
2018 CoNECD - The Collaborative Network for Engineering and Computing

Diversity Conference: Crystal City, Virginia Apr 29

Beyond Ramps and Signs: Rethinking Support Structures for Engineering Students with Disabilities

Mr. Alexander Michael Alvarez, University of Arizona Department of Biomedical Engineering

Alex Alvarez is an MD/PhD student at the University of Arizona. His primary research area for the PhD in Biomedical Engineering is in ultrasound characterization of electrical signals in the heart. A secondary focus is on promoting and advocating for inclusion of all people of diverse backgrounds in engineering, science, and medicine - especially in educational spaces for these fields.

Paula C Johnson, University of Arizona

Paula C Johnson is an Associate Librarian at the University of Arizona. She is the liaison to the College of Engineering, working out of UA Libraries' Research and Learning Department.

Stephanie Zawada M.S., The University of Arizona

A graduate student in Electrical & Computer Engineering at the University of Arizona, Stephanie Zawada is a research assistant to the Senior Vice President, Jon W. Dudas, former Under Secretary of Commerce for Intellectual Property, and co-investigator on a joint AZ-Israel collaboration in the lab of Marvin J. Slepian, MD, inventor of the SynCardia Artificial Heart. Bridging science, law, and business, Zawada has interned with the NIH Office of Technology Transfer, the Law Library of Congress, the Goldwater Institute, and Quarles & Brady LLP. Graduating from UA with a bachelor's in biochemistry as the Class of 2015's Gold Medal Senior, Zawada was the recipient of the General Electric/LULAC Scholarship (2012-2015) and a NASA Space Grant (2012-13). As a U.S. Senate intern, she assisted in the development of a HELP Committee memo during the landmark Supreme Court case that ruled in favor of cDNA patentability. She has promoted science-policy dialogue as editor of the ABA Biotechnology Law Newsletter, an AMSA Just Medicine Committee member, and an international representative to the 2017 AAAS Science & Diplomacy Leadership Workshop.

Dr. Linda R Shaw

Dr. Marla A Franco, University of Arizona

Marla A. Franco, Ph.D., serves as the Director of Assessment and Research for the Division of Student Affairs, Enrollment Management, Academic Initiatives, and Student Success at the University of Arizona, where she leads the design and implementation of research, assessment, and evaluation plans across 45 units and departments to support a data rich environment for improved student learning and strategic decision making. Dr. Franco has close to 20 years of experience in higher education, which has brought her countless opportunities to assess, research, and inform educational practice, particularly in ways that have helped educators best understand the unique needs and outcomes of diverse college student populations.

Dr. Vignesh Subbian, University of Arizona

Vignesh Subbian is an Assistant Professor in the Department of Biomedical Engineering and the Department of Systems & Industrial Engineering at the University of Arizona. His primary interests are biomedical informatics, healthcare systems engineering, and STEM integration.

Beyond Ramps and Signs: Rethinking Support Structures for Engineering Students with Disabilities

Alexander M. Alvarez¹, Paula C. Johnson², Stephanie Zawada³, Linda Shaw⁴, Marla Franco⁵, Vignesh Subbian^{1,6}

¹Department of Biomedical Engineering, The University of Arizona

²University of Arizona Libraries

³Department of Electrical and Computer Engineering, The University of Arizona

⁴Department of Disability and Psychoeducational Studies, The University of Arizona

⁵Student Affairs, Divisional Assessment and Research, The University of Arizona

⁶Department of Systems and Industrial Engineering, The University of Arizona

Introduction

Over the past fifty years, United States federal legislation has endeavored to expand opportunities for individuals with disabilities in a variety of arenas. Section 504 of the Rehabilitation Act and the Americans with Disabilities Act of 1990, in particular, has encouraged universities and post-secondary institutions to develop and implement policies that ensure equitable access, retention and graduation for students from underrepresented groups.

