# Accommodations for Disabled Students in STEM Fields: Research Considerations and a Literature Review

**Sage Maul, Purdue University**

Sage Maul (they/them) is a third year PhD student in Purdue University's School of Engineering Education. Sage's research explores structural factors on student experiences for disabled students and in electrical and computer engineering courses. Sage graduated with a Bachelor's of Science in Electrical Engineering from Purdue and worked in industry for 5 years before starting graduate school. Their experiences with accommodations in undergrad and getting diagnosed with ADHD as an adult inform their research work.

**Dr. Kirsten A. Davis, Purdue University**

Kirsten Davis is an assistant professor in the School of Engineering Education at Purdue University. Her research explores the intentional design and assessment of global engineering programs, student development through experiential learning, and approaches for teaching and assessing systems thinking skills. Kirsten holds a B.S. in Engineering & Management from Clarkson University and an M.A.Ed. in Higher Education, M.S. in Systems Engineering, and Ph.D. in Engineering Education, all from Virginia Tech.

**Dr. Senay Purzer, Purdue University**

Senay Purzer is a Professor in the School of Engineering Education at Purdue University. Her research is on engineering design reasoning.

**Prof. Ruth Wertz, Purdue University**

Dr. Wertz has earned a B.S. in Civil Engineering from Trine University, a M.S. in Civil Engineering from Purdue University, and a Ph.D. in Engineering Education.

# Accommodations for Disabled Students in STEM Fields: Research Considerations and a Literature Overview


## Abstract

There is an urgent need to understand the research on how we can support disabled students most effectively. The number of students reporting disabilities is increasing and the existing accommodation policies are not always effective. In this paper, we present an overview of the literature related to disabled student experiences with accommodations. We included both STEM and non-STEM literature because the body of literature in STEM is sparse and there is much that can be learned with a wider review. We discuss three main topics that are prevalent in the literature. First, we discuss the issue of access, where research suggests that not all students who qualify for accommodations get them. Secondly, we address the burden placed on students to learn to navigate the university procedures and the institutional disability support structures. Finally, we review persistent misconceptions that exist related to accommodations, such as the fact that not all students who have accommodations use them. The paper concludes with recommendations to inform research practices for research on disabled students.


## Introduction

Disabled students are underserved in engineering and other STEM fields, and one significant influence on their undergraduate education can be their experience seeking and receiving accommodations. Improving the system of accommodations in STEM education is an important step to improving inclusion for disabled students. However, little research within engineering education has focused on accommodations specifically. The purpose of our paper is to present a literature review on accommodations research in the broader education literature and identify gaps in what is known within the STEM education space. We will also highlight considerations for researchers looking to explore disabled student participation in postsecondary spaces. We will define disability and describe our choice to use both identity- and person-first language. We will discuss our choice to prioritize research that highlights disabled student voices.

Our literature review will explore: which disabilities have been the focus of research in higher education; problematic practices that require increased disabled student self-advocacy rather than systemic changes; the reasons for students' reluctance to use accommodations; the weaknesses of the accommodations approach; and suggestions for moving beyond accommodations. We will conclude by offering recommendations and reflections for researchers who want to research disabled students.

The purpose of this paper is to provide a place to start for those learning to conduct research related to the experiences of disabled students and/or students with accommodations in engineering education. This is not intended to be an exhaustive how-to guide, but rather a set of resources to help you get started.

In support of this goal, we first present an overview [3] of accommodations research in broader education literature and identify gaps in what is known on this topic. Next, we build on the

literature review to make recommendations and offer reflections for researchers studying this space.

**Positionality**

Sage Maul is a PhD student in Purdue University's School of Engineering Education who identifies as disabled. They had accommodations for chronic migraines during their undergraduate degree in electrical engineering. They frequently had difficulty getting engineering professors to understand and meet their accommodations needs. Sage worked in industry for 5 years and got diagnosed with ADHD before starting grad school. The contradiction between Sage's difficulty in coursework and success in industry drives their research interest in disabled students' experiences in engineering.

Kirsten A. Davis is a white U.S. citizen who identifies as able-bodied. She is an assistant professor in Purdue University's School of Engineering Education. Her research exploring engineering student learning through cross-cultural experiences and experiential learning programs is inspired by her time working as an engineer in industry.

Şenay Purzer is a professor of engineering education who identifies as able-bodied. Her involvement in research on disabled student experiences emerged from her passion to improve mentoring and institutional procedures around accommodations. When a graduate student approaches to seek accommodations, there are few resources to consult, including the burden on accommodations put on the students themselves. She is in a position to facilitate the translations of this research into practice, policy, and procedure.

