in our sample is researchers answering how a specific, diverse demographic is different from the majority in an academic engineering context through the use of surveys and interviews as the main data sources for the purpose of recruitment and retention of such diverse group. While the questions being pursued are warranted, through this work we exhort the community of engineering education researchers to expand the profiles of their work into the questions, demographics, and contexts described in our discussion as being understudied. These characteristics are industrial contexts, LGBTQ communities, Native Americans, among others. Furthermore, we strongly encourage the research community to address the topic of diversity from an *antideficit* perspective (Harper, 2010) and expand the rationales for the works being pursued beyond the idea of increasing recruitment and retention in order to remedy the underrepresentation of such diverse groups. As a product of our findings, we have developed a publication profile worksheet (as shown in Figure 1) to assist the community in expanding the diversity of studies published in our community. Figure 1 functions as a visual guide through which the authors can define and scope their individual work.

Through our content analysis we also found how overlapping identities are understudied, especially when both identities are underrepresented (e.g., women of color, queer minorities). This confirms the traditional handling of diversity discrete and dichotomous fashion. While it is important to centralize gender and race as the foundation upon which we broaden participation in engineering, understanding that people exist at the intersection of identities will take our research and the discussion to a deeper level of understanding; stepping away from the generalizations and coming closer to understanding the individual experiences of members of these groups. WIED and MIND are essential, but we need additional spaces to acknowledge the intersectional experiences, outside of these silos. Thus, as a research implication, we exhort ASEE to encourage these intersectional spaces in the form of collaborations across divisions, special sessions, or, if warranted, additional divisions. By creating these broader spaces, we can unify the diversity efforts being pursued across our research community and furthermore encourage the study of populations whose identities do not neatly place into the existing divisions. For example, the opportunity to present this year in the new *Diversity Division* enabled us to create this analysis and bring this topic to the attention of a wider audience than we could have previously. Further actions along this line and continued support of existing divisions can help the overall goal of broadening participation in engineering.




| Framing Questions | Topic | Ideas to Consider | |
|---|---|---|---|
| **Why?** | **Rationale** | • Country's changing demographics<br>• Gender differences<br>• Underrepresentation | • Workforce<br>• New theory<br>• Representation<br>• Etc. |
| **Who?** | **Demographics** | • Racial/Ethnic minorities<br>• Gender<br>• First generation college | • LGBTQ+<br>• Etc. |
| | **Organizational Status** | • Faculty<br>• Undergraduate<br>• K-12 | • Industry<br>• Undergraduate<br>• Etc. |
| **How?** | **Qualitative Data Sources** | • Interviews<br>• Panel proceedings<br>• Focus groups<br>• Reflective journals<br>• Open-ended surveys | • Student artifacts<br>• Online blogs<br>• Online Forum Posts<br>• Emails<br>• Etc. |
| | **Quantitative Data Sources** | • Surveys<br>• Representation information<br>• Retention rates<br>• Job placement rates<br>• Completion rates | • GPA<br>• SAT scores<br>• ACT scores<br>• Etc. |
| **What?** | **Publication Type** | • Program overview<br>• Program assessment<br>• Literature review | • Research<br>• Panel summary<br>• Etc. |

Figure 1. Publication Profile Worksheet

## 6. Limitations & Future Work

Among the limitations of our work, we would like to note that this is a qualitative analysis and we made tradeoffs between how closely we analyzed each conference paper and how many conference publications we could realistically include. In order to identify major themes, we did not have each conference paper reviewed by multiple authors for accuracy. As a result, we do not report specific numbers for the categories found, but we are confident we identified the major trends in our sample and our implications are supported in our analysis. We also scoped the study to only two years and are thus unable to state any conclusion on how the current definition of diversity has been influenced by the development of such throughout the existence of these divisions and engineering education research.

## 7. Acknowledgements

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VanAntwerp, J., & Wilson, D. (2015). Difference Between Engineering Men and Women: How and Why They Choose What They Do During Early Career (p. 26.543.1-26.543.21). ASEE Conferences. https://doi.org/10.18260/p.23881
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Whalin, R., Pagán-Trinidad, I., Villanueva, E., & Pittman, D. (2016). A Quarter Century of Resounding Success for a University/Federal Laboratory Partnership. ASEE Conferences. https://doi.org/10.18260/p.26419
Yatchmeneff, M. (2015). A Qualitative Study of Motivation in Alaska Native Science & Engineering Program (ANSEP) Pre-college Students (p. 26.94.1-26.94.18). ASEE Conferences. https://doi.org/10.18260/p.23435

