Barriers to Persistence for Engineering Students with Disabilities

Dr. Yvette Pearson Weatherton, Rice University

Dr. Yvette Pearson Weatherton holds a B.S. in Civil Engineering and M.S. in Chemistry from Southern University and A&M College and a Ph.D. in Engineering and Applied Science from the University of New Orleans. She is Associate Dean for Accreditation and Assessment in the George R. Brown School of Engineering at Rice University, a Program Evaluator (PEV) for the Engineering Accreditation Commission (EAC) of ABET, a registered Professional Engineer in Louisiana, a Fellow of the American Society of Civil Engineers (ASCE), a member of ASCE's Committee on Diversity and Inclusion, and a former Program Director in the Division of Undergraduate Education (DUE) at the National Science Foundation (NSF).

Dr. Renae Danielle Mayes, Ball State University

Renae D. Mayes, PhD, NCC is an assistant professor and director of the School Counseling Program in the Department of Educational Psychology. She completed her PhD in counselor education at The Ohio State University, after completing degrees at the University of Maryland, College Park (MEd in school counseling) and University of Missouri (BS in middle school math and social studies education). Mayes's line of research focuses on students of color in the k-16 pipeline in three areas including gifted education, special education, and urban education.

Ms. Carol Villanueva-Perez, Ball State University

Barriers to Persistence of Engineering Students with Disabilities: A Review of Literature

Abstract

Undergraduate student retention is dependent not only on academic aptitude, but also on non-academic factors, which include the ability to integrate fully into their academic environments. Non-academic factors are likely to more significantly impact the success of students with disabilities compared to their peers who do not have disabilities, especially within science, technology, engineering, and mathematics (STEM) disciplines, and engineering in particular. These include systemic as well as personal barriers.

An institution's culture and climate are among several systemic barriers that exist to impede successful matriculation of students with disabilities, particularly in engineering. Researchers have found engineering and law faculty members "were significantly less willing to provide accommodations" than their counterparts in other academic units. Reluctance and negative attitudes serve to foster environments that are counter to diversity and inclusion.

Studies have shown that incorrect estimates of self-efficacy are among personal barriers that hinder student success. Some students with disabilities tend to have lower academic self-efficacy than students without a disability, and those with the highest IQs appear to have the lowest perceptions of academic self-efficacy, perhaps because they are more aware of their weaknesses. Other students with disabilities appear instead to have unrealistically positive beliefs about their own capabilities. In some cases this may result in students not requesting needed accommodations, though this may result from other factors such as fear of stigmas associated with disability as well.

In this paper, we present a review of literature pertaining to systemic and personal barriers to success for students with disabilities in engineering. We conclude with a summary of promising practices for overcoming those barriers and needs for additional research.

Introduction

Studies show undergraduate student retention is dependent not only on academic aptitude, but also on noncognitive factors, which include the ability to integrate fully in their academic environments (Morganson, Mayor, Streets, Litano, and Myers, 2015; Tinto, 1993; Veenstra, Dey, and Heerin, 2009). Challenges with accessibility and negative faculty and staff attitudes create barriers to success and persistence for students with disabilities. "Cookie cutter" accommodations are not optimal in meeting individual, diverse student needs. Noncognitive factors are likely to more significantly impact academic performance of students with disabilities compared to their peers who do not have disabilities, especially within STEM disciplines. Problems such as the lack of accessibility and negative attitudes towards and perceptions of students with disabilities impede their ability to integrate into their academic environments, thus negatively affecting their performance, and ultimately their persistence. Further, students may be reluctant to request accommodations because they fear being stigmatized, and low self-esteem may limit their self-advocacy.

