Understanding Educational Barriers Faced by Students with Disabilities in STEM Programs

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Abstract

Students with disabilities in STEM programs may experience barriers that affect their academic participation, learning outcomes, and persistence. This study investigates accessibility-related experiences and perceptions among university students, with particular attention to classroom and laboratory learning environments. Data were collected through an anonymous student-designed survey administered during Fall 2025. A total of 147 valid responses were analyzed, including both students registered with the Office of Access and Accommodation (OAA) and students not registered with the office. The survey captured student demographics, disability type, awareness of disability services, and perceptions of accessibility and fairness in STEM instruction. This study is explicitly descriptive and exploratory in nature. Descriptive statistics were computed to characterize trends in accessibility perceptions, and a composite index was developed from eight awareness and attitudes items to summarize and describe the Likert-scale results. Findings suggest that students report generally high awareness of accommodation services and a strong understanding of the purpose of academic accommodation. However, results also indicate variability in experiences related to laboratory accessibility, faculty awareness of student needs, and perceived fairness and usability of some STEM course formats. Laboratory accessibility emerged as one of the most consistent areas where disability-related barriers remain visible. Students registered with OAA reported higher composite awareness/attitudes scores than non-registered students, suggesting that direct engagement with accessibility services may be associated with stronger awareness and clearer understanding of support systems. Importantly, this study interrogates institutional structures that normalize ableist barriers in STEM learning environments, treating accessibility not as an administrative add-on but as a systemic challenge embedded in how engineering education is designed and delivered. Overall, results highlight the importance of strengthening faculty training, improving communication protocols, and prioritizing laboratory accessibility in STEM learning environments to better support students with disabilities.

Keywords: accessibility, STEM education, college level students with disabilities, inclusion, learning environment, technology, learning disabilities, physical disabilities

Introduction

Accessibility in higher education has increasingly been recognized as a central component of effective learning environments, yet many institutional efforts still emphasize compliance-based accommodations rather than inclusive instructional design integrated into daily teaching practice. This compliance-first orientation reflects a form of normalized institutional violence: the structural marginalization of disabled students is rendered invisible when it is treated as an accommodation problem to be resolved individually rather than a systemic design failure to be corrected collectively. While accessible buildings and physical infrastructure remain essential, accessibility in academic settings is shaped just as strongly by how courses are structured and delivered. Students' learning experiences depend on the accessibility of instructional materials, clarity and flexibility of communication, assessment design, and the ability of faculty and instructional staff to respond appropriately to diverse learning needs. In STEM education, where courses often use standardized content delivery and high-stakes assessments, accessibility is particularly consequential because course structure can amplify barriers even when disability services exist and accommodations are available [1], [2], [3], [4].

These concerns are particularly critical in STEM education, where learning is often structured through high cognitive demands, time-intensive curricula, frequent examinations, and laboratory-centered instruction. Engineering and science courses frequently rely on rigid formats and time-bound assessment systems, which can unintentionally restrict participation for students requiring accommodations. Laboratory environments can be especially challenging because they include fixed equipment layouts, constrained space, safety requirements, and real-time task completion expectations that reduce flexibility in implementing accommodations. Research on inclusive laboratory participation emphasizes that students with disabilities face unique obstacles in lab settings and that addressing these barriers requires purposeful redesign of lab pedagogy, assessment structures, and instructional support [5], [6]. Engineering education literature similarly emphasizes that disability access in STEM must be addressed through both structural supports and inclusive instructional practices rather than solely through student-level accommodation requests [7], [8]. The persistence of these barriers, despite decades of disability legislation and institutional policy, is not incidental; it reflects normalized institutional structures that consistently place the burden of access on disabled students rather than on the institutions that design courses, labs, and assessments. This paper explicitly confronts those structures by documenting where and how they produce unequal conditions for students with disabilities in STEM.

At the same time, disability remains underreported and under-disclosed in higher education settings. Many students who could benefit from formal accommodations do not register with disability service offices or may delay disclosure until academic challenges become severe. Prior research suggests that this pattern is associated with perceived stigma, fear of being treated differently by peers or instructors, concerns over confidentiality, and emotional risk tied to identity management [9], [10], [11]. These findings are important because they demonstrate that the existence of institutional disability services does not guarantee accessibility in practice; instead, accessibility must be evaluated by whether students perceive services as usable, supportive, and safe to engage with. Consequently, capturing both students' experiences navigating accommodations and the awareness levels of the broader student population provides a more complete picture of how accessibility operates within STEM contexts [1], [12].

This study contributes to engineering education research by examining accessibility experiences and institutional awareness of disability services among university students, with particular attention to STEM learning environments. The research was conducted through an undergraduate-led survey initiative at a university. By analyzing both accessibility experiences among students with disability-related accommodation needs and campus-wide perceptions among the broader student body, this study provides evidence that can inform institutional improvement strategies and contribute to ongoing discussions around inclusive STEM learning.

The goal of this research is not only to document whether students perceive accessibility barriers, but also to identify where accessibility challenges most often emerge in STEM learning settings and how those challenges relate to awareness of services and engagement with accommodations. Such findings have practical relevance for faculty development, inclusive lab design, and institutional communication strategies that create supportive pathways for disabled students. Accessibility, particularly in STEM education, should not be treated as a set of isolated adjustments; rather, it should be conceptualized as an integrated component of instructional quality, educational responsibility, and inclusive engineering practice [5], [7], [13].

