Experiences of Students with Physical Disabilities in Engineering: A Literature Review

Julian Rodrigo Sosa-Molano, Florida International University

Julian is a graduate research assistant at Florida International University. He holds a BSc in Electronics Engineering from Pontificia Universidad Javeriana in Colombia and a MSc in Electrical and Computer Engineering from The University of Arizona. He is pursuing his PhD degree in Engineering and Computing Education at Florida International University. He has professional experience in Information Technology, Semiconductors, and Telecommunications in international companies such as Ecopetrol, Texas Instruments, and Ericsson. His research interests focus on inclusive STEM learning and teaching methodologies for students with physical disabilities.

Dr. Alexandra Coso Strong, Florida International University

As an assistant professor of engineering education at Florida International University, Dr. Alexandra Coso Strong works and teaches at the intersection of engineering education, faculty development, and complex systems design. Alexandra completed her graduate degrees in Aerospace Engineering from Georgia Tech (PhD) and Systems Engineering from the University of Virginia (UVa).

Experiences of Students with Physical and Sensory Disabilities in Engineering: A Mapping Review

Abstract

Research in the domain of engineering education has revealed that students with disabilities face obstacles and discriminatory practices during their academic journey in engineering. Even though accommodations are designed to support these students, these accommodations are not necessarily a complete "solution". Other studies have illustrated examples of students with disabilities who have dropped out of their engineering programs and opted to pursue different college majors. Moreover, scholars have suggested that research on disability in higher education is limited. In an effort to amplify the voices of these students and to better understand what is already documented in the literature, this conference paper will present a review of the literature on the experiences of undergraduate students with physical and sensory disabilities in engineering.

Motivation

Studies in the field of engineering education have demonstrated that students with disabilities in engineering encounter barriers and discrimination in their academic experiences [3] [6] [11]. According to the Americans with Disabilities Amendments Act, disability is defined 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..." [20]. Some examples of impairments are deafness, blindness, autism, paraplegia, cerebral palsy, multiple sclerosis, among others [7] that limit activities such as hearing, seeing, walking, reading, concentrating, talking, taking care of oneself, working and others [20].

Some authors suggest that students with disabilities at university level have to request accommodations on their own [12]. Accommodations such as extra exam time, note takers in class, assistance with learning techniques, or adaptive technology are aimed to provide these students with equal conditions in their learning process [12]. However, with accommodations designed to support these students, these resources do not necessarily create a complete "solution" to eliminate those barriers [12]. Without the necessary support and encouragement, students may choose to drop out of their engineering programs and opt to pursue different college majors [4]. In addition, research priorities and policy discussions within engineering education have ignored the perspectives and contributions of students with disabilities [4]. Unfortunately, however, the narratives of these students appear incomplete, as scholars have suggested that research on disability in higher education is limited [5] [11]. In an effort to amplify the voices of these students and to better understand what is already documented within the engineering education space, this conference paper presents a review of the literature centered on the experiences of undergraduate students with physical and sensory disabilities in engineering.

Those barriers might be reflected in the underrepresentation of students with disabilities in the scholar community. Between 11% and 15% of U.S. college students identify themselves as students with disabilities [7] [8] and about only 4% of these students with disabilities have enrolled in engineering majors [8]. As of 2015, while the 33% of the U.S. population held at least a bachelor's degree, only 14% of the population with disabilities had reached this level of higher education [9]. Furthermore, just 1% of students with disabilities have received a PhD degree in 2017 [10]. These statistics provide a glance of the disadvantaged position that students with disabilities hold, as compared to the general population in the U.S. Given the historically exclusionary nature of engineering as a discipline, the scholar community, especially in engineering, should further examine its own role in affecting the participation and success of engineering students with disabilities.

To provide a foundation for understanding the root causes of not only low enrollment, but also the challenging experiences of these students within engineering, this mapping literature review [18], sought to address the following research question: *What is the current landscape of literature about the experiences of undergraduate engineering students with physical and sensory disabilities?* The outcome of this mapping review will provide basis for a subsequent comprehensive analysis regarding the experiences of students with physical and sensory disabilities in engineering.