Ruth Wertz is an assistant professor of engineering practice in engineering education. She identifies as a white, cisgender woman who is able-bodied and non-neurotypical. All aspects of her professional work, including teaching, research, and mentorship, are deeply rooted in empathy-based and trauma-informed practices. Her interest and involvement in this project stem from her broader mission to improve access to accommodations, with particular focus on graduate education and faculty promotion and tenure. She is also an ADHD life coach who works with both academic and non-academic clients.

**Disability definition**

There are many ways to define disability. Even the disability studies field excluded many types of impairments until relatively recently [4]. Also, some argue that physical disability (like quadriplegia) and illness/disease (like multiple sclerosis) should be two different categories [5]. Invisible disabilities (like learning disabilities) can be missing from historical records altogether, making research on their histories near impossible [6]. Today, disability studies "involves scrutinizing not bodily or mental impairments but the social norms that define particular attributes as impairments, as well as the social conditions that concentrate stigmatized attributes in particular populations" [7]. This idea is referred to as the social model of disability. In this model, a disability is any attribute that society stigmatizes or views as an impairment. Society is what causes disability.

The opposite of the social model is the medical model of disability. Medical researchers often frame their work with disabled people as trying to put them in a "normal" state, as opposed to their "abnormal" disabled status [8]. This idea is similar to the colonial worldview identified in the anthropology theories of cosmopolitic and cosmopolitism works. The colonizers, or in this case the able-bodied, cannot recognize a worldview outside their own. They instead work to "fix" and adjust the people who are not able-bodied to eliminate disability/the possibility of another viewpoint. The medical model seeks a "solution" to the "problem" of disability. The extreme version of this model can lead to involuntary sterilization [9].

**Language choices**

There are multiple ways to refer to disabled people. Person-first language says that someone is a person before their disability (e.g., "person with diabetes"). Identity-first language lists the disability first (e.g., "diabetic person"). Academic writing tends to use person-first language for the most stigmatizing conditions, while identity-first language is used for relatively unstigmatized adjectives like "gifted children" [10].

Additionally, some people do not use the term disabled because they do not know they are disabled. Access to care is a major limiting factor. Not many people want to call themselves by that label if they lack a diagnosis. However, in addition to the general difficulties with accessing medical care in the US, the challenge of getting diagnosed with a disability is compounded by the other marginalized identities of a patient. For example, Black children are 69% less likely to get an ADHD diagnosis than White children [11].

Others may not consider their conditions disabling (e.g. some people with ADHD). Research on accommodations for students can include these people. Research on accommodations can also include temporary disabilities or conditions (e.g. a broken leg).

We use both identity-first and person-first language in this paper. We recommend asking individuals which language they prefer when writing about individuals.

**What are accommodations?**

In the US, many government offices define accommodations as a modification or adaptation to allow people with disabilities an equal opportunity to nondisabled people [12], [13]. Students in the US have different pathways to pursue accommodations depending on their schooling level. Students in K-12 schooling are covered by Section 504 and the Individuals with Disabilities Education Act (IDEA) [14]. Once students advance to postsecondary education, they lose protection from the IDEA and many of the protections from Section 504 [15]. Most college student protections come from the Americans with Disabilities Act (ADA), which was written as a document defining the civil rights of disabled Americans [16]. The ADA just specifies that accommodations need to be "reasonable" [17]. This legislation does not define accommodations. Religious postsecondary institutions don't need to provide accommodations at all [17]. "Reasonable accommodations" leaves a broad window for what accommodations can be. Furthermore, the ADA doesn't address how to determine if accommodations are effective at helping disabled people. The broadness of the legal language leaves a lot of room for questions

about accommodating postsecondary students. It is difficult to find detailed information about the exact nature of this on federal websites, as there is not one civil rights office in the US. Each federal department has their own Office of Civil Rights. For example, for this literature review we've referenced the Office of Civil Rights webpages from the Department of Education, the Department of Labor, the Department of Housing and Urban Development, and the Department of Health and Human Services.

**Overview methodology**

We conducted a literature review to understand the experiences of disabled students in higher education. We began with higher education generally to see disabled student experiences with accommodations across disciplines. Our next search focused on assessments in STEM postsecondary education. We conclude our review with an overview of recent engineering education research on postsecondary disabled students.