Literature Review

Inclusion and Institutional Barriers

Existing research shows that institutional infrastructure and inclusion methods influence students with disabilities in higher education. Brunengo et al. found that the integration of programming and 3D printing can successfully increase participation in STEM courses and assistive tools and learning methods can be easily integrated [14]. Similarly, Pang found that digital assistive technology can serve as a viable pathway for cultivating well-being in children and adolescents with disabilities, making a novel contribution to existing education literature by quantitatively synthesizing empirical evidence on these non-academic outcomes [15]. Druckman et al. conducted a survey to find evidence of bias in education. The survey found that there is bias based on disability, which contradicts the intent of Section 504, which emphasizes the need for equal access to accommodations [16]. Kreider et al. focused on analyzing students with disabilities' advocacy skills. The findings indicate that there is a need to create disability-focused advocacy projects to support personal development and broaden institutional benefits [17]. However, Almalky et al. investigated the availability, use, and impact of assistive technologies for university students with disabilities. Overall, the findings show a strong positive correlation between assistive technology use and improved academic performance, offering important guidance of policy makers, educators, and support centers working to enhance inclusion [18]. Zhao found that the use of generative AI in education was controversial due to its potential impact on academic integrity, yet some scholars suggested that it could benefit students with disabilities. Their research findings offered valuable insights and highlighted directions for future research, including larger, cross-institutional studies and deeper exploration of how different disabilities and backgrounds influence AI use in academic writing by providing major benefits for underrepresented students with disabilities, supporting their writing processes [19]. These findings show that access to tools without guidance is insufficient support for students.

The focus on training is also a key factor in students with disabilities' educational performance. Yokota et al. investigated how training influenced both explicit and implicit attitudes toward autism spectrum disorder (ASD) and physical disabilities. The study found significant positive changes in explicit attitudes towards disabilities that were not directly targeted by the training. However, only those who received training on physical disabilities showed changes in implicit attitudes towards people with physical disabilities, and they already possessed greater prior knowledge about these disabilities [20]. Sedlackova et al. studied the physical disabilities that affect students' educational experiences, and first-hand narratives from these students proved valuable to policymakers, teachers, and other stakeholders seeking to improve inclusive education. The study found that although students with physical disabilities were educated in mainstream settings, they reported challenges with daily activities, accessibility, and school participation, which influenced their self-perception of academic progress and future aspirations. These barriers, however, could be reduced through curriculum accommodations, appropriate support, and involving students' voices in decision-making [21], [22].

The demographic of students with disabilities has also been analyzed as a factor in access to higher education. Nieminem synthesized 42 research studies published between 2010 and 2022, involving 868 student participants, to examine students with disabilities' assessment experiences in higher education, using a meta-ethnographic approach. The researchers analyze qualitative studies to capture participants' lived experiences and to explore how these reflected both inclusion and exclusion through the concepts of access and participation. They found that designating inclusive assessments was not only essential for equitable learning but also for supporting diverse student identities, and it highlighted important directions for future research and practice towards a more inclusive educational environment [23]. Additionally, Myers found that college students with "Invisible" disabilities, such as ASD, ADHD, learning disorders, and mental health conditions, make up a growing share of undergraduates in the U.S., yet they continue to experience academic and social disadvantages compared to neurotypical and non-disabled peers. The study found a cumulative advantage-and-disadvantage process in which initial preparation gaps compound over time and influence later outcomes. Addressing these issues requires attention to how disadvantages build and reinforce one another throughout students' educational paths [24]. Finally, Lopez Gomez et al. studied the proportion of people with disabilities (PWD) in higher education, which has increased worldwide, including in Colombia. The study found that lower scores among PWD were largely explained by socioeconomic and educational disadvantages rather than the disability itself. it recommended improving data collection, staff training and institutional support to enhance PWD inclusion and academic success [25]. These studies highlight how the demographic of disabilities can impact higher education [4].

Existing Methods for Students in Higher Education

Efforts to improve higher education for disabled students currently have some gaps in policy structure and implementation. Previous research has found that the barriers experienced by students with disabilities while young can impact them in their early careers. Done et al. found that without inclusive policies, accessible designs, and cultural change, the education curriculum alone is not enough to support the students [26]. Feldman et al. found that early career outcomes are highly influenced by institutional structure and personal lifestyle factors [27]. Burgstahler et al. analyzed how accessibility can be improved during distance learning. They found that outlining access challenges, existing legislation, accommodation strategies, universal design principles, and standards would be beneficial to enhancing the accessibility of online courses [28]. Wright et al. decided to focus on examining whether video modeling is an effective strategy for teaching skills to students with intellectual disabilities. They found that there is insufficient evidence supporting whether video modeling for STEM instruction would be considered an effective tool for teaching students with disabilities [29]. Similarly, Nees examined the use of audio assistive technology and accommodations to further educational inclusion. The study found that audio technologies can improve accessibility and challenge the current stigma in the field [30]. However, Conde et al. explored how learning analytics can be effectively applied to support students with intellectual and developmental disabilities. They found that these learning analytics showed potential, but required adaptation to the specific learners' characteristics in order to be effective [31].