Methods for this Mapping Review

A mapping review is a type of literature review that facilitates the classification of articles into various categories, including theoretical perspectives, population groups, or settings, enabling an informed decision regarding a future comprehensive review and synthesis of the articles under consideration [18]. A mapping review is appropriate for this study because it promotes the organization of the articles in three main divisions of interest: theories, methods, and findings about students' experiences, which will provide a general view of the current landscape of the literature.

Inclusion and Exclusion Criteria

This mapping review focuses on the experiences of students with physical and sensory disabilities. By physical disabilities, we refer to any mobility impairment (spinal cord injury for example), while sensory disabilities refer to any visual or hearing impairment [19]. We selected to focus on physical and sensory disabilities because they are readily identifiable due to their visible nature [21]. Other types of disabilities such as learning or mental disabilities were out of the scope of this mapping review. The remaining inclusion criteria included: examination of the experiences of students with disabilities (for example, the article talks about the barriers students with disabilities face in classrooms, or the current state of disability studies in engineering education), focus on undergraduate programs in engineering (any engineering discipline), and an article published in 2013 or later. The sources consulted to find the peer review articles for this mapping review were the American Society for Engineering Education (ASEE) PEER Document Repository and the Educational Resources Information Center (ERIC). In the remaining of this

article, we will refer to students with physical and sensory disabilities as students with disabilities.

Among the exclusion criteria, we chose to exclude studies that focused on students' experiences in online education, settings and accessibility in online or learning systems. K-12 and graduate education-focused students were also excluded for this review. Studies that focused on the perceptions and experiences of engineering educators, instructors or teachers, whether those that had disabilities or were instructors of students with disabilities, were not included. Of those articles from a conference proceedings repository, the articles that were presented in regional conferences, section conferences or online conferences were discarded. This way, only the national conferences articles were selected. Lastly, as noted previously, studies of students with learning or mental disabilities, and/or emotional or behavior disorders were removed from consideration.

Selection Process

The ASEE PEER and ERIC databases were selected to capture diverse perspectives within educational research and within engineering education research specifically. The following combination of keywords and logic were used to find the best possible matches in the databases (ASEE PEER and ERIC):

- "Disability"
- "Disability" AND "Engineering",
- "Disability" AND "Engineering" AND "Experiences",
- "Disability" AND "Engineering" AND "Students with disabilities",
- "Disability" AND "Engineering" AND "Students with physical disabilities",
- "Students with disabilities" OR "Disabled students" OR "Handicapped students",
- "Students with disabilities" OR "Disabled students" OR "Handicapped students" AND "Physical disabilities" OR "Physical impairments",
- "Disability" AND "Engineering" AND "Experiences" AND "Undergraduate education" AND "Discrimination" AND "Marginalization" AND "Students with disabilities" OR "Disabled students" OR "Handicapped students" AND "Physical disabilities" OR "Physical impairments",
- "Disability" AND "Engineering" AND "Students with disabilities" AND "Students experiences", "Disability" AND "Engineering" AND "Students with physical disabilities" AND "Students experiences".

Once the initial searches were completed, the following process was used to select the specific articles for further analysis.

1) The search was conducted during different dates in the months of October and November 2023 to assure consistency in the articles found. So, a small dataset per date was assembled including the number of hits per keyword logic combination. Then an Excel macro was built to find the articles with the most appearances in the searches per date, keyword logic combination and database (PEER ASEE or ERIC). For example, a specific

article A appeared in seven out of the nine different keywords' combinations (described above) for a determined date in the PEER ASEE database, while an article B only appeared in two out those nine keywords' combinations for the same date and the same database. In this case, article A was then preserved to continue in the search, whereas article B was excluded.

2) The researchers evaluated the relevance of the articles according to their keyword logic combination, and number of appearances. This resulted in a total of 48 articles in PEER ASEE and 26 articles in ERIC (a total of 74 articles), which were considered by the authors an enough number of articles to proceed with the abstract screening.
3) An abstract screening was completed independently by two researchers to confirm that all articles complied with the inclusion/exclusion criteria.
4) A full text screening was completed to confirm articles complied with the inclusion/exclusion criteria.
5) The final number of articles was determined.