## 9. Appendix

## A. List of Publications

| Document Title | Author Shorthand | DOI |
|---|---|---|
| Best Practices for Underrepresented Minority Students in an Engineering Summer Bridge Program | Verdell et al., 2016 | 10.18260/p.26198 |
| "Turning away" from the Struggling Individual Student: An Account of the Cultural Construction of Engineering Ability in an Undergraduate Programming Class | Secules et al., 2016 | 10.18260/p.26239 |
| A Comparative Analysis of Underrepresented Engineering Applicants Admission Practices and their Academic Performance at the University of Illinois at Chicago | Darabi et al., 2016 | 10.18260/p.26279 |
| A Population Dynamics Model for Gender Diversification in Orthopaedic Surgery: A Case Study with Relevance to Engineering | Buckley et al., 2016 | 10.18260/p.26398 |
| A Program for Graduate Women in Engineering Pursuing Academic Careers (iFEAT: Illinois Female Engineers in Academia Training) | Horstman et al., 2015 | 10.18260/p.23429 |
| A Qualitative Look at African American Students Perceptions of Developing Engineer of 2020 Traits Through Non-curricular Activities | Martin et al., 2015 | 10.18260/p.23434 |
| A Qualitative Study of Motivation in Alaska Native Science & Engineering Program (ANSEP) Pre-college Students | Yatchmeneff, 2015 | 10.18260/p.23435 |
| A Quarter Century of Resounding Success for a University/Federal Laboratory Partnership | Whalin et al., 2016 | 10.18260/p.26419 |
| A Scaffolding Case Study for Teaching Engineering Problem Solving to Underrepresented Minorities | Girgis, 2015 | 10.18260/p.23446 |
| A Sense of Belonging: Creating a Community for First-generation, Underrepresented groups and Minorities through an Engineering Student Success Course | Liptow et al., 2016 | 10.18260/p.26439 |
| A Series of Singular Testimonies: A New Way to Explore Unearned Advantages and Unearned Disadvantages | Martin et al., 2015 | 10.18260/p.23449 |
| AC 2011-290: A Multi-Institution Comparison of Student's Development of an Identity as an Engineer | Matusovich et al., 2011 | N/A |
| AdvanceRIT Connect Grants: Driving Momentum for Disruptive Change for Women STEM Faculty | Mason et al., 2015 | 10.18260/p.23501 |
| Advisor Perspectives on Diversity in Student Design Competition Teams | Walden et al., 2016 | 10.18260/p.26537 |
| African American Women in the Academe: A Comprehensive Literature Review Through the Lens of Intersectionality | Ross et al., 2015 | 10.18260/p.23505 |

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| After School Matters: Expanding the Time to Engage Minority Middle School Girls in STEM | Luster-Teasley et al., 2016 | 10.18260/p.26543 |
| An Exploration into the Impacts of the National Society of Black Engineers (NSBE) on Student Persistence | Ross et al., 2016 | 10.18260/p.27280 |
| An Investigation of Pathways to Computing for Middle and High Schoolers in the U.S. South | Kastner et al., 2016 | 10.18260/p.26227 |
| An Iterative Process to Assess and Optimize Diversity Programming | Louie et al, 2015 | 10.18260/p.23542 |
| Assessing the GRIT of Incoming Engineering Students | Bottomley, 2015 | 10.18260/p.23588 |
| Assessing the Impact of Research Experiences on the Success of Underrepresented Community College Engineering Students | Enriquez et al., 2015 | 10.18260/p.23591 |
| Assessing the Success of Programs for Women in Engineering | Bottomley et al., 2015 | 10.18260/p.23594 |
| Attracting Minorities to ET Through TECHFIT | Harriger et al., 2015 | 10.18260/p.23606 |
| Attracting Women to Engineering through Service-Based Learning | Manoosingh, 2015 | 10.18260/p.23607 |
| Attraction and Retention of Inner-city Under-represented Minority Students for Careers in STEM: Parent Perspectives | Coates, 2016 | 10.18260/p.26349 |
| Barriers to Broadening Participation in Engineering Competition Teams | Pan et al., 2016 | 10.18260/p.26365 |
| Black Male "Buoyant Believers" in Engineering and Engineering-related Fields | Long et al., 2015 | 10.18260/p.23623 |
| Building The Two-Way Bridge: *A Software Engineering Master's Program for Liberal Arts Graduates* | Laird et al., 2015 | N/A |
| Bulls-Eye Mentoring: Developing a Program Intervention in the College of Engineering | Wilson et al., 2015 | 10.18260/p.23650 |
| Capturing Our Stories in Our Voices: Constructing a Narrative Analysis Study of African-American STEM Mentors | Mondisa, 2016 | 10.18260/p.26448 |
| Career Advancement Through Academic Commercialization: Acknowledging and Reducing Barriers for Women Engineering Faculty | Turrentine et al., 2015 | 10.18260/p.23666 |
| Catching Up to the 51%: Promoting Female Student Engagement in Computing Education | Lansiquot et al., 2015 | 10.18260/p.23672 |
| Challenges, Opportunities, and Impacts of S-STEM Projects: Insights for Institutional Capacity Building at Minority-serving Institutions | Pearson et al., 2016 | 10.18260/p.26472 |
| Changes in Latino/a Adolescents' Engineering Self-efficacy and Perceptions of Engineering After Addressing Authentic Engineering Design Challenges | Mejia et al., 2015 | 10.18260/p.23678 |