According to the 2015 Disability Status Report: United States published by Cornell University (2016), 12.6% of non-institutionalized Americans have disabilities. This fraction increases with age, ranging from 0.7% for ages under 5 years to 49.8% for ages 75 and above (Erickson, Lee, & von Schrader, 2016). While data from Erickson et al (2016) and the National Science Foundation (2017) reflect college attendance at approximately the same rates for persons with and without disabilities, there are discrepancies in degree attainment between the two groups. Roughly 33% of people without disabilities hold a bachelor's degree or higher, compared to only 14% for their counterparts with disabilities (Erickson et al, 2016). That report further shows the employment rate for people with disabilities (35.2%) is less than half that of people without disabilities (78.3%) (Erickson et al, 2016). Though the employment gap is smaller among scientists and engineers (nearly 85% and 65% employment rates for people with and without disabilities, respectively), there are still notable differences between the two groups. This indicates that students who are able to overcome barriers to degree attainment still face barriers when pursuing opportunities in the STEM workforce. For those who are successful in obtaining employment, the distribution across industry, academic, and government employment sectors is approximately the same for engineers and scientists with and without disabilities (National Science Foundation, 2017). According to the National Science Foundation (2017) and Pearson Weatherton, Daza, and Pham (2011), students with and without disabilities express interest in majoring in science and engineering at the same rates. In order to understand and address the gaps that occur in degree completion and employment, we must identify and eliminate the barriers students face in postsecondary education.

The purpose of this paper is to present a review of literature to elucidate systemic and personal barriers that hinder the success of students with disabilities in engineering, along with promising practices for overcoming those barriers and needs for additional research. The search was conducted using EBSCOHost Academic Search Complete and ProQuest using combinations of terms related to engineering education, STEM education, and students with disabilities.

Disability on College Campuses

The Americans with Disabilities Act Amendments (2009) define disability as "(a) a physical or mental impairment that substantially limits one or more major life activities of such individual; (b) a record of such an impairment; or (c) being regarded as having such an impairment..." Chapter 126 requires equal opportunity for individuals with disabilities, and specifically prohibits discrimination against people with disabilities. Section 508 of the Rehabilitation Act of 1973 requires all federal agencies and entities that receive federal funding (including post-secondary institutions) make their computer-based resources, including websites, accessible to all users. Section 504 of the same law prohibits discrimination against people with disabilities and their exclusion from participation in or benefits of programs and activities receiving federal funding. Although several pieces of legislation require equal access and educational opportunities for students with disabilities, educators and administrators at post-secondary institutions are not as knowledgeable of them as their counterparts in K-12 education.

Students with disabilities are attending postsecondary institutions are higher rates than in the past. As students transition from high school to postsecondary institutions, they have the

opportunity to access supports at their respective institutions. These supports are guided by federal policies (e.g., Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973) that state that postsecondary students must be granted the opportunity to compete with their non-disabled peers. Students may seek support for a myriad of disabilities that were previously covered under the Individuals with Disabilities Education Act (IDEA; see IDEA for all 13 categories of disabilities). However, the most common disability for which students seek support at their respective postsecondary institutions is specific learning disabilities, that is, a

> disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia (IDEA, 2004).

Additionally, students commonly seek services related to Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD), psychological or psychiatric conditions (e.g., depression, anxiety), or health impairments/conditions (Raue & Lewis, 2011).

Securing support services at postsecondary institutions for students with disabilities is vastly different than K-12 education. For example, at universities, students with disabilities have to seek out services on their own to initiate the process (Hamblet, 2014). As students formally request accommodations, they must provide current documentation indicating they have a disability. Once reviewed and considered eligible for services, colleges will generally provide basic accommodations with the caveat that colleges may "reject accommodations that create a fundamental alteration to school requirements or entail providing a personal service or aid" (Hamblet, 2014 p. 54). Accommodations and supports are disability-specific and may include extra exam time (93%), note takers in class (77%), assignments or notes given by faculty (72%), assistance with learning or studying techniques (72%), different exam styles (71%), and adaptive equipment and technology (70%) (Raue & Lewis, 2011). It is important to note that all students with disabilities on college campuses do not receive services. Despite making contact with the appropriate university offices for disability support, students may be unable to provide adequate documentation of disability or may be found ineligible for services. Students with disabilities may also forego making contact with said offices regardless of whether or not they could benefit from services.