It is notable to mention that the execution of the Excel macro to find the articles with most appearances was the step that favored the greatest reduction in the articles list. This macro was based on the functions sumproduct, countif and indirect, using also an ordered index for the different datasets (search dates and keyword logic combinations). In the same way, the abstracts scan and full text reading assured the inclusion/exclusion criteria, filtering out some articles that could pass to that point because they included most of the keywords used in the search. The articles ultimately chosen for this analysis featured accounts from students with physical or sensory impairments or detailed the obstacles these students encounter in their educational journeys.

Table 1 shows the breakdown of the steps that were taken and the number of articles per step to finalize the number of articles to be analyzed:

Table 1. Breakdown of the process to find the articles.

Screening Process Steps	**Number of Articles**	
	ASEE	**ERIC**
Initial articles published 2013 - 2023	1381	1252
Remove of Regional and Sectional Conferences	888	583
Relevant articles selected according to their keyword logic combination, and number of appearances	48	26
Abstract Screen	13	9
Full Text Screen	12	5
Final Number of Articles	**17**	

Results

The results of this mapping review focus on breaking down the current landscape of research and discussion about the experiences of students with physical and sensory disabilities within engineering education. In particular, the subsequent discussion includes the theories used, methods used, and findings about students' experiences. By landscape, we mean to understand the scope, scale and possible gaps within the existing body of work that has been conducted. These results may bring us to a consecutive extensive review of the experiences of students with disabilities in engineering. Table 2 summarizes the characteristics of the articles examined in this mapping review.

Theoretical stances

Across the 17 papers in this review, we found that their theoretical sections discuss the definition of the term "disability", models to describe disability (medical model, social model, model of co-curricular support), theories that support the studies' findings (social identity theory, self-categorization theory, professional identity), and concepts that explain beliefs and behaviors of students with disabilities (self-efficacy, "Otherness", core self-evaluations and engineering studies).

The term disability had different connotations and the types of disabilities described included a broad range of situations that can be perceived as obstacles in the development of students in engineering. Some of the articles examined for this mapping review define disability through The Americans with Disabilities Act (ADA) (2009) definition [9] [12] [20]. However, other articles in this review prefer to describe disability using models. Some of the most common cited models in this review are the medical model and the social model of disability. In the Medical Model, disability is perceived as a condition requiring treatments, therapies or surgeries to be cured or eliminated. The Social Model views disability as a consequence of social injustice, which requires significant changes in both physical and social environments. [4] [14] [16]. The social model is recognized as a constructivist critique of the medical model [14].

Even with the focus in physical and sensory disabilities in this review, the articles still discussed several types of disabilities. Cech [4] indicated that disability is an "umbrella" that covers different types of experiences and embodiments such as "physical atypical embodiments (e.g. physical disabilities), structural or functional atypicalities (e.g. persistent medical conditions), chronic sickness, and mental health difficulties" [4]. Amos and colleagues [1] included different disabilities such as blindness or visual impairments, hearing impairments, orthopedic or mobility impairments, speech or language impairments, learning, mental, emotional and psychiatric conditions [1]. From these articles, we see how the term disability can have different connotations and the exploration of the experiences of students with disabilities should consider the nuances it implies. The solutions we can provide to barriers a paraplegic student may endure are very different from the solutions to those barriers a blind student might encounter. We can therefore imagine how this might impact institutions, faculty, and administrators that are responsible for providing services to students with disabilities.