Although inclusion of students with disabilities should be addressed in line with this legislation, improving the inclusion of students with any form of disability within the STEM fields has not been adequately addressed within the larger body of literature discussing diversity and equitable access. To date, efforts to enhance diversity within engineering in higher education have focused primarily on improving the male/female ratio in both student and faculty populations and on increasing the numbers of underrepresented ethnic populations such as African Americans, Latinx and Native Americans. While there is an expanding body of engineering education literature [1-3] that addresses the need to improve gender and ethnic diversity, there remains a gap in scholarship that addresses the need to improve access for STEM students with disabilities. As such, in this paper, we aim to examine and report efforts around inclusion of engineering students with disabilities at a large, public Research I Institution, and provide recommendations for improving and such initiatives.

Background

The AAAS Resource Directory of Scientists and Engineers with Disabilities first published in 1978 and now in its fourth edition [4] presents data and statistics on people in science and engineering with disabilities and includes details on type of disability, age of onset, ethnicity, and other demographic information. It serves as a resource for people with disabilities, educators, researchers, and those establishing policy, programs or practices to serve them. People with disabilities in STEM fields are encouraged to provide their personal data for this resource, even if they choose not to be listed in the resource directory, as collecting accurate demographic information on disability can be difficult. In many instances, the decision is made to keep such information confidential due to concerns that self-identification might invite unwelcome attention and erroneous assumptions about the capabilities of individuals with disabilities, and fears of discrimination [5]. Additionally, in the higher education context, insufficient systems for consolidating information from different sources (e.g., disability resource center, counseling center, bursar's office, the graduate school, undergraduate office of admissions) results in missing data pertaining to engineering students with disabilities.

Despite this difficulty in collecting demographic information from peoples with disabilities, the National Science Foundation (NSF) issued a report - *Women, Minorities, and Persons with Disabilities in Science and Engineering* - which attempts to track such data. In addition, according to its 2017 report, the U.S. Census Bureau's American Community Survey estimated the percentage of the general population with some sort of disability to be 13%. In 2012, nearly 11% of undergraduate students and 7% of graduate students reported a disability. For both graduate and undergraduate students, the proportion with disabilities who enroll in science and engineering is roughly similar (20-25%) to those without disability [6].

Need for scholarship on students with disabilities in engineering: There is little discussion in the literature about the experiences of students with disabilities as they enter engineering programs and the kinds of programs and resources available to support them through their educational experiences. Individuals with disabilities are one population whose experience with problem solving and traits of tenacity and resilience can make for successful pathways in engineering [7]. The education and leadership of persons with disabilities is the means for the type of engineering that will further open the doors to persons with disability. “Research accountable to, and preferably done by, disabled people offers the best insights into disability” [8]. University engineering colleges should be leading the way in recruiting and retaining students who understand disability in order that they may develop an understanding of technical design processes. Beyond access to facilities, programs, and equipment - engineering students need to feel welcomed and accepted by educators and fellow students. As such, in this paper we examine the extent and scope of support systems at the University of Arizona (UA) that engineering students with disabilities may require to complete their educational goals. In addition, we identify challenges and potential strategies that universities and their engineering programs can leverage to better support students with disabilities

Methods

We considered the availability and utilization of resources offered by three intramural organizations for students with disabilities: 1) the UA Disability Resource Center (DRC) which offers accommodations, support structures, and community for all students with any temporary or permanent disability, 2) the UA Strategic Alternative Learning Techniques (SALT) Center which offers tutoring, academic skills workshops, one-on-one learning specialist training, and more for students accepted into their program with learning disabilities, attention deficit hyperactivity disorder, and other learning differences, and 3) the UA College of Engineering itself.

Resource Availability

We performed a review of disability resources available at the University of Arizona using the Google search engine. We found current information (2010-2017) regarding disability resources at UA on arizona.edu webpages [9-42, 56], higher education information websites [43-48], disability access websites [49-51], and news websites [52-55].

The resources accessed were representative of what a student might see when trying to access disability resources. We did not include redundant resource links. The keywords and phrases we employed during the search are included in Table 1.

| Search Terms | Number of hits (in thousands) |
|---|-------------------------------|
| Disability University of Arizona | 3,380 |
| Accommodations University of Arizona | 8,750 |
| Accessibility University of Arizona | 1,050 |
| Disability Resources University of Arizona | 559 |
| University of Arizona Students with Disabilities | 6,150 |
| University of Arizona Students with Disabilities Accommodations | 1,620 |
| University of Arizona Students with Disabilities Resources | 5,970 |

Table 1 – Keywords and phrases for disability resource availability at the University of Arizona

In addition, we considered university-sponsored webpages for the DRC (drc.arizona.edu), SALT Center (salt.arizona.edu), and College of Engineering (engineering.arizona.edu) to determine resource availability, assuming prior student awareness of these specific resources. We categorized the resources that specifically corresponded students with disabilities as one of the following: academic access, physical access, technology access, and social support.