Gonzalo et al. found that the Quality of Life Supports Model was applicable in many cases. They found that higher education aligns with the model, but only a few aspects, which limit its impact on students' quality of life [32]. Similarly, Hatzikiriakidis et al. investigated how healthy lifestyle interventions can be implemented in people with disabilities' lifestyles. They found that the successful implementation of these interventions depended on flexibility, organization, and support; however, further research is deemed necessary [33]. Beimel evaluated 44,520 surveys and found that with increased variety and extent in lessons, the gap between disabled and non-disabled students decreased drastically [34]. However, Kayhan et al. found that existing methods during academic registration were enough, but academic and social practices need to be improved [35]. Additionally, Giannoulis et al. Analyzed how disabled students often face obstacles that cannot be overcome when it comes to accessing modern sources of knowledge. The researchers found that integrated tools for creating plans and proposals at the management level would benefit students by providing improved access to services [36]. Seale et al. also examined how technology is used in higher education and its impact on students with disabilities. They found that students do not have an issue accessing technology, 97% of students own a mobile phone, 96% own a laptop, 68% own an iPod or MP3 player, and 52% own some form of assistive technology (AT). Finally, Gebeshuber et al. emphasized the importance of overcoming social, infrastructural and attitudinal barriers within engineering education; introducing multiple design principles, outreach efforts, and support structures created for disabled students and staff [37]. Overall, the studies found that higher education that includes instructional reform and assistive technology for students with disabilities would be more beneficial.

Data and Methodology

Data Source and Study Context

This study examines accessibility and disability-related learning experiences in STEM education, with a particular emphasis on how students perceive barriers and support systems within campus learning environments. The work was conducted as part of an undergraduate research initiative at a U.S. university and was designed to document both the lived experiences of students who require accommodations and the broader student population's awareness and perceptions of accessibility services. Since engineering and other STEM programs involve lecture-based instruction, laboratory requirements, team-based activities, and assessment structures that may pose unique constraints, accessibility within STEM is a meaningful area for educational research and institutional improvement. To explore these questions, the research team developed and distributed a structured survey instrument intended to capture both accessibility experiences and institutional awareness.

Survey responses were collected during the Fall 2025 semester. Participation was voluntary and anonymous, and students completed the survey electronically. The final dataset included 147 valid responses. The survey link was disseminated through course announcements, campus email lists, and student organization channels. The total number of students who received the survey invitation is not precisely known due to the multi-channel distribution method; therefore, a formal response rate cannot be calculated. While responses included participants across academic levels and major fields of study, the design specifically sought to include respondents registered with the Office of Access and Accommodation (OAA) to analyze experiences among students actively engaged with accessibility services. Importantly, the study recognizes that disability status is not always disclosed and that accommodation registration is influenced by factors beyond need, including stigma, uncertainty about eligibility, and perceived burdens of administrative processes. Therefore, the survey was structured to capture perceptions both among OAA-registered students and the general student body. Given the exploratory nature of this study and the small size of the OAA-registered subgroup (n = 17), all analyses should be interpreted as descriptive and hypothesis-generating rather than inferential or generalizable. Readers are cautioned against over-interpreting fine-grained differences within the OAA subgroup, as the small sample limits statistical reliability.

Survey Instrument and Measures

The survey instrument comprised demographic and accommodation-related questions, as well as multiple Likert-scale item sets designed to measure perceptions of accessibility in learning environments. Demographic questions included academic year and field of study, which allowed the analysis to contextualize accessibility perceptions across different stages in the academic pathway and across disciplines. Additional questions captured whether students were registered with OAA and included items assessing disability type and mobility aid use.

The dataset included two different Likert-scale components. The first component focused on disability-specific learning experiences and accessibility challenges. These items measured perceptions of physical classroom accessibility, the accessibility of instructional materials, faculty awareness of accessibility needs, lab accessibility, accessibility of lab assignments, the quality of support provided by instructors and teaching assistants, and perceptions of inclusion and belonging in STEM. Responses followed a five-point Likert structure, with values ranging from strongly negative to strongly positive. However, because these questions were most relevant to students with direct accommodation needs, they were answered by a smaller subset of respondents, which resulted in a reduced analytic sample for the disability-specific block.

The second Likert component was aimed at campus-wide awareness and attitudes regarding accessibility services and learning inclusivity. These items assessed whether students were aware that the university offers disability services, whether they knew how to request accommodations, whether they believed STEM classrooms and labs were physically accessible, and whether they believed students with disabilities face greater difficulty in STEM settings, including laboratory environments. Several items also addressed fairness perceptions related to exam formats and institutional support. This block was answered broadly and therefore provided a larger sample for statistical inference and scale-based analysis.

Data Preparation and Cleaning

The raw dataset required cleaning and standardization prior to analysis, as responses were recorded in mixed formats across items. Several Likert responses were stored as text strings such as "Strongly agree," "Neutral," and "Strongly disagree," while other responses were numeric. To enable consistent quantitative analysis, all Likert values were recoded into aligned five-point numerical scales. Missing responses were retained as blank or null values and treated as missing data.

Statistical Analysis Strategy

The analysis relied primarily on descriptive methods to provide a clear overview of respondent characteristics and to identify patterns of accessibility perceptions. Descriptive statistics were computed for demographic variables, OAA registration status, disability categories, and Likert response distributions. These descriptive results were used to establish baseline context and to identify key themes such as lab accessibility barriers and variation in faculty support perceptions. Consistent with the exploratory and descriptive orientation of this study, no inferential statistical tests (e.g., t-tests, regression) were used to draw causal or generalizable conclusions. Mean comparisons and frequency distributions are presented as descriptive summaries to characterize the sample rather than to make population-level inferences.