The authors of the articles screened in this review grounded their studies using a variety of theories. Golding and colleagues [6] implemented a theory-informs-practice model named Model of Co-Curricular Support (MCCS), which promoted the integration and engagement of students with the university in four main areas: academic, social, professional, and university integration [6]. On the other hand, Social Identity Theory (SIT), Self-Categorization Theory (SCT), and Professional Identity were the theoretical frameworks used by McCall and colleagues [7] [8]. SIT posits that belonging to a group is shaped by the shared values and behaviors of its members in contrast to those of other groups [7]. As an illustration, women are incompatible with the civil engineering field as it is believed that construction sites and fashion do not go hand in hand [7]. SCT describes how groups of people maintain relations with other groups with whom they share positive values, and distance themselves from other groups with whom they keep negative values [7]. Professional Identity is the identity the individual forms when they "learn, internalize, and maintain values, behaviors, symbols, and discourse of a profession" [7]. SIT and SCT were used in these studies to recognize the ways in which students with disabilities in civil engineering shaped their identities and self-identified with favorable attributes as members of a group [7][8].

Self-efficacy and "Otherness" were concepts used by Lezotte and colleagues to support their study [9]. Self-efficacy is the "belief in one's ability to succeed" [9] and is linked to self-advocacy and self-determination. According to Lezotte and colleagues, self-efficacy is a crucial skill for students with disabilities because it determines their persistence and success in engineering courses [9]. Self-efficacy is more effective when students with disabilities participate in extra-curricular activities, meaning that these activities provide them with motivation for completing their academic responsibilities. Otherness occurs when the student with disabilities feels different from their classmates because they are misunderstood or misconstrued by them. This situation creates the stigma of being "othered" among students with disabilities [9]. Thus, certain theories concentrated on personal growth, whereas others emphasized interpersonal connections.

There are also some bodies of literature featured by the studies considered in this mapping review. Core Self-Evaluations (CSE) allowed Smedema and colleagues [15] to evaluate how students with disabilities assess themselves in order to find the relation between functional disability and life satisfaction, in other words, how happy these students are according to their disability [15]. Engineering Studies (ES), as a scholarship proposed by Slaton [14], looks for encouraging the participation of underrepresented groups in engineering through categories of identity or difference, supporting the engineering teaching and learning process. ES deal with presumptions that physical disability is associated with disability of the mind or visual and hearing impairments are linked to cognitive limitations. Finally, other authors suggest UDL (Universal Design for Learning) as a conceptual framework of educational principles and practices to improve the educational performance of all students. These authors recognize that single methods of educational delivery are insufficient to satisfy the diverse needs of students, especially students with disabilities. For such a reason, the multiple methods of educational delivery offered by UDL improve equity and assist students with disabilities in their specific academic challenges [1] [16].

As noted, several theories supported the research in the articles subject of this review. Topics include social identity, social categorization, professional identity, self-assessment, self-efficacy, social models, and learning. A common trend across these theories is the desire to consider the student with a disability, not as a devalued person who needs to cure their impairments, but as a valuable human being whose situation is the object of stereotypes and stigmas which are products of the social and structural environments. As a minority group, students with disabilities can reach high levels of self-efficacy, overcoming this "otherness" and being successful in their academic endeavors.

Methods approaches

The studies incorporated in this mapping review employed both qualitative and quantitative methodologies to investigate the experiences of such students. While the quantitative studies were focused on feelings and resources for students with disabilities, qualitative studies were targeted to skills and relationships with others. Both approaches were used in studies that asked about experiences of discrimination or stigmas.

Five quantitative studies included a large number of participants (from 33 to 1,729 students) with physical, hearing, or visual disabilities. One example of these studies leveraged the MUSIC inventory developed by Amos and colleagues [1], where MUSIC captures an individual's eMpowerment, Usefulness, Success, Interest, and Caring as it relates to an experience. MUSIC was employed to determine the factors that drive students' motivation for succeeding in their coursework [1]. The survey was completed by 48 students with disabilities (no type specified). Students revealed in the surveys that they had comparatively significant utilization of technology course resources such as live Zoom lectures, teacher PowerPoint presentations, or lecture videos [1]. In Cech [4], the ASEE Diversity and Inclusion Survey (ASEE-DIS) was completed by 1,729 students enrolled in engineering programs in eight U.S. colleges or universities. The focus of the survey was asking students about their experiences with engineering peers and professors. The study did not clarify the portion of surveyed students that had disabilities [4]. The participants with disabilities in this study expressed for example that they are less inclined to report feelings of acceptance by their colleagues or that they preferred to stay at home because they do not feel welcome on campus [4].