Resource Utilization

Both the UA DRC and SALT Center regularly collect data on student resource utilization and report them annually. We requested data on undergraduate engineering students from both centers to better understand specific ways in which engineering students access and utilize these resources and how best to expand services to this population.

From the DRC, aggregate data comparing broad categories of resource utilization during the academic year 2016-17 by engineering students as well as all other students were collected and reported. These data were organized around two different categories: (1) student requests, which included anything that a student self-recognized as a need in order to perform appropriately in a class, and (2) classes needing accommodations which included all courses in the academic year that needed various forms of accommodations. In addition, a DRC representative qualitatively reported what engineering students tend to request most from the DRC. Finally, overall student population data was collected from the University of Arizona's 2016-17 Fact Book.

From the SALT Center, metrics regarding student utilization across six broad categories of resource offerings were identified based on hourly use of these resources by engineering students – Academic Skills (including planning, reading, and testing skills), Learning Specialist (including any meetings over phone, email, or in person with learning specialists), Tutoring (for any particular topic or subject), Math and Science Lab (for drop-in tutoring of math and science subjects), Writing Lab (for drop-in tutoring on writing and editing), and Tech Coaching (for help in utilizing tech resources) . In addition, we collected specific information on the majors of engineering students and courses for which students were seeking academic support.

Results

Resource Availability

We found 34 webpages offering resources for students with disabilities on the arizona.edu website through a simple internet search. Of these webpages, 15 pages were DRC materials ranging from 'FAQ' and disability accommodation enrollment for new students to step-by-step instructions on how to report a barrier on campus to the DRC [9, 16, 18-19, 24, 27-30, 32, 34-35, 37, 41-42]. Three webpages directed readers to the SALT Center [17, 22, 23], while one page listed the campus policies for both physical and academic access for disabled students [21]. Other webpages we found in this search included resources for disabled students in buildings such as the library, bookstore, and fitness center [12, 33, 43, 47], while others highlighted accommodations in certain programs such as study abroad or IT/online programs [15, 25, 30, 50, 14, 44].

While searching for resources on the engineering.arizona.edu website directly, a search for the term 'disability' results in six hits. Four of these were syllabi for specific engineering courses, in which the course description requests students to inform the professor directly in the case that they "anticipate or experience physical or academic barriers based on disability or pregnancy" [56]. The other two refer to admissions/applications for the College of Engineering and a Summer Engineering Academy.

Resource Utilization

Aggregated data from the DRC is presented in Table 2. Qualitatively, the DRC also reported that the most common request in engineering was to increase the amount of time available for completion of an exam.

| | <i>All Colleges</i> | <i>College of Engineering (%)*</i> |
|--|---------------------|------------------------------------|
| <i>Total Population</i> | 34,072 | 2852 (8.4%) |
| <i>Student Requests</i> | 3331 | 125 (3.8%) |
| <i>Courses Requiring Accommodation</i> | 1310 | 254 (19.4%) |

*Percent of the results from all colleges made up by the College of Engineering

*Table 2 – DRC resource utilization by undergraduate students in academic year 2016-2017. Total population indicates the total number of undergraduate students. Student Requests indicates the total number of requests made by students on their own behalf (not the total number of students requesting). Classes needing accommodation indicates the total number of courses that required DRC resources in making accommodations for any number of students. *Percent of*

Data from the SALT Center indicating the type and amount of resources utilized by students is presented in Table 3. Of the students that utilize SALT resources, class standing ranged from freshman to senior. Most students who use SALT Center resources had not yet selected their specific major in engineering (typically declared in the first or second year of undergraduate studies). In addition, of the 19 courses in which tutoring was sought, only three were upper division courses (typically taken in third or fourth year) and only seven were within specific engineering college offerings (the rest including math, science, and general education courses that students must complete to be eligible to take upper division coursework).