The Awareness and Attitudes items were analyzed using both a composite index approach and item-level descriptive comparisons. All Likert-scale responses recorded as text categories (“Strongly Disagree,” “Disagree,” “Neutral,” “Agree,” “Strongly Agree”) were standardized and coded numerically on a 1–5 scale (1 = Strongly Disagree, 5 = Strongly Agree). Coding direction was consistent across items such that higher values reflected stronger awareness and more positive attitudes toward accessibility services and inclusive learning conditions. Moreover, a composite index was constructed to summarize overall Awareness and Attitudes. For each respondent, the composite score was calculated as the mean of the eight standardized Likert items, producing an index that retained the original Likert interpretation (range 1–5). It should be noted that the survey instrument was developed by the undergraduate research team and has not undergone formal external validation; accordingly, findings should be interpreted as exploratory descriptions of this sample rather than validated measurements. Composite scores were then compared across groups based on registration status with the Office of Access and Accommodation (OAA). To supplement composite findings and identify item-specific patterns, item-level comparisons were conducted by calculating response distributions and mean scores for each Awareness and Attitudes question. Results were visualized using a stacked Likert chart to present the proportion of respondents selecting each agreement category across the eight items.

Results

Respondent Characteristics

A total of 147 students completed the survey. Respondents represented a range of academic years and academic majors, allowing the analysis to capture accessibility perceptions across the undergraduate progression. Representation from STEM disciplines was substantial, including students in engineering and science-related programs. Since the survey addresses disability and accessibility experiences, the sample reflects both students with documented accommodation needs and students without registration, providing a broader lens on the campus environment.

As illustrated in Figure 1, the majority of respondents are juniors (32.2%), followed closely by sophomores (28.8%) and freshman (24%). Note that although the legend for Figure 1 includes a graduate student category, the percentage for this group is not visibly labeled in the figure due to the small proportion of graduate respondents in the sample. This distribution shows how accessibility and inclusion are necessary within all levels of undergraduate programs.

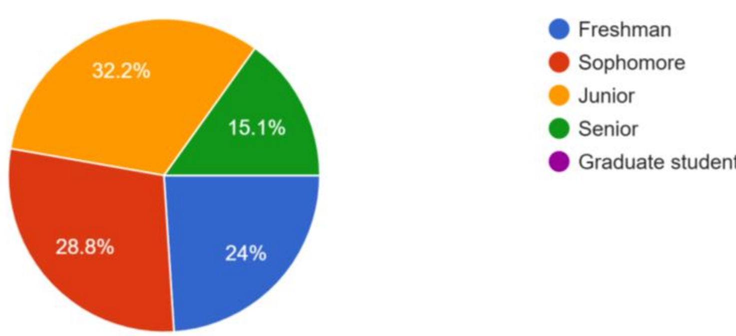

Figure 1. Distribution of Academic Level

Across the sample, a majority of students were not registered with the Office of Access and Accommodation. 17 students indicated that they were registered with OAA, accounting for approximately 11.6% of responses, while 130 students (88.4%) reported that they were not registered (Figure 2). This pattern is noteworthy because it highlights how disability service engagement represents a relatively small portion of survey respondents, even in a study focusing on accessibility. This does not imply that disability prevalence is low, as disability is often underreported in higher education settings; rather, it suggests that registration is selective and may reflect systemic barriers to formal engagement.

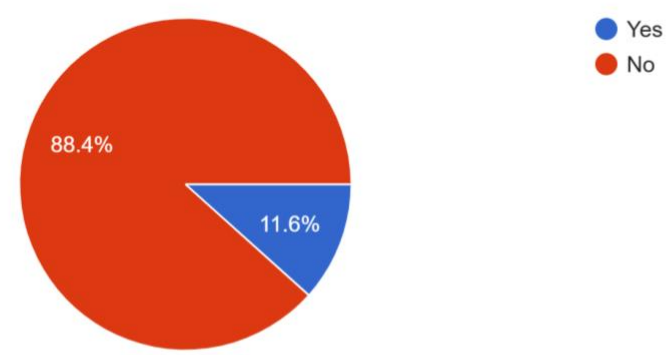

Figure 2. Registration Distribution

Disability Profile of Respondents

As shown in Figure 2, among respondents who identified as having a disability or selected disability categories, the most commonly reported disability types were learning disabilities, mental health disabilities, and chronic health conditions. This distribution is consistent with national patterns in higher education, where invisible disabilities are more prevalent than visible or mobility-related disabilities. The prominence of learning and mental health disabilities is especially important in STEM settings, where curricula often involve high cognitive load, intense scheduling, and frequent examinations. These contexts can increase the relevance of accommodations such as extended test time, alternative exam environments, note-taking support, flexible attendance policies, and accessible instructional materials.

Responses also included information related to mobility aids, although this category appeared less frequently. This reinforces the importance of approaching accessibility as a multidimensional challenge involving physical space, instructional design, and assessment systems, rather than defining accessibility primarily in terms of building infrastructure.