Lezotte and colleagues [9] developed a quantitative study to ask students about their experiences and perceptions of inclusivity and potential "otherness". This study compared the experiences between students with disabilities and students without disabilities. The survey was completed by a total of 214 engineering students, including 33 (15.4%) who identified themselves as having a disability (visual impairments, among others). The results of this survey describe, for instance, that the students with disabilities are less likely to feel welcome in the college of engineering, to feel valued by the college of engineering, or to think that their engineering faculty cared about them as a person, in comparison to the students without disabilities [9]. Finally, in this group of quantitative studies, Smedema and colleagues performed a quantitative descriptive design using a multiple regression analysis [15]. The participants were 97 students with disabilities who completed psychological and vocational instruments and follow-up surveys. The participants in

this study indicated that they experienced difficulties in daily activities with or without the help of a person or assistive devices [15].

Of the qualitative approaches, six of the studies based their data collection on surveys and interviews that provided insights into students' experiences. Bellman and colleagues [2] used an online survey consisting of six open-ended questions to ask students with disabilities in STEM majors about the benefits they perceived in their academic performance, after receiving, in average, 12 in-person coaching sessions. In these coaching sessions, students learned new skills and strategies for important topics such as stress management, writing, prioritizing, time management, and note-taking [2]. Cardoso and colleagues [3] employed a Consensual Qualitative Research (CQR) approach to interview six college students with diverse disabilities (musculoskeletal conditions among them) and understand their experiences in their pursuit of careers in STEM. CQR is a qualitative approach that facilitates the comprehension of complex information by tackling challenges associated with qualitative research. These challenges include possible concerns regarding validity emerging from bias and interpretation, as well as the absence of structured approaches for coding and analysis. In CQR, researchers apply a consistent semi-structured interview protocol to all participants, and multiple judges and auditors analyze the data [3].

A case study was conducted by Golding and colleagues [6] to explore the self-efficacy development and growth pathways of students with disabilities, in this case, with hearing impairments. This case study describes the story of a student who progressively was losing her hearing capacity and had to face a lack of caring and even hostility from misunderstanding faculty. Leveraging the support of her family, some faculty, and some disability and academic institutions, the student was able to succeed in higher education [6]. Another case study conducted by Schearer and colleagues [13] described the experiences of rehabilitation engineering students with mobility or dexterity disabilities. By responding to surveys, focus groups, and interviews, these students reflected on the impact in their lives of three common themes: "the visibility of disability, the age and life experiences of the student, and the degree of the physical disability" [13].

Grounded theory was the qualitative approach used by McCall and colleagues to "give voice" to students who "have been historically stigmatized, marginalized and discriminated against" [7]. The research employed grounded theory to explore the process through which students with disabilities shape their professional identities in the course of their undergraduate studies [8]. The study focused on 23 students, all with diverse types of disabilities (hearing, visual, mobility, and other impairments). Semi-structured interviews were the main data source, each interview lasted between 60 and 90 minutes each and employed critical incident techniques and constructivist interviewing approaches [8]. In their findings, the authors illustrate the case of one student who shared how he felt different in college compared to his high school, and how he had faced troubles in requesting his accommodations [8].

The experiences of students with disabilities in engineering have been researched employing both quantitative and qualitative designs as the studies in this mapping review have demonstrated. There are interesting instruments such as MUSIC and CQR that were employed to

learn more about the experiences of the students. It is worth noting that certain studies utilized student communities with disabilities, such as the Minority-Disability Alliance in Science, Technology, Engineering, and Mathematics (MIND Alliance) or AccessSTEM, for participant recruitment.

Understanding students' experiences

The experiences of the students with disabilities in engineering in this mapping review can be synthesized into four major themes: marginalization and discrimination, impact of accommodations, challenges in the engineering field, and impact on identity, which are explained in detail below.