| | <i>Hours Utilized</i> | <i>% of Total Hours Utilized at SALT Center</i> |
|-----------------------------|-----------------------|---|
| <i>Math and Science Lab</i> | 132.9 | 38.1 |
| <i>Learning Specialist</i> | 94.5 | 27.1 |
| <i>SALT Tutoring</i> | 60.5 | 17.4 |
| <i>Academic Skills</i> | 33.2 | 9.5 |
| <i>Writers Lab</i> | 25.3 | 7.3 |
| <i>Tech Coaching</i> | 2.4 | 0.7 |

Table 3 – SALT Center resource utilization by undergraduate engineering students in academic year 2016-2017. Math and Science and Writers Lab are drop-in tutoring for any questions in Math and Science or Writing. Learning Specialist indicates time spent over email, phone, or in person with dedicated learning specialists at the SALT Center. SALT Tutoring includes specific appointment-based tutoring with SALT tutors in particular courses. Academic Skills include workshops and meetings regarding improvement of general academic skills. Tech Coaching includes meetings to help students with utilizing their technological resources.

Discussion

The results of our preliminary investigation on the availability and utilization of resources by engineering students with disabilities at the UA demonstrates a few important lessons in how support structures can be designed to better support students with disabilities.

Targeted Outreach to Students with Disabilities at the College Level

The first and most important lesson is ensuring that college leadership involve students with disabilities in diversity and inclusion efforts, rather than relying on the efforts of the university at-large. This is especially important for two reasons: (1) a large portion of the student experience is made up of time in the classroom and in engineering spaces and university-wide efforts cannot always influence these spaces to ensure that a positive and accepting culture exists, and (2) engineering contains unique spaces such as machine shops, collaborative learning spaces, etc. that require specific solutions for accessibility. Thus, instead of assuming that the university’s larger disability centers can serve engineering students with disabilities needs, we recommend that colleges of engineering find ways to bring students with disabilities into the conversation and allow them to define what needs they have and what support structures they are looking for in the pursuit of their educational goals. As discussed above, the data collected by the SALT center and by the DRC only demonstrate those feelings that are reported by students and largely miss out on the sentiments of students who cannot report for a variety of reasons. By hosting listening sessions and surveys related to larger inclusion efforts (and not just focused on disability), we believe that colleges of engineering can demonstrate a concerted effort to support students at the college level and find novel ways in which they can support their students so that there is a culture of inclusion for students with disabilities in engineering spaces.

Universal Design in Engineering Classroom Spaces

A second essential takeaway from the DRC data is the need for redesigning engineering classroom spaces using principles of universal design. Requests for classroom accommodations were

disproportionately higher for engineering students than the overall student population, indicating a need for universal design in engineering classrooms and spaces. Universal design in classrooms is targeted not at increasing accommodations but at ensuring that all students' needs are addressed in the design of the class, allowing for effective engagement and better access so that individual accommodations become unnecessary [57]. AccessEngineering, an initiative at the University of Washington, supported by the National Science Foundation (NSF) is an exemplary model and resource for broadening participation in engineering and supporting engineering students with disabilities using such principles of universal design [57]. Their recommendation for employing universal design and better wraparound resource utilization during the first years of undergraduate education will go a long way to ensure that students have access to the resources that they need.

Increased Awareness of Resource Availability in Colleges of Engineering

A third important lesson from our study is the need for increased awareness of resource availability in colleges of engineering. While engineering students made up 8.37% of the undergraduate population at the UA, only 3.75% of requests made to the DRC were from engineering students. One potential reason for this could be a lack of knowledge of available resources. As can be seen in our analysis of resources offered to students at the UA, the lack of specific references to disability services on the College of Engineering website starkly contrasts the large array of services offered by the DRC and SALT Center. This indicates that while the student population at large may have access to disability resources, the College of Engineering may be lacking in its promotion and offering of resources. Thus, we recommend colleges of engineering include dedicated information for students with disabilities on accessing resources and community spaces in both website and social media spaces. In addition, we recommend that faculty and advisory staff in engineering spaces learn about the specific accommodations that are available to students and actively engage in outreach to students who might benefit from various support services/accommodations so that these services truly wrap around students.