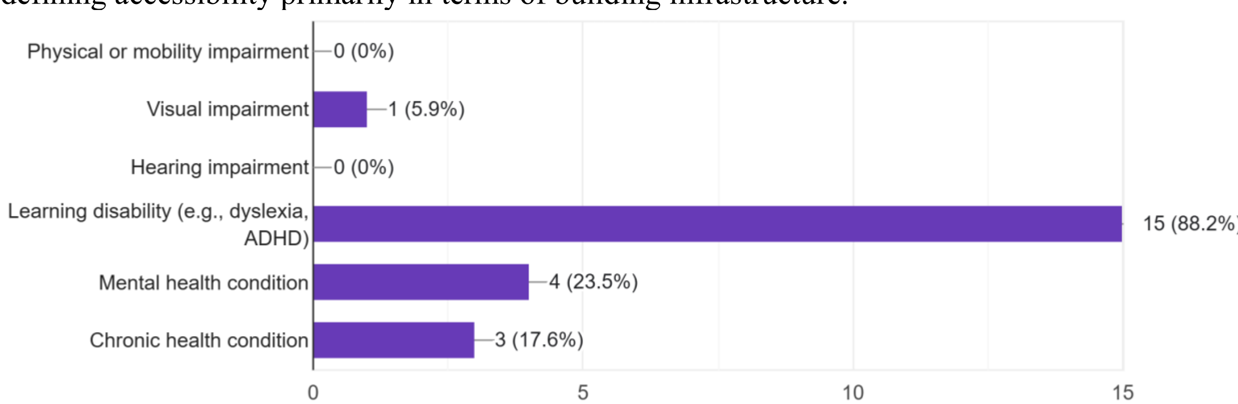

Figure 3. Disability Distribution

Students Registered with OAA Demographics

The data collected provides insight into student demographics and accessibility within the school. The majority of respondents were within the engineering field, followed by science majors, and then business majors. The distribution demonstrates the broad need for accessibility within all programs at the school. Important note on interpretation: The OAA-registered subgroup consists of only 17 respondents. All results presented in this section should be interpreted as descriptive observations about this specific sample. Percentages derived from n = 17 represent only one or two individuals per response category, and readers are cautioned against drawing broad generalizations from these figures. Figure 4 shows that the majority of students registered with OAA feel that classroom buildings at the university are physically accessible, and the majority of the students rated this a 4 (29.4%) or 10 (58.8%), indicating that there is still some room for improvement regarding the physical accessibility level of the buildings.

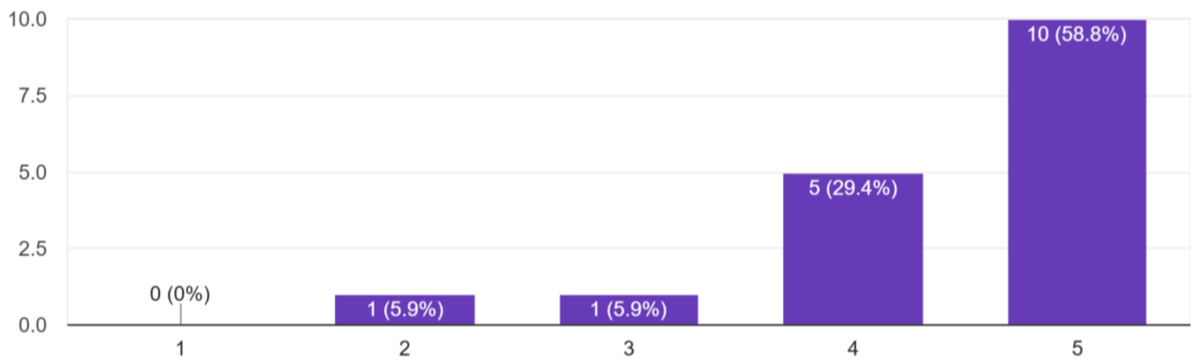

Figure 4. Classroom Building Accessibility Rating

Figure 5 shows the accessibility rating of classroom materials. The majority of students rated this a 4 (47.1%) or 5 (35.5%), indicating that the students feel that the materials are made accessible for them. The remaining students rated this a 3 out of 5, meaning there is room for improvement.

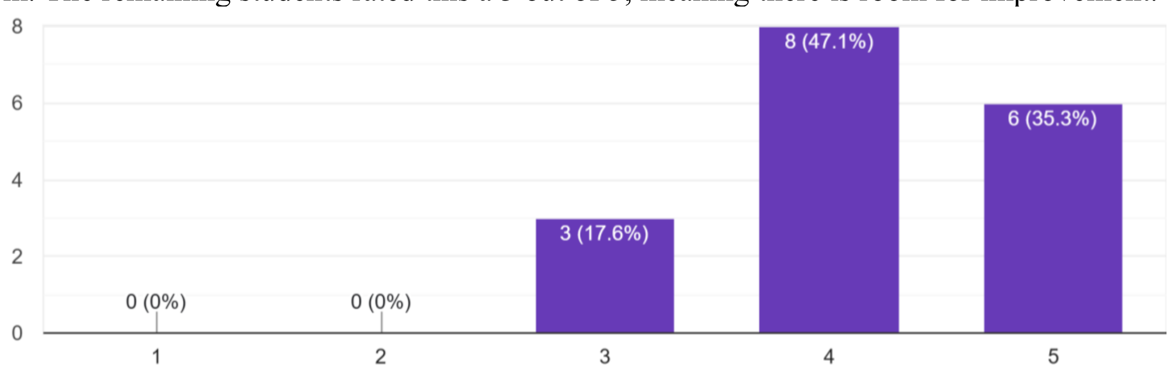

Figure 5. Classroom Material Accessibility

As shown in Figure 6, 35.3% (4/5) and 29.4% (5/5) of OAA students reported that professors and faculty have been made aware of accessibility needs. The remaining 29.4% of students demonstrated that professors and faculty are not aware of their accessibility needs. This scoring does not depict whether the classroom has been made accessible, but whether they are aware.