Marginalization and discrimination. Across three studies, the stories and findings about students' experiences reinforce an environment where students with physical disabilities indicate they are not accepted by their peers and prefer to stay home from school because they do not feel welcome, manifesting marginalization or stereotypes. In those same studies, the students describe feelings as though they are seen by their classmates as less skilled, feeling that they are academically underneath their colleagues without disabilities, and perceiving themselves as less welcome, valued, or wanted in the college of engineering. Such findings portray an engineering education environment that marginalizes these students in social contexts, failing to adequately appreciate and value them. Consequently, in some cases, this situation leads students to contemplate abandoning their engineering majors [4] [9] [11].

Impact of Accommodations. Some students with disabilities prefer to not disclose their impairments to avoid requesting accommodations. One of the studies [8] illustrates the case of a student who was requested several proofs of his disability by faculty in order to have his accommodation granted, asking more questions than were necessary. Some faculty were even rude and hostile when students demanded accommodations [6]. Similarly, certain faculty members hesitated to offer accommodations due to doubts about the legitimacy of medical diagnoses and concerns about the fairness of providing accommodations selectively to specific students [12]. In addition, some institutions suffered from insufficient provisions for accommodations, including accessible buildings and lab adaptations for students with disabilities [17]. These four studies exemplify how some engineering students with physical and sensory disabilities may feel hesitant to request accommodations, or how there are still gaps present in the design and provision of these accommodations.

Challenges in the Engineering Field. Certain students with disabilities in engineering programs think about leaving their careers or they do not see themselves working as engineers in the near future [4] [9] [11]. Some of these students find engineering education "as individualistic and competitive" and encounter barriers in the engineering curricula, such as struggling to pass mandatory courses or experiencing a waning interest in the curriculum's content [11]. Additional hurdles in engineering include students with disabilities facing a lack of readiness for college-level coursework after high school, insufficient understanding among faculty and staff regarding the requirements and capacities of these students, prevailing negative stereotypes that

compromise educational quality, and limited resources available to these students in higher education institutions [17].

Impact on identity. Research focusing on the identities of students with disabilities is insufficient. Some students with disabilities in engineering choose to keep their conditions confidential to avoid being stigmatized or discriminated [8]. Female students with disabilities identify conflicts with male students in a male-dominated field [11]. Existing studies often incorporate disability within broader discussions of social identities [7]. These facts impact the research about the formation of the identity of engineering students with disabilities, both at college and future work levels.

In their findings related to the experiences of students with physical or sensory disabilities, the articles examined in this mapping review reveal that these students have to endure several barriers such as marginalization, discrimination, undervaluing of their significance both as human beings and students, discouragement to continue and finish their programs in engineering, and negative stereotypes.

Table 2. Summary of characteristics of the articles subject of this mapping review

Study	Focus	Theory or Concepts	Methods	Participants
Amos et al. (2021)	Needs of students with disabilities in engineering	UDL – Universal Design for Learning	Quantitative, using MUSIC Inventory and surveys	303 undergrad: 255 without disabilities and 48 with disabilities
Bellman et al. (2015)	Efficacy of providing academic coaching services to students with disabilities	Academic coaching	Qualitative, using a six open-ended questions online survey	41 students with diverse types of disabilities.
Cardoso et al. (2016)	Experiences of minority students with disabilities in their pursuit of STEM careers	MIND alliance, Vocational Rehabilitation	Qualitative, using a Consensual Qualitative Research (CQR) instrument	Six college students with disabilities
Cech (2021)	Experiences of social marginalization, professional devaluation and persistence intentions in students and professionals with disabilities in engineering	Social model of disability	Quantitative, through the application of the ASEE Diversity and Inclusion Survey (ASEE-DIS)	1,279 students in STEM
Erickson and Larwin (2016)	Students with disabilities in two-years institutions	Vocational Rehabilitation	Meta-analysis	Not specified
Golding et al. (2018)	Experiences of engagement from within and beyond the classrooms for students with disabilities	Model of Co-Curricular Support (MCCS)	Qualitative Case Study	One student with hearing impairments
Groen et al. (2018)	Ways in which students with disabilities in engineering form their professional identity	Professional Identity, Social Identity Theory (SIT), Self-Categorization Theory (SCT)	Qualitative, Grounded Theory	40 students with different types of disabilities
Groen-McCall et al. (2019)	How engineering students with disabilities develop or fail to develop their professional identities	Social Identity Theory (SIT), Intersectionality, Identity Salience	Qualitative, Longitudinal Grounded Theory, combination of intensive and constructivist interviewing approach and critical incident technique	23 students with different types of disabilities