Early and Targeted Support during Freshman and Sophomore years

Finally, our analysis of the SALT Center data suggests that support structures for students with disabilities, particularly learning disabilities, should be heavily targeted during freshman and sophomore years. Most resources accessed by students at the SALT Center were for tutoring in math and science-based subjects; most courses in which appointment-based tutoring was sought were lower division courses; and most of tutoring work was for courses outside of specific engineering departments, indicating that students in lower division courses need more hours and support to ensure their success. The majority of early coursework in engineering programs involve basic math and science coursework. By promoting resources and increasing tutoring services for engineering students in basic science and math coursework, colleges of engineering can ensure that these students persist and are better prepared for upper division coursework.

Limitations

An important limitation to highlight is the large number of students that are not included in the aggregated data. Although these data sets do provide comprehensive insight on the services accessed at these centers, as briefly mentioned above, data collection on populations with disabilities can prove challenging for any of a number of reasons including the social and cognitive costs of self-identification with a given label which can lead to stigmatization by peers and faculty and difficulty in capturing individual experiences with disability in survey questions [58]. Thus, in our study, stigma, lack of knowledge, or other reasons may have prevented students from feeling comfortable enough to reach out or access resources. Indeed, through an anonymous survey collected in 2016 at the UA to determine the campus climate [59], undergraduate survey respondents (of which 9.1% were from the College of Engineering) self-identified with disabilities indicated that they felt their opinions and individuality were less valued, had a lower sense of belonging, and heard faculty and students express negative or

stereotypical views about physical, cognitive, sensory, or emotional disabilities at higher rates than students self-identified as not disabled. In addition, students self-identifying with a disability also felt overwhelmed by several socioeconomic challenges (e.g., skipped meals or ate less due to insufficient money or food, and experienced an unstable residence for financial reasons more often than those students self-identifying as not disabled). Given the unique demands of engineering programs, it is essential that we develop wraparound services tailored specifically to engineering students.

An additional limitation to highlight is the lack of regularly-collected data and monitoring systems for students with disabilities. Although there is a campus-wide climate survey administered every five years and there are data available from the DRC and SALT Center, no regular mechanism at the university level exists to collect consistent data, monitor the services accessed by students with disabilities, and inform decision-making for these students. This ultimately also limited the data that we had access to for our analysis and the conclusions that we could draw, considering the non-standardized format of data collection.

Conclusion

In this pilot study, we examined the resources available to support engineering students with disabilities at a large, public university. Preliminary results showed that while resource availability at the university level is high, promotion of these resources is disproportionately low and targeted initiatives to increase accessibility in engineering spaces is limited to nonexistent. Regarding resource utilization, preliminary results indicated that engineering students with disabilities in lower division courses needed more tutoring support for these courses to ensure their success. Additionally, these results showed that knowledge of available resources for students with disabilities may be limited in the engineering student community and disproportionately high number of accommodations are necessary for engineering classrooms. Based on these results, we have developed four recommendations for supporting engineering students with disabilities: (1) Targeting specific outreach efforts to engineering students with disabilities at the college level to address the unique needs of these students and create a culture of accessibility, (2) implementing principles of universal design in engineering classroom, laboratory, and other maker spaces, (3) increasing awareness of resource availability for engineering students, staff, and faculty so that students may have greater access to these services; and (4) developing targeted support structures for engineering students in their freshman and sophomore years.

Acknowledgements

We are very grateful to the University of Arizona Disability Resource Center and SALT Center for providing the data used in this study.