Together, all three create an overview [3] of research on postsecondary students in the U.S. with accommodations and/or disabilities. We only look at research on U.S. postsecondary students for this paper. Disability definitions and the bureaucracy around accommodations vary dramatically from country to country.

Our review prioritized literature that let students with disabilities and/or accommodations speak for themselves during data collection. Research from authors who spoke with students' parents instead of students themselves was excluded. All papers were peer-reviewed. The overview of non-STEM literature excluded papers published before 2000.

**Results**

*Overview of non-STEM literature on postsecondary student accommodations in the US*

Not all students who qualify for accommodations get them: Disabled graduate students face three major challenges. First, the student has to decide whether to disclose their disability to their institution or not [18]. This decision is not easy as there are many myths and misconceptions highlighted in the literature with regards to disabled students [19]. The student may also not be able to explain their disability or may not want to place additional burdens on their graduate mentors [20]. A hindrance to research on disabled students is that many choose to not disclose their disability status [21]–[24].

Second, following a decision to disclose, the student must then learn to navigate the university procedures and the institutional disability support structures. This is an extra burden on the student. In addition, the accommodations the university provides may not be useful with respect to the experiential and spontaneous nature of graduate education or tailored towards the specific disability of the student [25]. Also, students can request accommodations due to the Americans with Disabilities Act (ADA) [26]. The ADA only calls for "reasonable accommodation," which can make it difficult for everyone involved to navigate accommodations [17].

Finally, even in situations where there is strong institutional support and student-advisor relationships, there is the potential unintended consequences of accommodations such as the

separation of the student from the mainstream group [25]. A comprehensive approach is necessary to address the specific challenges and diverse needs of disabled graduate students.

Not all students who have accommodations use them: Many previous studies have explored why students with disabilities do not use accommodations available to them from their institutions. Many researchers found that students wanted a sense of normalcy or self-sufficiency so they avoided requesting accommodations [27]–[29]. Further, students who chose not to disclose their disabilities tended to have little or inaccurate knowledge of how the accommodations process worked at their institutions [28]–[31]. Students' lack of knowledge may be due to the dramatic difference in acquiring accommodations in K-12 educational spaces and postsecondary institutions [31]. Students who had been diagnosed as children often struggled to explain their disabilities to others, and some did not know what their disabilities were [29], [32]. Beyond student preferences and characteristics, disabled students often base their decision to disclose on faculty and peer attitudes. We explore faculty and peer influences on disabled students' decisions to request accommodations below.

Faculty behavior can also influence students' decisions not to request accommodations [27]–[31], [33]. Some faculty refused to abide by accommodations letters from disability resource centers [28]–[32], while others made additional rules for students using accommodations [33]. For example, Ehlinger & Ropers [33] spoke with a student whose instructor told her to sit at the back of the classroom if she wanted to use her accommodations in class. The student chose not to use her accommodations because she didn't want to sit in the back. Other faculty influences on student decisions can be less obvious. Multiple researchers spoke with students who were afraid that requesting accommodations might affect professors' letters of recommendation for them [27], [28]. Over their time in postsecondary education, students have a lot of opportunities to interact with professors. Their overall experiences can correlate to their decision to request accommodations. Cole & Cawthon [30] found that a student's perception of their experiences with faculty corresponded to their decision to disclose their disability. Students who did not ask for accommodations had more negative experiences with professors than positive ones. Students who only gave professors their accommodation letters had mixed experiences, while students who gave instructors their letters and had a conversation with them had more positive than negative experiences with faculty. Many students have at least one horror story about accommodations and professors. Marshak et al. [29] interviewed several students who encountered professors who did not believe students were disabled or that their disability caused their absence, in spite of the documentation provided to instructors. Disabled students base many of their decisions to use accommodations on faculty attitudes.

Peers also influenced students' decisions not to disclose their disabilities. If an accommodation interfered with a student's sense of belonging with other students, the disabled student might consider the accommodation unhelpful regardless of its effect on their academic performance [34]. Disabled students in multiple studies reported that they were afraid of their peers viewing accommodations as "special treatment" [27]–[29]. Toutain's [31] literature review on the barriers students encounter getting their accommodations found several papers that discussed disabled

students' awareness of negative reactions from their peers. Peer perception is an important factor in disabled students' decisions to use (or not use) accommodations.