Barriers to Success

Systemic Barriers

Many institutional missions contain statements that indicate diversity and inclusion are important, and even a priority; however, the culture and climate may not be welcoming to or supportive of students with disabilities. Jensen, McCrary, Krampe, and Cooper (2004) found that faculty members were reluctant about providing accommodations for students with learning disabilities because they questioned the legitimacy of the diagnoses and they were concerned about the fairness of giving one student more time or more leniency when completing exams and

other coursework. Interestingly, they found the faculty members in their study held generally negative attitudes towards all students, thinking they "… [tried] to get by with as little effort as possible" (p. 85). The faculty members also expressed a sense of "burden" related to providing accommodations; specifically, the authors noted "…faculty feel burdened by requests for extra work or alterations in their instructional practices" (Jensen, McCrary, Krampe, & Cooper, 2004). Rao and Gartin (2003) examined the impact of gender, discipline, academic rank, and other parameters on faculty members' attitudes towards students with disabilities and their willingness to provide accommodations. The study included 18 accommodations that varied across several types of disabilities (e.g., physical, learning, etc.). Results indicated engineering and law faculty members "were significantly less willing to provide accommodations" than their counterparts in other academic units. Reluctance and negative attitudes serve to foster environments that are counter to diversity and inclusion.

Baggett (1994) surveyed and interviewed over 400 university faculty members and administrators to study their awareness of disabilities. Most indicated they were either unfamiliar or very unfamiliar with the range of university services available to students with disabilities; and they were unfamiliar or very unfamiliar with disability-related legislation such as the ADA. To improve their knowledge, they showed a preference for published resources such as service directories and handbooks as opposed to workshops and open houses that would allow hands-on training by experts in the field.

Whitney, Langley-Turnbaugh, Lovewell, and Moeller (2012) studied the impact of a STEM learning community on benefits for students with disabilities. The study was conducted using the students' perspectives. Students were asked to rate the benefits of their engagement in the learning community, which consisted of a seminar course that provided academic and social support to STEM students with disabilities. Academic-related benefits such as improved grades, study habits, and time management skills were among the five highest priority benefits identified (improved grades were highest).

Personal Barriers

Before even pursuing postsecondary educational opportunities, students with disabilities may have a limited knowledge indicating that engineering, let alone careers in STEM in general, can be for them. This may be due to the lack of role models and networking opportunities in STEM careers and even belief from parents and teachers that students with disabilities cannot be successful in STEM (Hawley, Cardoso & McMahon, 2013; Martin, Stumbo, & Collins, 2011). As such, students with disabilities are less likely to enroll and be successful in STEM courses in high school (Hawley et al., 2013; Martin et al., 2011). Lack of exposure to STEM careers and courses may ultimately lead to a lack of interest. Additionally, this may contribute to limited skill development, not due to lack of aptitude, rather due to lack of exposure and opportunities.

As previously stated, the very process of pursuing support can be a challenge for some students. Provided the nature of college-level disability support offices, students have to request accommodations and present current documentation detailing their disability (Habmlet, 2014). While students may have had an individualized education plan (IEP) and student support team in high school, it does not mean that they were made aware of the process or documentation needed

to secure services in college. If students know about college-level disability support services and pursue them, they may present documentation from high school, which in many instances is not sufficient for services at the college level (Hamblet, 2014). In this case, the student would then have to get the appropriate documentation, which can be a costly endeavor. As such, success in college for students with disabilities hinges on their ability to secure services and supports.

Once in college, even with support, students with disabilities still must adjust to a new level of rigor. The college environment differs greatly in comparison to high school. For example, reading loads are much higher, coupled with long lectures, with fewer assignments and exams constituting grades, with little to no structure that is typically provided in high school (Hamblet, 2011). While these are challenges that all students face, students' disabilities can further complicate the college experience (Hamblet, 2014; Norvilitis, Sun, & Zhang, 2010). For example, students with specific learning disabilities or ADHD may struggle even more because their respective disabilities impact their learning, concentration, and planning, which are the exact skills needed to be successful in the college environment (Hamblet, 2014). Additionally, students with specific learning disabilities or ADHD may struggle with organizational skills, listening comprehension, academic coping strategies, and study skills (Norvilitis et al., 2010)

The systemic barriers described previously, namely those related to faculty attitudes, can trigger personal barriers related to self-efficacy. Because disability at the university level is not well understood, the authenticity of disabilities, particularly invisible disabilities, is often questioned (Hawley et al., 2013). This may lead to faculty members viewing students with disabilities as being lazy, unmotivated, and academically dishonest (Hawley et al., 2013). These negative perceptions in addition to challenges with adjustment may contribute to the self-efficacy of students with disabilities. This means that students with disabilities may develop negative beliefs about their own capabilities, leading to lower levels of self-efficacy compared to students without disabilities (Jenson, Petri, Day, Truman, and Duffy, 2011). Should students with lower levels of self-efficacy experience failure, it confirms their lack of ability to be successful and can become a self-fulfilling prophecy, where students with disabilities feel completely helpless to improve their situation and easily become passive learners. Students with low perceived self-efficacy are reported to be much less strategic in their approach to learning and much more teacher dependent (Jenson, Petri, Day, Truman, Duffy 2012).