References

- [1] D. Chubin, G. May, E. Babco. "Diversifying the Engineering Workforce." *J. Eng. Ed.*, vol. 94, no 1, pp. 73-86, Jan. 2005.
- [2] D. Bilimoria, S. Joy, X. Liang. "Breaking barriers and creating inclusiveness: Lessons of organizational transformation to advance women faculty in academic science and engineering." *Human Resource Management*, Special Issue, Aug. 2008.
- [3] W. Lee, C. Brozina, C. Amelink, B. Jones. "Motivating incoming engineering students with diverse backgrounds: Assessing a summer bridge program's impact on academic motivation." *J. Women and Minorities in Sci. and Eng.*, vol. 23, no. 2, 2017.
- [4] American Association for the Advancement of Science, "The AAAS Resource Directory of Scientists and Engineers with Disabilities" brochure. [Online]. Available: <http://ehrweb.aaas.org/resource/resourceBrochure.pdf>. [Accessed Dec. 30, 2017]
- [5] L. Mullins, M. Preyde. "The lived experiences of students with an invisible disability at a Canadian university." *Disability & Society*, vol. 28, pp. 147-160.

- [6] National Science Foundation, “Women, Minorities, and Persons with Disabilities in Science and Engineering. [Online] Available: <http://www.nsf.gov/statistics/2017/>. [Accessed Dec. 30, 2017]
- [7] T. S. Barger. "Engineers with disabilities: inveterate problem solvers." *IEEE Spectrum*, vol. 54, no. 1, pp. 19-19, January 2017.
- [8] T. Shakespeare. The social model of disability. In L. J. Davis (Ed.), *The disability studies reader* (3rd ed.) (pp. 266–273). New York, NY: Routledge
- [9] University of Arizona Disability Resource Center, “Accessible Transportation.” [Online]. Available: <http://drc.arizona.edu/students/accessible-transportation> [Accessed Jan. 2, 2018]
- [10] University of Arizona Office of Student Engagement, “Accessibility and 100% Engagement.” [Online]. Available: <http://ose.arizona.edu/accessibility-and-100-engagement> [Accessed Jan. 2, 2018]
- [11] UAOnline, “Accessibility.” [Online]. Available: <http://uaonline.arizona.edu/accessibility> [Accessed Jan. 2, 2018]
- [12] University of Arizona Library, “Accessibility.” [Online]. Available: <http://new.library.arizona.edu/accessibility> [Accessed Jan. 2, 2018]
- [13] University of Arizona, “Designing Accessibility.” [Online]. Available: <http://www.arizona.edu/designing-accessibility> [Accessed Jan. 2, 2018]
- [14] University of Arizona, “IT Accessibility.” [Online]. Available: <http://itaccessibility.arizona.edu/> [Accessed Jan. 2, 2018]
- [15] University of Arizona Office of Global Initiatives, “Disability Abroad.” [Online]. Available: <https://global.arizona.edu/study-abroad/disability-abroad> [Accessed Jan. 2, 2018]
- [16] University of Arizona Disability Resource Center, “FAQs.” [Online]. Available: <http://drc.arizona.edu/students/faqs-students> [Accessed Jan. 2, 2018]
- [17] University of Arizona Strategic Alternative Learning Techniques, “SALT Center.” [Online]. Available: <https://www.salt.arizona.edu/> [Accessed Jan. 2, 2018]
- [18] University of Arizona Disability Resource Center, “UA Online.” [Online]. Available: <http://drc.arizona.edu/students/ua-online>. [Accessed Jan. 2, 2018]
- [19] University of Arizona Disability Resource Center, “Introduction to DRC.” [Online]. Available: <http://drc.arizona.edu/about/introduction-drc> [Accessed Jan. 2, 2018]
- [20] University of Arizona, “DRC Center Paves Way for All Students.” [Online]. Available: <http://www.arizona.edu/drc-paves-way-all-students> [Accessed Jan. 2, 2018]
- [21] University of Arizona, “Policies – Disability.” [Online]. Available: <http://archive.catalog.arizona.edu/2011-12/policies/disability.htm> [Accessed Jan. 2, 2018]
- [22] University of Arizona, “SALT Center Model.” [Online]. Available: <http://www.arizona.edu/salt-center-model> [Accessed Jan. 2, 2018]
- [23] University of Arizona Strategic Alternative Learning Techniques, “Future Students – Accommodations.” [Online]. Available: <https://www.salt.arizona.edu/future-students/accommodations> [Accessed Jan. 2, 2018]
- [24] University of Arizona Disability Resource Center, “Report Campus Access Barrier.” [Online]. Available: <http://drc.arizona.edu/forms/report-campus-access-barrier> [Accessed Jan. 2, 2018]
- [25] University of Arizona Global Initiatives, “Accessible Earth.” [Online]. Available: <https://global.arizona.edu/study-abroad/program/accessible-earth> [Accessed Jan. 2, 2018]
- [26] University of Arizona Student Affairs and Enrollment Management, “UA Advances Accessibility University-Wide Captioning”. [Online]. Available: <http://saem-aiss.arizona.edu/news/ua-advances-accessibility-university-wide-captioning> [Accessed Jan. 2, 2018]
- [27] University of Arizona Disability Resource Center, “Cart Service.” [Online]. Available: <http://drc.arizona.edu/workplace-access/cart-service> [Accessed Jan. 2, 2018]
- [28] University of Arizona Disability Resource Center, “Access Lecture Content.” [Online]. Available: <http://drc.arizona.edu/students/access-lecture-content> [Accessed Jan. 2, 2018]
- [29] University of Arizona Disability Resource Center, “Accessible Vehicles.” [Online]. Available: <http://drc.arizona.edu/about/accessible-vehicles-ua-motorpool> [Accessed Jan. 2, 2018]