Lezotte et al. (2020)	Comparison of the experiences of students with and without disabilities in engineering	Self-efficacy, self-determination, perceptions of "otherness"	Quantitative, online surveys	214 engineering students: 33 with disabilities, 181 without disabilities
Martin et al. (2021)	Inclusion of students with disabilities in STEM	Not specified	Qualitative, interviews	24 participants with physical disabilities
McCall et al. (2020)	Experiences of students with disabilities in engineering	Multiple dimensions of identity and Intersectionality	Qualitative, Grounded Theory, semi-structured interviews	Three participants with disabilities
Weatherton et al. (2017)	Literature review about systemic and personal barriers for students with disabilities in engineering	Not specified	Search of articles in EBSCOHost Academic Search Complete and ProQuest	Not specified
Schearer et al. (2019)	Impact of a research experience in rehabilitation engineering on students with disabilities	Not specified	Qualitative, interpretive study through a case study	25 students
Slaton (2013)	Engineering epistemologies around issues of disability	Engineering Studies (ES), Disability Theory by Siebers (2008), Social model of disability	Qualitative case study	One student with visual impairments
Smedema et al. (2015)	Assessment of the relation between functional disability and life satisfaction	Core Self-Evaluations (CSE)	Quantitative, using multiple regression analysis	97 students in STEM
Summers and Rogge (2015)	Effects of the design of a disability studies course in STEM students	Disability Studies (DS) and Universal Design (UD)	Qualitative through interviews to students	Not specified
Thurston et al. (2017)	Challenges, lessons learned, and practices of working with students with disabilities in STEM education	Not specified	Mixed methods	One hundred seventeen projects and 97 Principal Investigators (PIs).

Conclusions

The current landscape of the literature explored in this mapping review reveals that the experiences of students with physical and sensory disabilities have been investigated by leveraging theories from the disability research space, along with those commonly used to examine the experiences of engineering students more broadly. For instance, the social model of disability, disability theory, and disability studies were some of those that were developed specifically with the lives and experiences of people with disabilities, while social identity theory, professional identity, and intersectionality are actively being used within education research and more specifically, engineering education. The use of these diverse perspectives and viewpoints creates opportunities for scholars to consider theories that are specific to disability, along with those specific to education, and opens up the possibility for the development of theories that overlap both research spaces.

Furthermore, the choice of methodology and research tools offers the flexibility to employ quantitative or qualitative approaches. Even though this mapping review did not find mixed methods studies, combining qualitative and quantitative research designs could be helpful for analyzing the experiences of students with disabilities, as it can provide the in-depth explorations of qualitative and the broader explorations that quantitative allows for. The studies examined in this mapping review indicated that students with disabilities are open to engaging in surveys, focus groups, or interviews. This participation is crucial for advancing research in this field.

Nevertheless, Lezotte and colleagues [9] found the involvement of students with disabilities in their survey was lower compared to their counterparts without disabilities. This underscores the need for the engineering community to encourage students with disabilities to be more forthcoming in expressing their emotions, sentiments, and concerns. In addition, the research in this field would amplify the voices of students with disabilities and benefit from overrepresenting this group in samples.

Lastly, the insights collected from this mapping review on the experiences of students with physical and sensory disabilities in engineering bring to light four essential themes. These themes necessitate attention not only from the engineering education research community but also from faculty, administrators, staff, policymakers, and society at large. The issues of marginalization, discrimination, the effects of accommodations, challenges within the engineering field, and impacts on identity significantly affect the academic performance of these students, limiting their potential success as future engineers. As a result, more research about the experiences of students with physical and sensory disabilities in engineering programs is needed. Recognizing students with disabilities as deserving individuals with voices that should be heard, fostering inclusivity within the field of engineering is imperative.

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