Some students with disabilities have an inflated sense of self-efficacy, and may perceive their abilities as being greater than they actually are. This, too, is problematic as students may believe a particular task to be an easy undertaking, but later find that the task is more difficult or takes longer than anticipated, which may lead to non-completion. Incorrect estimates of self-efficacy may develop from faulty evaluation of task requirements or from lack of self-knowledge, two weaknesses known to be common among students with learning difficulties (Izzo, Murray, Priest, & McArrell, 2011). However, when students have a better understanding of their respective disability, they are likely to understand what they need, have a healthier sense of self-efficacy, and be better self-advocates.

Promising Practices

Rule and Stefanich (2012) held a conference during which students with disabilities and their parents, faculty members, administrators, and support services representatives discussed challenges faced in STEM subject areas. The goal was to provide recommendations to better meet the needs of the students. The participants identified several factors that either helped or hindered success of students with disabilities in STEM subject areas. Those factors may be broadly categorized as student attitudes and actions, faculty attitudes and actions, accessibility, or other and are listed in Table 1 (Rule and Stefanich, 2012).

Table 1. Factors that Impact Success of Students with Disabilities
(from Rule and Stefanich, 2012)

Categories	Helpful Factors	Non-helpful Factors
Student attitudes and actions	• Healthy self-esteem, positive attitude • Strong motivation & task commitment • Self-advocacy, self-awareness of needs	• Failure to disclose need for accommodations • Poor self-esteem • Limited time management skills for some students with disabilities
Faculty attitudes and actions	• High expectations, case-by-case approach to accommodations • Universal design instructional strategies • Intense training for meeting specific needs • Regular professional development	• Teacher prejudice, belief that all disabilities are the same • Assuming requests for accommodations are being made to gain an advantage
Accessibility	• Text support, Braille • Assistive technology, talking calculators, smart boards	• Inaccessible labs
Other	• Parental involvement and realistic, high expectations • Tutoring, peer, and other academic support services • Lab assistants who make work accessible, but do not complete students' work • Transition services (high school to post-secondary, two-year to four-year, school to workforce)	• Assistants who do too much for students, don't allow students to experience and learn

Corcoran (2010) conducted case studies of students with disabilities who persisted through their first year of transition to a community college and identified seven stages of transition that impacted the students' persistence: "pre-college experiences that influence academic involvement, initial encounters which created first impressions, transition shock, support-seeking and strategic adjustment, prioritizing and balancing of college and non-college commitments, recognizing success, and a sense of belonging to the college community" (p. 104). Many of these are directly related to the culture and climate of an institution, which are shaped by the

attitudes and actions of individuals within the institution. The author also emphasized the importance of gaining the perspectives of the students to properly and fully understand the barriers they face in order to meet their needs.

Recommendations

Post-Secondary Institutions

As a starting point, university administrators should engage students, faculty members, and staff with disabilities in devising solutions for accessibility campus-wide (classrooms, laboratories, offices, recreational facilities, etc.). The ADA and other regulations provide standards, but frequently they fall short of meeting the needs of people with disabilities in an optimal manner. Institutions that will be most successful with inclusion for students with disabilities will begin by including their perspectives in program development, planning, and other aspects of the academic community. We offer the following additional recommendations:

- Provide opportunities for graduate student (teaching assistant) and faculty development focused on:
  - legal mandates for equal education opportunities for students with disabilities;
  - the nature of disabilities, including the wide array of invisible disabilities;
  - creating learning environments conducive to success for all students (positive interpersonal interactions, high expectations);
  - applying principles of universal design for learning to their courses;
  - teaching engineering students to consider accessibility as a design constraint, and to employ principles of universal design in their work.
- Provide personal and academic development opportunities for students with disabilities focused on:
  - healthy self-esteem, self-efficacy, and effective self-advocacy;
  - community building with other students with disabilities as an opportunity to support and share strategies for success with one another; and
  - community building in groups of diverse learners (with and without disabilities) to teach and promote true inclusivity (this should also involve personal skills development opportunities for students without disabilities).
- Create stronger partnerships with high schools to:
  - promote engineering and other STEM fields to educators, administrators, and counselors as viable options for students with disabilities;
  - engage students with disabilities and their parents in outreach activities; and
  - provide information and build relationships that will improve students' transitions from secondary institutions to post-secondary institutions in engineering (and other STEM) programs in particular.

