Missing from the Classroom: Current Representations of Disability in Engineering Education

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Introduction

Higher education is currently receiving a new wave of calls for diversity and inclusion, through student-driven calls to action (on campuses such as Harvard and the University of Mississippi) as well as institutionally-driven efforts (e.g., Virginia Tech's InclusiveVT and related initiatives). Engineering disciplines are no exception to this call, which affects both engineering education and the workforce. ASEE includes "age, belief system, disability status, ethnicity, gender, gender identity, gender expression, national origin, race, sexual orientation, socio-economic status, and any other visible or non-visible differences"[1] within its definition of diversity. Recognizing the efforts of its members and divisions to advance diversity and inclusion efforts, ASEE even took the step of naming 2015 as the Year of Action on Diversity.

The year 2015 also marked the 25th anniversary of the passage of the Americans with Disabilities Act (ADA), a major piece of law focusing on the civil rights of the disabled community. The history of this Act includes disability activists abandoning their mobility devices at the base of the U.S. Capitol Building to crawl up its 83 steps, in protest to numerous delays in passing the bill as well as the lack of access ramps at this public building.[2]

Disability, however, goes beyond mobility concerns. The ADA defines disability for the individual level as: a) a physical or mental impairment, b) a record of such impairment, or c) being regarded as having an impairment.[3] Within the context of higher education, students are afforded "reasonable accommodations" to address such impairments, though these do not necessarily equate to inclusion within the classroom.

Donna Riley, a member of ASEE and professor at Virginia Tech, has already asked, "What does it mean that in 2012 there was no expressed space for disabled engineers on this Island [of Other], or elsewhere at ASEE?"[4] when such a space exists for different affiliation-based organizations, such as the Society of Women Engineers, in the ASEE national conference Exhibit Hall. I push this question further by asking, "*Where is disability expressed (at all) within engineering education itself*?" With over 16% of the civilian noninstitutionalized population within the 21-64 age range in the United States being reported as part of the disabled community in 2010,[5] this group equals or exceeds the populations of other reported minority groups in the 18-64 age range.[6] Why, then, does disability receive so little coverage?

A brief note on language
This paper might seem a bit jarring due to my discussion of disability. I have chosen to use identity-first (i.e., "disabled people") language throughout this piece, as opposed to person-first (i.e., "people with disabilities"). My linguistic decisions are based in part on the social model of

disability.[7] The social model puts forth the idea that structural and social barriers are an important component of what disables people, as opposed to their bodies or minds; or, as Margaret Price coined, their "bodyminds".[8] This choice is also reflective of the position of self-advocates from within the disabled community who point out that disability can be a large part of an individual's identity that influences their experiences in the world,[9] similar to the influence of identifying with specific gender, racial, veteran, economic, or sexual orientations.

Method

This literature review was conducted through a database search for ASEE conference papers from 2010 through 2015. I performed this search using the keyword "disab*" to include the various permutations of wording that might be used (e.g., disability as well as disabled); I intentionally did not expand the search to include outdated terms such as handicap, lame, or crippled. The sources used were the ASEE national conference search engine and the USB jump drive included with the 2015 conference materials. I initially categorized the search results based on where in the paper disab* appeared and how it was used; Table 1 provides the number of papers for each year that included disab* in either the author notes or the reference list *only*, as opposed to in the body of the paper somewhere.

Table 1. ASEE annual conference "disab*" search results

Year	Search results, number of papers	Disab* exclusively used in author notes and/or references	Disab* used in paper text
2010	81	18	63
2011	116	32	84
2012	99	30	69
2013	119	63	56
2014	103	35	69
2015	14	6	8
Total	532	184	349

The initial division of papers illustrates one manner in which "disab*" is used within engineering education conference papers, and served as a basis for an initial set of categories. This set had three major categories: 1) paper itself not about disability, disab* found within the biographical notes or the reference list; 2) disability in design projects; and 3) disability as major focus of paper. As the conference papers were reviewed using these categories, it became apparent that further development was necessary; for example, a paper that included the phrase "disable the car"[10] in the body of its text was discovered by the keyword search, but did not fit into the categories previously described.