- [30] University of Arizona Disability Resource Center, "Study Abroad Access." [Online]. Available: <http://drc.arizona.edu/students/study-abroad-access> [Accessed Jan. 2, 2018]
- [31] UANetwork, "Making Technology Accessible for All." [Online]. Available: <https://uaatwork.arizona.edu/lqp/making-technology-accessible-all> [Accessed Jan. 2, 2018]
- [32] University of Arizona Disability Resource Center, "Residence Hall Accommodations." [Online]. Available: <http://drc.arizona.edu/students/residence-hall-accommodations> [Accessed Jan. 2, 2018]
- [33] University of Arizona Bookstore, "Accommodations." [Online]. Available: <https://uabookstore.redshelf.com/accessibility/> [Accessed Jan. 2, 2018]
- [34] University of Arizona Disability Resource Center, "Exam Accommodations." [Online]. Available: <http://drc.arizona.edu/students/exam-accommodations> [Accessed Jan. 2, 2018]
- [35] University of Arizona Disability Resource Center, "Campus Accessibility." [Online]. Available: <http://www.arizona.edu/campus-accessibility> [Accessed Jan. 2, 2018]
- [36] University of Arizona, "Academic Support." [Online]. Available: <http://www.arizona.edu/academic-support> [Accessed Jan. 2, 2018]
- [37] University of Arizona Disability Resource Center, "Connect." [Online]. Available: <http://drc.arizona.edu/students/connect> [Accessed Jan. 2, 2018]
- [38] University of Arizona Student Affairs and Enrollment Management, "Disability Resource Center." [Online]. Available: <http://saem-aiss.arizona.edu/student-affairs/disability-resource-center> [Accessed Jan. 2, 2018]
- [39] University of Arizona Diversity, "Creating Inclusive Classrooms." [Online]. Available: <http://diversity.arizona.edu/creating-inclusive-classrooms> [Accessed Jan. 2, 2018]
- [40] University of Arizona Diversity, "Graduate Student Resources." [Online]. Available: <http://diversity.arizona.edu/graduate-student-resources> [Accessed Jan. 2, 2018]
- [41] University of Arizona Disability Resource Center, "About Curricular Access." [Online]. Available: <http://drc.arizona.edu/outreach-education/about-curricular-access> [Accessed Jan. 2, 2018]
- [42] University of Arizona Disability Resource Center, "About Physical Access." [Online]. Available: <http://drc.arizona.edu/outreach-education/about-physical-access> [Accessed Jan. 2, 2018]
- [43] B. Burrows. "5 Great Schools for Students with Special Needs: Part One." Nov. 9, 2016. [Online]. Available: <https://www.studyusa.com/en/a/1408/5-great-schools-for-students-with-special-needs-part-one> [Accessed Jan. 2, 2018]
- [44] AccessingHigherGround.com, "UDL, Accessibility and Quality Assurance." [Online]. Available: <http://accessinghigherground.org/udl-accessibility-and-quality-assurance-collaborations-at-the-university-of-arizona-for-accessible-online-classes/> [Accessed Jan. 2, 2018]
- [45] BestCollegesOnline, "20 Incredible Colleges for Students with Special Needs." [Online]. Available: <http://www.bestcollegesonline.com/blog/20-incredible-colleges-for-special-needs-students/> [Accessed Jan. 2, 2018]
- [46] CollegeChoice, "50 Best Disability Friendly Colleges and Universities." [Online]. Available: <https://www.collegechoice.net/50-best-disability-friendly-colleges-and-universities/> [Accessed Jan. 2, 2018]
- [47] R. Schachter. "Learning Disabled Students Welcome." Apr. 25, 2012. [Online]. Available: <https://www.universitybusiness.com/article/learning-disabled-students-welcome> [Accessed Jan. 2, 2018]
- [48] D. Smith-Barrow. "Succeed in College as a Learning Disabled Student." *US News and World Report*. Aug. 28, 2013. [Online]. Available: <https://www.usnews.com/education/best-colleges/articles/2013/08/28/succeed-in-college-as-a-learning-disabled-student> [Accessed Jan. 2, 2018]
- [49] M. Bohanon. "Moving Beyond Stigma to Support Students with Invisible Disabilities." May 19, 2017. [Online]. Available: <http://www.insightintodiversity.com/moving-beyond-stigma-to-support-students-with-invisible-disabilities/> [Accessed on Jan. 2, 2018]
- [50] A. Carbajal. "University of Arizona Creates First Accessible Study Abroad Course." [Online]. Available: <http://ability360.org/livability/education-livability/university-arizona-creates-first-accessible-study-abroad-course> [Accessed on Jan. 2, 2018]