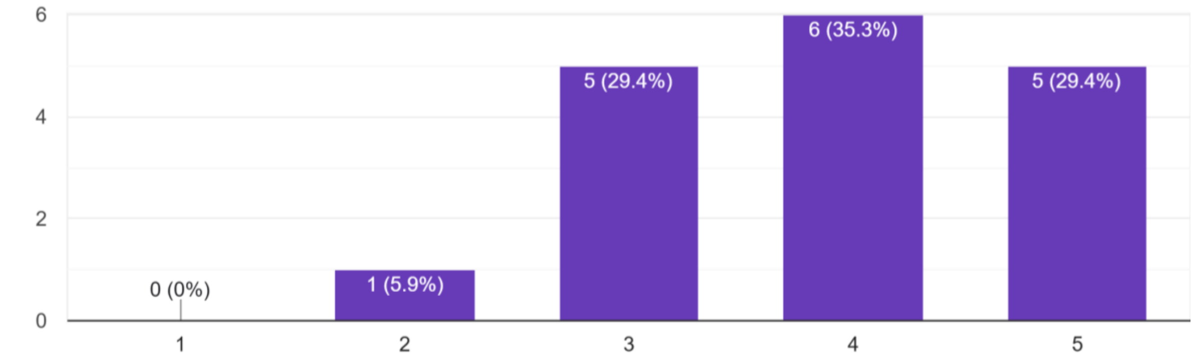

Figure 6. Professor Awareness regarding Accessibility Needs

Figure 7 demonstrates OAA students' awareness and acceptance of their peers' disabilities. The majority of students rated this 4 out of 5, indicating they feel accepted by their peers. The rest of the students rated this a 2 out of 5, indicating that they could improve their acceptance of students with disabilities.

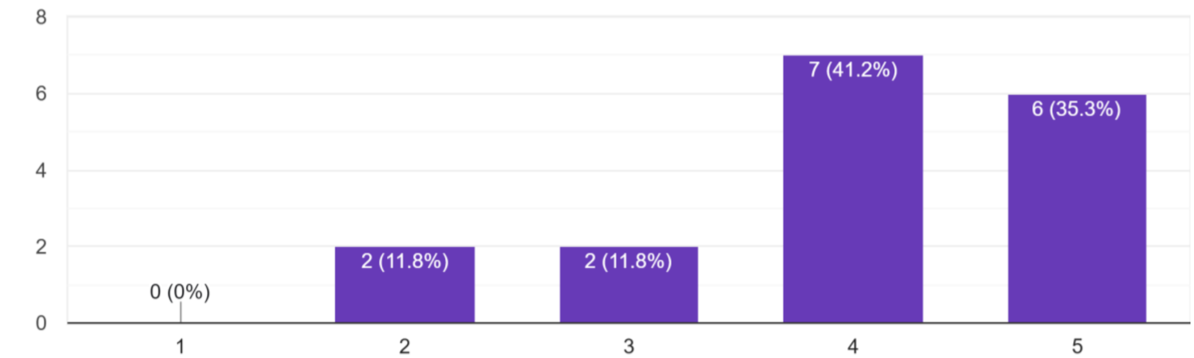

Figure 7. Student Acceptance

Figure 8 shows the OAA students' opinion on the accessibility of laboratory spaces and equipment. The majority of students (52.9%) mentioned that the laboratory spaces are physically accessible to them. The remaining students rated this category as a failure since the spaces are not accessible to them

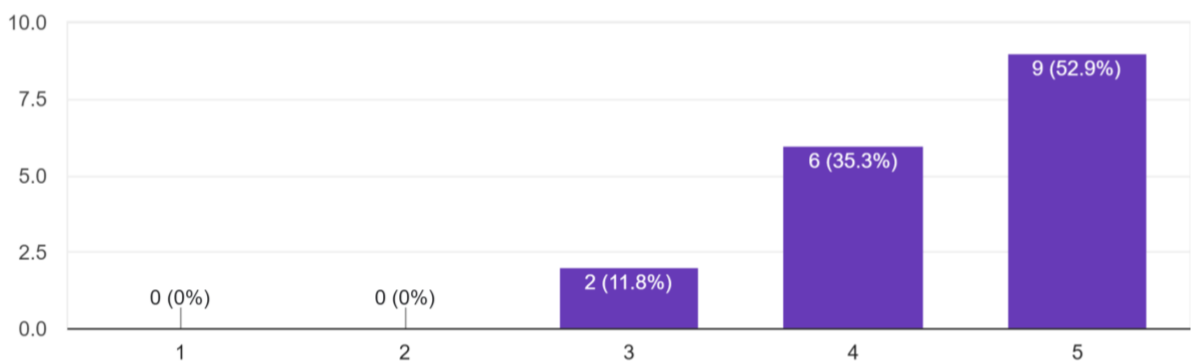

Figure 8. Laboratory Accessibility

Figure 9 shows whether the lab assignments are accessible. 70.6% of OAA respondents rated the assignment as a 5 out of 5, meaning that the assignment is accessible to them. This could be targeted as an area for improvement in the school's future operations.