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| Changes in Undergraduate Engineering College Climate and Predictors of Major Commitment: Results from Climate Studies in 2008 and 2015 | Fitzpatrick et al., 2016 | 10.18260/p.26475 |
| Changing the World for Good: Tech Trek Alabama Changes 8th Grade Girlsâ€™ Attitudes Towards STEM | Gaede, 2015 | 10.18260/p.23683 |
| Chasing the Holy Grail: Pushing the Academic Persistence of Highly Motivated, Underprepared URM Students Pursuing Engineering | Bracey et al., 2016 | 10.18260/p.26489 |
| Comparative Dimensions of Disciplinary Culture | Murzi et al., 2015 | 10.18260/p.23708 |
| Comparison of Mastery Learning and Traditional Lectureâ€“Exam Models in a Large Enrollment Physics Course | Masi et al., 2015 | 10.18260/p.23719 |
| Connectivity at RIT - Developing & Delivering an Effective Professional Development Workshop Series for Women Faculty in STEM | Dell et al., 2016 | 10.18260/p.26575 |
| Constructions of Gender in Three Campaigns to Recruit Women to Engineering: Is Outreach Combatting or Reinforcing Gender Inequality? | Blosser, 2015 | 10.18260/p.23738 |
| Creating a Student Organization to Engage Female Students Better | Natarajarathinam, 2015 | 10.18260/p.23755 |
| Creating Inclusive Environments in First-year Engineering Classes to Support Student Retention and Learning | Paguyo et al., 2015 | 10.18260/p.23757 |
| Cyber War is not Gender War - Experiences of Creating a Productive Heterogeneous Environment in Cyber Security Research | Winders et al., 2015 | 10.18260/p.23776 |
| Dark Matters: Metaphorical Black Holes that Affect Ethnic Underrepresentation in Engineering | Tull et al., 2016 | 10.18260/p.26636 |
| Design for Aging with BIM and Game Engine Integration | Wu et al., 2015 | 10.18260/p.23799 |
| Design of an Interactive Multidisciplinary Residential Summer Program for Recruitment of High School Females to Engineering | Monaco et al., 2016 | 10.18260/p.26684 |
| Developing an Effective Mentoring Program for Early-career STEM Faculty: Lessons Learned from the First Three Years of an ADVANCE PAID Program | Guessous et al., 2015 | 10.18260/p.23829 |
| Developing an Intensive Math Preparation Program to Enhance the Success of Underrepresented Students in Engineering | Hum et al., 2015 | 10.18260/p.23830 |
| Developing and Implementing Effective Campus Work-Life Policies: The Story of One NSF ADVANCE Project | Carpenter et al., 2015 | 10.18260/p.23834 |
| Development of a STEM Summer Program for Underrepresented High School Students : A Success Story | Villiers et al., 2015 | 10.18260/p.23868 |