Future Research Needs

The vast majority of diversity and inclusion efforts and literature have focused on gender, race, and ethnicity. By comparison, relatively little emphasis has been placed on students with disabilities, especially in STEM disciplines, engineering in particular. Corcoran (2010) stated,

"… few studies explore the quality of access and participation of students with disabilities in … higher education programs and services" (p. 6). Though not specifically related to disability status, Pohan & Aguilar (2001) observed differences in faculty members' personal beliefs and their attitudes (and actions) in professional settings that hinder diversity and inclusion efforts. They also noted a lack of validated instruments for assessing educators' attitudes and beliefs about diversity and inclusion. Kim-Rupnow & Burgstahler (2004) investigated the perceptions of students with disabilities relative to technology-based support activities. The authors discussed gaps in literature related to studies of the impacts of support services for students with disabilities and addressed part of that gap for technology-based supports.

Further research is recommended on the following topics:

- students' perspectives on the quality of accessibility and participation in STEM courses, including engineering laboratories;
- how experiences for students with disabilities may (or may not) vary by discipline;
- valid and reliable instruments for assessing faculty, staff, and administrator attitudes and practices related to diversity and inclusion, disability in particular;
- impacts of inclusive practices and behaviors of university faculty, staff, and administrators on attitudes and outcomes such as self-esteem, self-advocacy, academic performance, and persistence of students with disabilities in engineering; and
- how intersection of other identities (e.g., being an underrepresented minority) with that of disability affects outcomes for engineering students.

Conclusion

Students with disabilities are likely to face a myriad of challenges transitioning to postsecondary educational opportunities in addition to their pursuit of an engineering degree. Students may face systemic barriers like a general lack of support and negative views from faculty members while also struggling personally with the overall adjustment to college as someone with their unique abilities. These experiences alone can push students with disabilities out of engineering and, perhaps, out of college altogether. However, when universities and engineering programs commit to cultivating the talent of all students, especially those with disabilities, students can develop the self-confidence needed to be successful.

References

ADA Amendments Act of 2008, Pub. L. No. 110-325, §3 (2009).

Bagget, D. (1994, March). A study of faculty awareness of students with disabilities. Paper presented at the Annual Conference of the National Association for Developmental Education Kansas City, Missouri.

Bensimon, E. M. (2004). The diversity scorecard: A learning approach to institutional change. *Change*, *36*(1), 44-52.

Corcoran, L. A. (2010). *Factors influencing transition and persistence in the first year for community college students with disabilities* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global; ProQuest Social Sciences Premium Collection. (Order No. 3427515).

Erickson, W., Lee, C., & von Schrader, S. (2016). 2015 Disability Status Report: United States. Ithaca, NY: Cornell University Yang Tan Institute on Employment and Disability (YTI).

Hadley, W. M. (2007). The necessity of academic accommodations for first-year college students with learning disabilities. *Journal of College Admission, 195*, 9-13.

Hamblet, E. C. (2011). *7 steps for success: High school to college transition strategies for students with disabilities*. Arlington, VA: Council for Exceptional Children.

Hamblet, C.E. (2014). Nine strategies to improve college transition planning for students with disabilities. *Teaching Exceptional Children, 46*, 53-59.

Hawley, C. E., Cardoso, E., & McMahon, B. T. (2013). Adolescent to adulthood in STEM education and career development: The experience of students at the intersection of underrepresented minority status and disability. *Journal of Vocational Rehabilitation, 39*, 193-204.

Individuals with Disabilities Education Improvement Act of 2004, Pub. L. No. 108-446, 118 Stat. 2647 (2004).