- [51] Special-Education-Degree.Net, “Top Colleges Open Up to Special Needs Students.” [Online]. Available: <https://www.special-education-degree.net/top-colleges-open-up-to-special-needs-students/> [Accessed on Jan. 2, 2018]
- [52] J. Steinberg. “Hard Decisions for Learning Disabled.” *NY Times*. Nov. 3, 2011. [Online]. Available: <http://www.nytimes.com/2011/11/06/education/edlife/hard-decisions-for-learning-disabled.html> [Accessed on Jan. 2, 2018]
- [53] B. Pallack. “Special-ed grads to get new path at UA.” *AZ Daily Star*. Nov. 10, 2010. [Online]. Available: http://tucson.com/news/local/education/college/special-ed-grads-to-get-new-path-at-ua/article_a36b8608-7fee-5be9-b4ae-cd2a0e07d780.html [Accessed on Jan. 2, 2018]
- [54] G. Telis. “Project Offers Path to College for Intellectually Disabled.” *AZ Public Media*. Mar. 5, 2013. [Online]. Available: <https://www.azpm.org/s/14077-project-focus-offers-path-to-college-for-intellectually-disabled-students/> [Accessed on Jan. 2, 2018]
- [55] J. Yu. “Unique Program at UA helps students with intellectual disabilities.” *Tucson News Now*. Jan. 6, 2016. [Online]. Available: <http://www.tucsonnewsnow.com/story/30980023/unique-program-at-ua-helps-students-with-intellectual-disabilities> [Accessed on Jan. 2, 2018]
- [56] University of Arizona, “ECE 503 Fall 2016 Syllabus.” [Online]. Available: <http://www2.engr.arizona.edu/~tandonr/teaching/Syllabus-ECE-503-Fall-2016.pdf> [Accessed on Mar. 1, 2018]
- [57] University of Washington DO-IT, “Universal Design vs. Accommodation.” [Online]. Available: <https://www.washington.edu/doi/universal-design-vs-accommodation> [Accessed on Jan. 2, 2018]
- [58] Institute of Medicine (US) and National Research Council (US) Committee to Review the Social Security Administration's Disability Decision Process Research: N Mathiowetz, GS Wunderlich, ed. Survey Measurement of Work Disability: Summary of a Workshop in *Methodological Issues in the Measurement of Work Disability*. Washington (DC): National Academies Press (US); 2000. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK225427/>
- [59] University of Arizona Campus Climate Survey [Online]. Available: <https://deanofstudents.arizona.edu/university-arizona-campus-climate-survey> [Accessed on Jan. 2, 2018]