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| Dialogues Toward Gender Equity: Engaging Engineering Faculty to Promote an Inclusive Department Climate | Jackson et al., 2016 | 10.18260/p.26835 |
| Difference Between Engineering Men and Women: How and Why They Choose What They Do During Early Career | VanAntwerp et al., 2015 | 10.18260/p.23881 |
| Diversity in Chemical Engineering Education: Status and Perspectives | Bodnar et al., 2015 | 10.18260/p.23892 |
| Diversity Stalled: Explorations into the Stagnant Numbers of African American Engineering Faculty | McGee et al., 2015 | 10.18260/p.23893 |
| Easing the Tortuous Road that Underrepresented Minorities Travel to Become Engineering Faculty | Cutright et al., 2015 | 10.18260/p.23903 |
| ECE-GIRLS: High School Girls Explore Electrical and Computer Engineering Program | Gong et al., 2016 | 10.18260/p.26883 |
| Empathy and Gender Inequity in Engineering Disciplines | Jacobs et al., 2016 | 10.18260/p.26936 |
| Empowering Male Students as Allies for Gender Equity Within an Engineering College | Abrams et al., 2016 | 10.18260/p.26945 |
| Engaging Female Students Using a First-year Wearable Electronics Project | Morgan et al., 2015 | 10.18260/p.23943 |
| Engaging Freshmen Women in Research Feedback from Students and Best Practices for Faculty | Bateman et al., 2015 | 10.18260/p.23944 |
| Engaging Minority Students in Sustainable Bioenergy and Water Quality through an Education and Research Network | Castillo et al., 2016 | 10.18260/p.26966 |
| Engaging Pre-college Minority Students at a Technical Engineering Research Conference | Cruz-Gonzelez et al., 2016 | 10.18260/p.26968 |
| Engineer of 2020 Attributes and the Black Male Future Engineer: A Review of Literature | Tolbert et al., 2016 | 10.18260/p.26982 |
| Engineering Achievement: An Exploratory Case Study of Minority Engineering Organization Chapter Activities | Yates et al., 2016 | 10.18260/p.27297 |
| Engineering Bait-and-Switch: K-12 Recruitment Strategies Meet University Curricula and Culture | Lachney et al., 2015 | 10.18260/p.23954 |
| Engineering Degree Trends for African American Women and Men | Bowman, 2015 | 10.18260/p.23956 |
| Engineering Identity Implications on the Retention of Black Women in the Engineering Industry | Ross et al., 2016 | 10.18260/p.26652 |
| Engineering Student's Self-Concept Differentiation: Investigation of Identity, Personality, and Authenticity with Implications for Program Retention | Stoup et al., 2016 | 10.18260/p.26666 |
| Enhance Computing Curricula with High-Performance Computing Teaching and Research | Cui et al., 2015 | 10.18260/p.23990 |
| Ethnic Student Organizations in Engineering: Implications for Practice from Two Studies | Martin et al., 2016 | 10.18260/p.26744 |

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| Experiences in Establishing an Outreach Program for Attracting and Retaining Minorities to Engineering | Alba-Flores et al., 2016 | 10.18260/p.26813 |
| Exploring Barriers in the Engineering Workplace: Hostile, Unsupportive, and Otherwise Chilly Conditions | Yonemura et al., 2016 | 10.18260/p.26843 |
| Extracurricular Engineering Activities and College Success | Gonzalez et al., 2016 | 10.18260/p.26875 |
| Factoring Family Considerations into Female Faculty Choices for International Engagement in Engineering, IT, and Computer Science | Quan et al., 2015 | 10.18260/p.24093 |
| Female Millennial Perceptions of Engineering as a Brand | Kissane et al., 2015 | 10.18260/p.24109 |
| Gaining Insights into the Effects of Culturally Responsive Curriculum on Historically Underrepresented Student's Desire for Computer Science | Miller, 2016 | 10.18260/p.26997 |
| Gender and Department Heads: An Empirically-Inspired Literature Review | Beddoes et al., 2015 | 10.18260/p.24149 |
| Gender in the Workplace: Peer Coaching to Empower Women in the Classroom and as Professionals | Groh, 2016 | 10.18260/p.27304 |
| Gendering Engineering Leadership: Aspirations vs. Shoulder Tapping | Rottmann et al., 2015 | 10.18260/p.24152 |
| Graduate Women Lean In: Building Community and Broadening Understanding | Rojewski et al., 2015 | 10.18260/p.24162 |
| Help-Seeking Among Undergraduate Men and Women in Engineering | Wolfe et al., 2015 | 10.18260/p.24178 |
| Honing Interpersonal Communication Skills for Difficult Situations: Evidence for the Effectiveness of an Online Instructional Resource | Dawson et al., 2015 | 10.18260/p.24187 |
| How do Male and Female Faculty Members View and Use Classroom Strategies? | Ross et al., 2016 | 10.18260/p.25475 |
| How Students Choose Their Engineering Major: Effects of Gender and Race or Ethnicity | Valle et al., 2015 | 10.18260/p.24197 |
| How the Pathway to Engineering Affects Diversity in the Engineering Workforce: A Silicon Valley Case Study | Baker et al., 2015 | 10.18260/p.24199 |
| How to Develop Alaska Native STEM Students in Middle School and High School | Yatchmeneff et al., 2016 | 10.18260/p.27308 |
| Human-Centered Computing Scholars: Fostering a New Generation of Underrepresented and Financially Disadvantaged Researchers | Gilbert et al., 2015 | N/A |
| HYPOTHEkids Maker Lab: A Summer Program in Engineering Design for High School Students | Kyle et al., 2016 | 10.18260/p.25511 |
| Impact of Mentoring and Enrichment Activities on the Academic Careers of Underrepresented STEM Doctoral Students | Gordon et al., 2015 | 10.18260/p.24224 |
| Impacts of Outreach on Entering College Students' Interests in STEM | Miorelli et al., 2015 | 10.18260/p.24233 |