Izzo, M.V., Murray, A., Priest, S., & McArrell, B. (2011). Using student learning communities to recruit STEM students with disabilities. *Journal of Postsecondary Education and Disability*, 24(4), 301-316.

Jensen, J. M., McCrary, N., Krampe, K., & Cooper, J. (2004). Trying to do the right thing: Faculty attitudes toward accommodating students with learning disabilities. *Journal of Postsecondary Education and Disability*, *17*(2), 81-90.

Jenson, R.J., Petri, A.N., Day, A.D., Truman, K.Z., & Duffy, K. (2011). Perceptions of self-efficacy among STEM students with disabilities. *Journal of Postsecondary Education and Disability*, 24(4), 269-283.

Kerby, M. B. (2015). Toward a new predictive model of student retention in higher education: An application of classical sociological theory. *Journal of College Student Retention: Research, Theory & Practice*, 17(2), 138-161. doi: 10.1177/1521025115578229

Kim-Rupnow, W. S & Burgstahler, S. (2004). Perceptions of students with disabilities regarding the value of technology-based support activities on postsecondary education and employment. *Journal of Special Education Technology, 19*(2), 43-56.

Lombardi, A., Gerdes, H., & Murray, C. (2011). Validating an assessment of individual actions, postsecondary, and social Supports of college students with disabilities. *Journal of Student Affairs Research and Practice*, *48*(1), 107-126, doi:10.2202/1949-6605.6214.

Martin, J. K., Stumbo, N. J., Martin, L. G., Collins, K. D., Hedrick, B. N., Nordstrom, D., & Peterson, M. (2011). Recruitment of students with disabilities: Exploration of science, technology, engineering, and mathematics. *Journal of Postsecondary Education and Disability, 24,* 285-299.

Morganson, V. J., Major, D. A., Streets, V. N., Litano, M. L., & Myers, D. P. (2015). Using embeddedness theory to understand and promote persistence in STEM majors. *The Career Development Quarterly*, *63*(4), 348-362.

National Science Foundation, National Center for Science and Engineering Statistics. (2017). Women, minorities, and persons with disabilities in science and engineering: 2017. Special Report NSF 17-310. Arlington, VA.

Norvilitis, J. M., Sun, L., & Zhang, J. (2010). ADHD symptomatology and adjustment to college in China and the United States. *Journal of Learning Disabilities, 43*(1), 86-94. http://dx.doi.org/10.1177 /0022219409345012

Pearson Weatherton, Y., Daza, S., and Pham, V. (2011). Perceived barriers to participation in engineering: Why underrepresented groups remain underrepresented. *Proceedings of the Annual Conference of the American Society for Engineering Education*. Vancouver, BC.

Pohan, C. A. & Aguilar, T. E. (2001). Measuring educators' beliefs about diversity in personal and professional contexts. *American Educational Research Journal*, *38*(1), 159-182.

Rao, S. & Gartin, B. C. (2003). Attitudes of university faculty toward accommodations to students with disabilities. *Journal for Vocational Special Needs Education*, *25*(3), 47-54.

Raue, K & Lewis, L. (2011). Students with disabilities at degree-granting postsecondary institutions (NCES 2011-018). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office. Retrieved from http://nces.ed.gov/pubs2011/2011018.pdf

Rule, A. C. & Stefanich, G. P. (2012). Using a thinking skills system to guide discussions during a working conference on students with disabilities pursuing STEM fields. *Journal of STEM Education: Innovations and Research*, *13*(1), 43-54.

Spady, W. G. (1970). Dropouts from higher education: An interdisciplinary review and synthesis. *Interchange*, *1*(1), 109–121.

Suter, W. N. (2012). *Introduction to educational research: A critical thinking approach*, 2nd edition. Los Angeles: Sage.

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research*, *45*(1), 89–125.

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition*, 2nd edition. Chicago: University of Chicago Press.

Veenstra, C. P., Dey, E. L., & Herrin, G. D. (2009). A model for freshman engineering retention. *Advances in Engineering Education*, *1*(3), 1-31.

Whitney, J., Langley-Turnbaugh, S., Lovewell, L., & Moeller, B. (2012). Building relationships, sharing resources, and opening opportunities: A STEM learning community builds social capital for students with disabilities. *Journal of Postsecondary Education and Disability*, *25*(2), 131-144.