Accommodations often do not accommodate students: Accommodations offer a limited way to make postsecondary education accessible for students. Disabled students are required to do most of the work in this approach. They must work with the disability center on their campus to prove their need for accommodation. Then students with disabilities must interact with all their instructors every semester to request accommodations. Even if disabled students are up for this task, the approach is arduous and leaves many behind. Students who don't have diagnoses are one of the groups accommodations cannot help.

Several researchers mentioned the lack of a physically accessible campus as a problem for disabled students [29], [35], [36]. For example, Marshak et al. [29] quote a student who uses a wheelchair on this issue. One of his final exams was scheduled on the second floor of a building without an elevator. The student's desire for self-sufficiency was so strong that he crawled up the stairs with his wheelchair on his back so he could take the exam. Campuses should build accommodations into the design of their buildings and work to update their facilities so that disabled students can access as much of campus as able-bodied students. Disabled students should not bear the additional burden of researching every place on campus to see if they are accessible.

Many people question if accommodations are effective. Examples are common throughout disability literature. Students who were granted the accommodation to take exams in a distraction reduced environment or with extended time noted that they could not ask the professor questions during the exam, even though their peers in the rest of the class were able to [37]. These students found the extended time helpful, but lamented how they could not ask clarifying questions. The alternative is generally to take exams in the professor's office to get extended time, but many professors had other students dropping by for office hours at the same time. The increase in distractions often cancelled out the benefit of asking the professor questions. Stein found that students chose whether to use their extended time on a class-by-class basis. Multiple researchers wrote about students who had accommodations for notetakers in their courses. Some students said their campus Disability Resource Center (DRC) offices (or equivalents) would say they could offer note takers, but then the DRC would take weeks to find one [29]. Three articles specifically said that confidentiality of the disabled students' identities was a problem when asking for note takers [28], [29], [37]. Other issues include poor quality notes, difficult-to-read handwriting, and note taker absenteeism [31], [34].

Additionally, some authors worry that accommodations are giving people an unfair advantage. Multiple researchers thought that students doing too well with accommodations was a concern [38], [39]. Ketterlin-Geller & Johnstone [38] brought up that they think it is problematic that a student who does not need accommodations could be given them. These views are in conflict with authors who research why many disabled students decline to use accommodations.

Despite their intentions, accommodations often do not adequately meet disabled students needs. The next section of this paper will highlight the ways postsecondary institutions can go beyond accommodations.

Moving beyond accommodations: In this theme we will highlight the need to go beyond accommodations to make campuses accessible for disabled students. Abes and Wallace wrote that "[d]isability is often seen in college through an accommodation lens (Peña, 2014); however, accommodations merely grant access to ableist institutions rather than change the ideological structures that necessitate accommodation" [33, p.558]. Other accommodations are unclear if they help disabled students. The current model of only giving accommodations when a student goes through the process of requesting them results in a lack of access in many places. We will discuss ways to accommodate students who cannot or will not request accommodations (including Universal Design) and how cultural centers can offer support to disabled students.

Many previous studies have focused on ways to accommodate students who cannot or will not formally request accommodations. For example, some studies suggested that designing courses to minimize the number of accommodations requests would make it easier for disabled students [38], [40], [41]. Ehlinger & Ropers [33] used narrative methods within a transformative paradigm to look at the ways instructors can use their classroom cultures to make disabled students feel more welcome in their courses. They talked with instructors who said they cared about students, created a community in the course, validated identities, and cultivated diverse viewpoints that facilitated disabled student learning. On the opposite end of the spectrum, Ehlinger & Ropers [33] found that instructors who expected students to fail, were difficult to contact, or made it seem like certain types of people would not be enrolled in the course inhibited disabled student learning. For example, one student had an instructor tell their class that none of the students would be familiar with a medication because they were not pharmacists. The student felt this meant the instructor did not think anyone taking that medication would be in college. Ehlinger & Ropers' [33] findings show ways for instructors to make disabled students feel more welcome in their courses and improve learning. Instructors can make a space for many different types of students as part of making their classrooms more accessible to disabled students. Instructors should avoid conveying that they expect only certain kinds of people to be in their courses.

Universal Design (UD) is frequently recommended as an approach to integrate accommodations inherently into courses [38], [40], [42]. UD is "[t]he design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" [43]. It began in architecture and has spread throughout many disciplines. UD applied to postsecondary education would mean both curriculum and college campuses are designed so that disabled students can access the same or an equivalent experience to able-bodied students. For example, instructors can record lectures and share the recordings with students to allow students to study at the times that work best for them [40]. Similarly, in the larger college campus, university administrators can make sure that sidewalks have curb cuts so that wheelchair users can use sidewalks on campus.