Further categories then matured during the review process; this included opening and reviewing each pdf to determine where and how disab* was used within the paper. These categories developed from the usage of the keyword disab* by each paper's authors; the first reading of the papers further refined the initial sorting into the categories outlined below:

Category 0 - "Software and hardware" – The paper itself has no relation to disability as an identity; tags include software and hardware that might be "disabled" (e.g., a car, robot, or line of code)

Category 1 - "Authors and references"– The paper does not discuss disability; tags include author errata, in the reference list (specifically, NSF reports), an underrepresented minority category, or within syllabus errata

Category 2 - "Low design"– Disability used as a design constraint or requirement; tags include reference to the Americans with Disabilities Act (ADA)[3], assistive technology design projects for "people with disabilities" (sometimes shortened to "PwD"); few to no references to specific client needs,

Category 3 - "High design" – Disability included as a facet of the design client (i.e., high design); tags include specific disabilities, meeting with the client, multiple references to client needs in paper

Category 4 - "Perceptions and accommodations" – Disability as it relates to engineering student or faculty perceptions; tags include reflection on disabilities, working alongside people with disabilities, mention of students with disabilities in classroom with regards to basic accommodations

Category 5 - "Access and inclusion" – Disability used as a focal point of the paper; tags include inclusion disabled within STEM fields, STEM classroom accessibility, experiences of students with disabilities in STEM field

Findings

A total of 532 papers were found through the keyword search, with the results of categorizing the papers listed below in Table 2. Many of the papers (15.3%) included in the results were not in fact about disability, resulting in the development of category 0, or "Software and hardware." Over half of the papers found via this search, 58.4%, fell within category 1. Such papers typically included disability in the list of categories of traditionally underserved identity groups within engineering; others had an edition of the NSF "Women, Minorities, and Persons with Disabilities" report listed in the references for papers concerned with the recruitment and/or retention of women or racial minorities in STEM fields. As shown in Table 2, there is a striking number of papers where disability is only mentioned in an offhand manner; if papers categorized as 0 or 1 were excluded, the search would have found only 142 papers total over the course of the six-year timeframe.

Considering then the remaining 142 papers, over four-fifths of the search results were specifically concerned with design projects (categories 2 and 3). These projects typically discussed the ADA as a set of design requirements or considered specific client needs in a "service" context. They use simulations (e.g., dark glasses and oven mitts) to imagine "extreme experiences" to create more innovative designs, without recognizing that the experience labeled

as "extreme" are part of *normal* lived experiences for those who have low vision or fine motor control impairments.[11]

Table 2. Number of papers in each category, by year

	0	1	2	3	4	5
	Software and hardware	Authors and references	Low design	High design	Perceptions and accommodations	Access and inclusion
2010	14	40	21	3	2	1
2011	16	69	21	4	1	5
2012	18	59	18	2	2	0
2013	16	72	26	2	0	3
2014	17	62	13	4	5	2
2015	0	7	5	0	0	2
Total	81	309	104	15	10	13

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Very few papers explicitly considered disabled engineering students and/or disabled engineers in a manner that categorized them as a 4 or 5. I provide an example from each category below as the beginning of a deeper approach towards disability within engineering education that focused on lived experiences and the concept of inclusion, instead of simulation exercises and design constraints.

Category 4:"Perceptions and accommodations"

One of the papers within this category was titled, "I did not anticipate this: Experiences from the first year"[12]in part for its discussion of faculty perspectives on disability within engineering classrooms. This paper provided a few examples from the authors concerning the basics of the accommodation process along with a discussion of the types of accommodations the authors witnessed in the classroom, including recording devices, lab assistants, and extended time for assessments.

Category 5:"Access and inclusion"

Going beyond the concept of accommodations within the classroom context, other authors examine accessibility in higher education. Behm et al specifically focused on the needs of Deaf students in a lecture setting, recognizing that such students are under-represented *and* underserved within higher education because of their limited access to classroom information.[13]

Limitations

As previously mentioned, there were a limited number of papers discovered while searching the 2015 conference USB drive. Due to using the USB jump drive as the 2015 paper source, there might be additional papers that were excluded from the analysis. However, when attempting to use the new PEER (Papers on Engineering Education Repository) document system, there were additional discrepancies in the number of papers found during the time frame of the study.