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| Impacts of Service-Learning Projects on the Technical and Professional Engineering Confidence of First-Year Engineering Students | Siniawski et al., 2015 | 10.18260/p.24234 |
| Implementation of Advocates and Allies Programs to Support and Promote Gender Equity in Academia | Bilen-Green et al., 2015 | 10.18260/p.24242 |
| Including Universal Design in Engineering Courses to Attract Diverse Students | Blaser et al., 2015 | 10.18260/p.24272 |
| Incorporating Engineering in a High School FACS and Chemistry Class | Boyd, 2014 | N/A |
| Increasing Diversity in Engineering: Capacity Building Matters | Kant et al., 2014 | N/A |
| Increasing STEM Engagement in Minority Middle School Boys through Making | Ladeji-Osias et al., 2016 | 10.18260/p.25676 |
| Institutional Transformation Guided by a Multi-frame Organizational Analysis Approach | Bailey et al., 2015 | 10.18260/p.24313 |
| Instructional Strategies for Incorporating Empathy in Transdisciplinary Technology Education | Gray et al., 2016 | 10.18260/p.25746 |
| Interactive Panel on Perspectives and Practical Skills for Men as Advocates for Gender Equity | Genalo et al., 2015 | 10.18260/p.24343 |
| Interactive Panel: Improving the Experiences of Marginalized Students on Engineering Design Teams | Meadows et al., 2015 | 10.18260/p.24344 |
| Interdisciplinary Seminar Series: Increasing Awareness for Research, Recognition of the University, and Professional Development Opportunities | Newman et al., 2016 | 10.18260/p.25442 |
| Into the Light: Diffusing Ccontroversy and Increasing Transparency in the Faculty Salary Equity Study Process | Marchetti et al., 2016 | 10.18260/p.25450 |
| Into the Pipeline: A Freshman Student's Experiences of Stories Told About Engineering | Brewer et al., 2015 | 10.18260/p.24355 |
| KS-LSAMP Pathways to STEM: A System Approach to Minority Participation in STEM | Grauer et al., 2015 | 10.18260/p.24389 |
| Leadership, Management, and Diversity: Missed Opportunities Within Student Design Competition Teams | Walden et al., 2015 | 10.18260/p.24396 |
| Leaning into Engineering: Tenured Women Faculty and the Policies and Programs that Support Them | Karpman et al., 2016 | 10.18260/p.25529 |
| Lessons Learned from a High School Robotics Workshop | Ma et al., 2016 | 10.18260/p.25549 |
| LGBT Professionals Workplace Experiences in STEM-Related Federal Agencies | Cech, 2015 | 10.18260/p.24431 |
| Liberal Studies in Engineering Programs Creating Space for Emergent & Individualized Pathways to Success for Women in Computing Disciplines | Lehr et al., 2015 | 10.18260/p.24432 |
| Listening and Negotiation | Callahan et al., 2016 | 10.18260/p.25571 |

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| Making Changes: Application of an NSF-ADVANCE PAID Grant at a Predominantly Undergraduate Institution (PUI) | Vitolo et al., 2016 | 10.18260/p.25658 |
| Mapping Assets of Diverse Groups for Chemical Engineering Design Problem Framing Ability | Svihla et al., 2016 | 10.18260/p.25675 |
| Mentoring African-American Science, Technology, Engineering, and Mathematics (STEM) Undergraduates: An African-American STEM Mentorâ€™s Perspective | Mondisa et al., 2015 | 10.18260/p.24483 |
| Methodology for Studying Gendered Differences among Secondary Students' Perceptions of Engineering | Bazylak et al., 2016 | 10.18260/p.25712 |
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