Saia [36] conducted a unique study in which they interviewed students about their experiences with a Disability Cultural Center (DCC) on their campus. A DCC is different from a Disability Resource Center (DRC) or similarly named office because its purpose is not to handle student accommodations. A DCC exists as a place to facilitate disabled students forming community together. The students Saia interviewed noted that while the DRC was helpful regarding accommodations in classes, the disabled students faced a lot of ableism and microaggressions on campus. The DCC was able to give students a safe space to talk about the social experience of being disabled on their campus. Saia's work shows that disabled students can find belonging if they are given community spaces. This can mitigate some of the weaknesses of the accommodations approach in postsecondary environments.

*Assessments in postsecondary STEM education*

Research on disabled students in postsecondary STEM courses covers a variety of topics. The articles we found for STEM education research on increasing accessible assessment focused on ADHD and learning disabilities the most [21]–[23], [26], [44]–[52], with other disabilities taking a backseat. Much of this research discussed putting the responsibility on disabled students for their own success. These focused on methods like increasing disabled student self-advocacy and offering support groups. Only a few papers offered suggestions on changing exams to be inherently more accessible.

Also, engineering faculty are considerably worse at granting student accommodations than faculty in other fields [1]. Additionally, engineering students who share their disability status and accommodations with faculty and peers experience questioning from them on whether the disabled student's accommodations are necessary [2]. Since students face many barriers to getting their accommodations met, many don't request accommodations at all.

*Engineering education overview*

Although engineering education does not have a large body of research on disabled students, several researchers are bringing the conversation about students with disabilities and/or accommodations into the field. Recent journal papers include topics such as ableism in engineering, engineering identity for students with disabilities, and asset-based looks at students with ADHD [2], [51], [53]. Broadening the scope to conferences offers many more papers, on topics such as website accessibility, faculty interactions, and graduate student accommodations policies [54]–[56].

**Recommendations and reflections for researchers**

These recommendations and reflections are born from the first author's experiences as a disabled student in engineering coursework, as well as the first author's conversations with other disabled students.

1. Talk to disabled students themselves. Unfortunately, this is a common issue with disability research. Many studies choose to center the people in a disabled person's life, instead of the disabled person themselves [57]. If you're talking to a population where you wouldn't talk to a participant's parents or instructors for able-bodied students (e.g.

college undergraduates), do the same for disabled students. If you think you can't talk to disabled students themselves, ask yourself why.

2. Be clear about your selection criteria for participants and define your terms. For example, many studies say they look at learning disabilities, but then never say what they consider a learning disability. To make matters even more confusing, health professionals generally do not include ADHD as a learning disability, but acknowledge that ADHD impacts learning [58]–[60]. This lack of clarity leaves readers uncertain who is included in research findings. Reflect on your research questions to see what kinds of disabilities you want to include in your research. What populations of students do you want to investigate? What circumstances?
3. Disabled people are often asked to do work for less compensation than their able-bodied peers (e.g. there is a lower minimum wage for workers with disabilities [61]). Compensate your participants. If you don't have funding to pay participants, what other ways can you engage in reciprocity with them? Can you help them change some institutional structures? Can you write them letters of recommendation? There are many ways to show participants you value their time and energy.
4. Many disabled students have negative experiences talking to faculty about their disabilities [2], [28]–[31], [33], [36], [55], [62], [63]. If the researchers are all faculty, consider hiring students who are peers to your participant group to interview them/interact with them. This can increase both the comfort of your participants and the richness of the data you collect.

## Conclusion

The goal of this paper was to do a literature review and offer suggestions to researchers on researching disabled students in U.S. postsecondary engineering education. We began by defining our terminology and explaining our language choices. The literature review highlighted the areas most explored in research on students with accommodations and/or disabilities in higher education spaces. Our review of higher education research in general showed that not all students who qualify for accommodations get them and accommodations often do not accommodate students. Our higher education review concluded by sharing suggestions for moving beyond accommodations. Our investigation into literature about assessment in postsecondary STEM education displayed the prevalence of certain disabilities over others and putting the responsibility onto disabled students for their own success. Our look at engineering education research on disabled students shows the breadth of recent research in this area. Our recommendations and reflections offer suggestions for future researchers who want to explore this area. Future research will explore the ways systems (not individuals) can support disabled student success in postsecondary engineering environments.

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