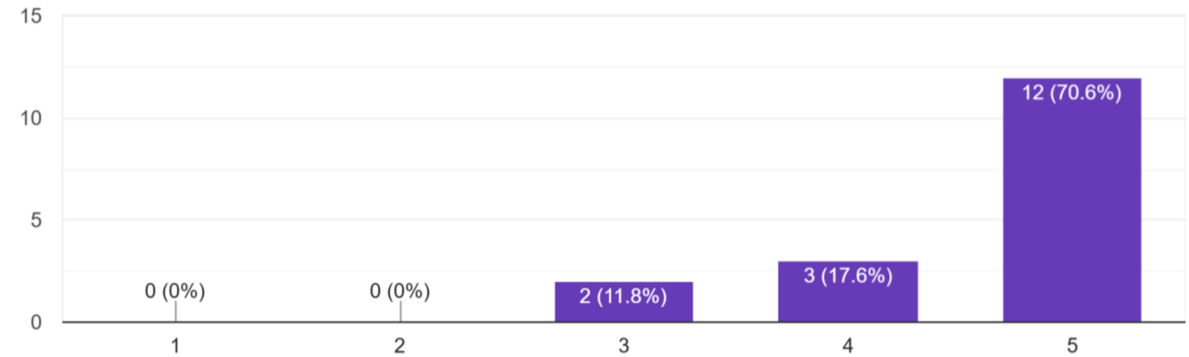

Figure 9. Lab Assignment Accessibility

Figure 10 depicts the support given by the lab instructors or teaching assistants. 23.5% of OAA respondents chose the 3 out of 5 options, meaning that they do not fully agree with the statement that the lab instructors or teaching assistants fully support them. Based on this, there is room for improvement either in the training or the protocol that they follow.

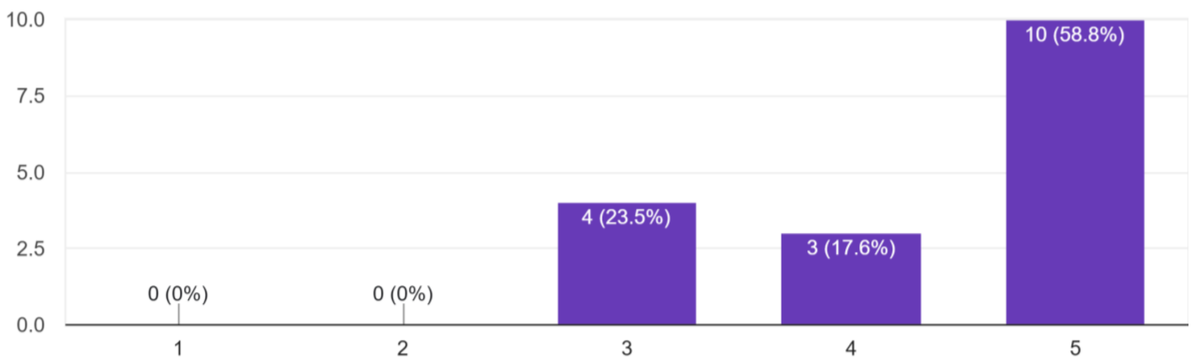

Figure 10. Lab instructor and teaching assistant support

Figure 11 shows whether OAA students believe the Office of Access and Accommodation can support their academic needs. 47.1% found that the office supported their needs, while only about 23.5% indicated there is room for improvement.

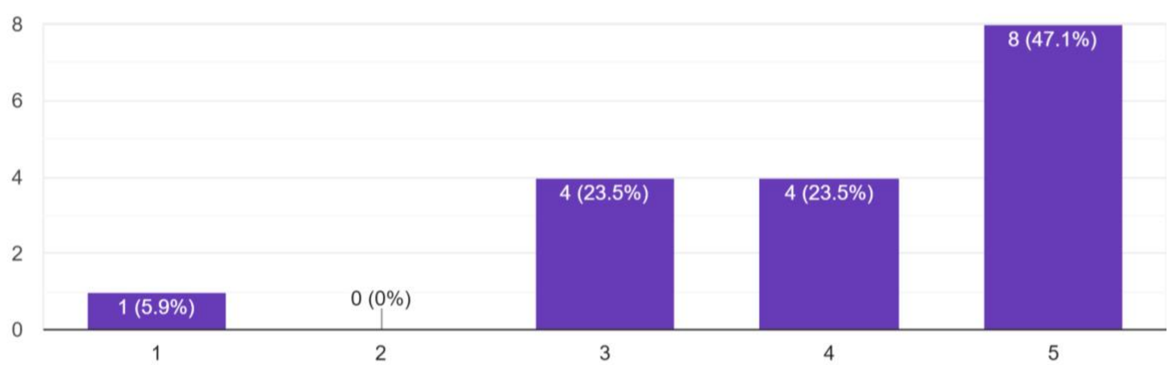

Figure 11. Support given by the Office of Access and Accommodation

Figure 12 shows how well the university communicates its way of helping and providing support to the OAA students. 29.4% of students rated this a 3 out of 5, meaning that there is still room for improvement in the university's communication.