Discussion and implications

The purpose of this paper was to critically examine the current representations of an identity category (disability) that is less investigated than other identities within the context of engineering and engineering education. While two and a half decades have passed with the ADA in place to mandate "reasonable accommodations" and accessibility in terms of employment, education, and transportation, significant structural and social barriers to access still exist. Implied through the lack of papers that focus on disability as an identity, these findings indicate that within engineering education, the experiences of the disabled community, of disabled students, and of disabled engineers are not yet part of our concepts of diversity and inclusion. With even the 2015 Best Diversity Paper Awards limited to discussing disability through design projects,[14] the need to face the challenge of starting conversations about disability remains pressing.

One potential place to start this conversation is through further developing service/design projects, pushing papers from "low design" to "high design" as a result. Incorporating practices from user-centered and universal design would continue to provide authentic design experiences for students, while also recognizing that "cripping up" by using a wheelchair for an afternoon or trying to manipulate tools while wearing oven mitts does not account for the myriad of lived, disabled experiences. Enhanced design experiences could include increasing interactions with disabled clients themselves, so that they could articulate their own needs in the spirit of the disability rights motto, "Nothing about us, without us."[15]

References

1. ASEE, "Diversity," 2015. [Online]. Available: http://diversity.asee.org/awards. [Accessed: 10-Jun-2015].
2. "Protests/Activism," Action for Access, Jun-2015. [Online]. Available: http://www.actionforaccess.mohistory.org/protestsactivism.php.
3. Americans with Disabilities Act of 1990. 1990.
4. D. Riley, "The Island of Other: Making space for embodiment of difference in engineering," presented at the 120th ASEE Annual Conference and Exposition, Atlanta, GA, 2013.
5. M. W. Brault, "Americans with disabilities: 2010," U.S. Census Bureau, Washington, DC, 2012.
6. "Women, minorities, and persons with disabilities in science and engineering: 2015," National Science Foundation, 2015.
7. M. Oliver, "The individual and social models of disability," 1990.
8. M. Price, Mad at school: Rhetorics of mental disability and academic life. Ann Arbor, MI: University of Michigan Press, 2011.
9. B. Haller, "Journalists should learn to carefully traverse a variety of disability terminology," 07-Jan-2016. [Online].Available: http://ncdj.org/2016/01/journalists-should-learn-to-carefully-traverse-a-variety-of-disability-terminology/.
10. Y. Tang, R. Ramachandran, L. Head, and L. Chatman, "System-on-chip as a theme for achieving seamless

transition from a two-year college to a four-year university," presented at the ASEE Annual Conference and Exposition, Louisville, KY, 2010.

11. M. Green, C. C. Seepersad, and K. Holtta-Otto, "Extreme experience interviews for innovative designs: Classroom assessment of a new needs-gathering method," presented at the ASEE Annual Conference and Exposition, Louisville, KY, 2010.

12. T. Shepard, A. Hoxie, and M. Anderson, "I did not anticipate this: Experiences from the early years," presented at the 121st ASEE Annual Conference & Exposition, Indianapolis, IN, 2014.

13. Behm, Gary, Raja Kushalnagar, Joseph Stanislow, and Aaron Weir Kelstone Enhancing Accessibility of Engineering Lectures for Deaf and Hard of Hearing (DHH): Real-Time Tracking Text Displays (RTTD) in Classrooms," presented at the 122nd ASEE Annual Conference and Exposition, Seattle, WA, 2015.

14. J. A. Mejia, D. Drake, and A. Wilson-Lopez, "Changes in Latino/a adolescents' engineering self-efficacy and perceptions of engineering after addressing authentic engineering design challenges," presented at the 122nd ASEE Annual Conference and Exposition, Seattle, WA, 2015.

15. Charlton, J. I. (1998). Nothing about us without us: Disability oppression and empowerment (1st ed.). Berkeley: University of California Press. doi:10.1525/j.ctt1pnqn9