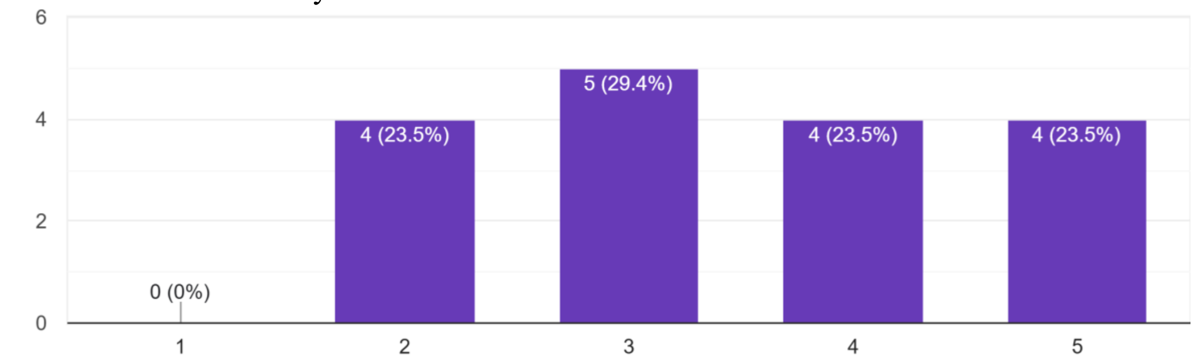

Figure 12. University Communication

Figure 13 shows whether faculty and staff are interested in improving accessibility and inclusivity for students. The majority of OAA students, 88.2%, rated this highly, so there is minimal room for improvement.

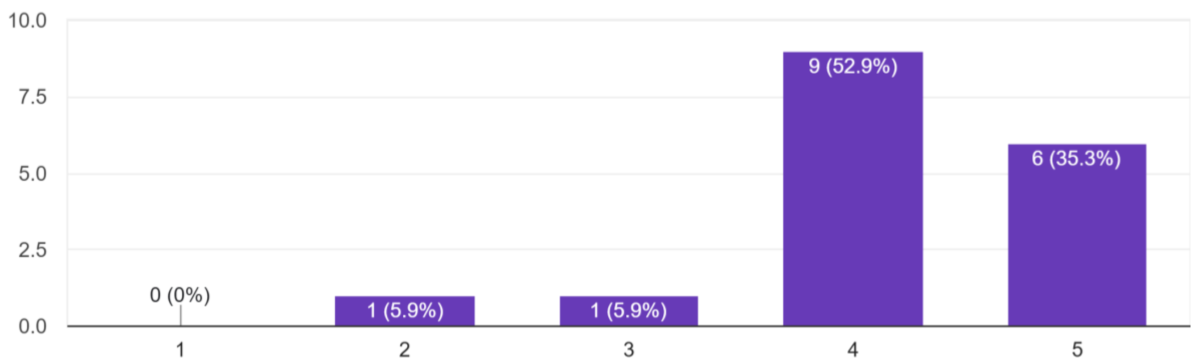

Figure 13. Faculty and Staff Interest

Figure 14 demonstrates the inclusivity of STEM programs. Most students rate it a 3 or higher out of 5, while 5.9% rated it lower, indicating that inclusivity could be improved.

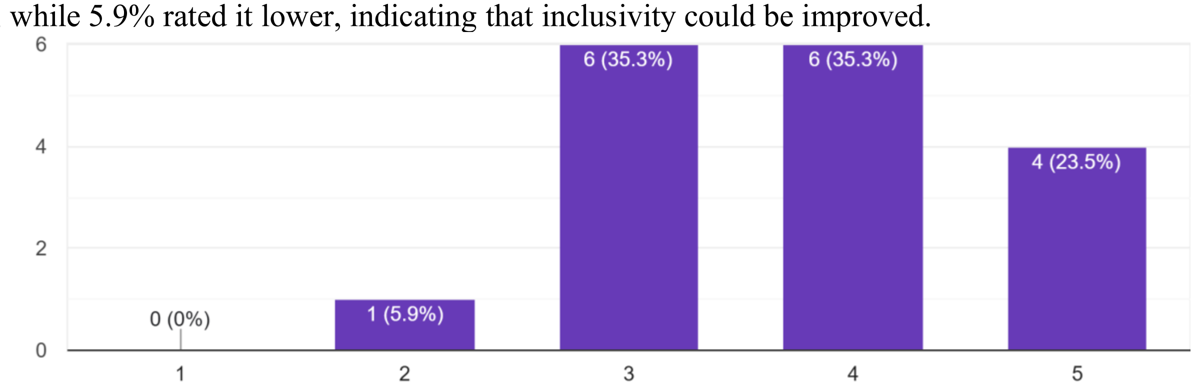

Figure 14. STEM Program Inclusivity

The main barriers reported by students with disabilities in STEM programs were difficulty concentrating or understanding instructions. Additional barriers were due to health conditions or miscommunications with OAA. The recommendations to address these barriers focused mainly on making explanations and communication clearer. Given that this section draws on responses from only 17 OAA-registered students, these findings should be interpreted with caution as descriptive observations rather than statistically reliable conclusions. Readers should avoid over-interpreting fine-grained differences within this subgroup.

Students Demographics

Most students responded that their own participation in research or advocacy did not influence their experiences as a student with disabilities and that they do not have a mobility aid. Figure 15 was based on students' awareness of the university's accessibility services. 53.4% of students reported being aware of the services the university offered, while only 0.7% reported not being.

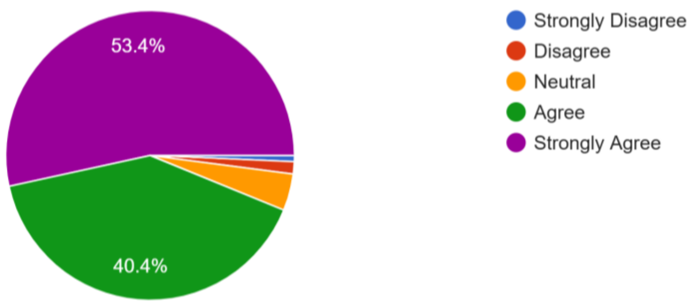

Figure 15. Student Awareness

Figure 16 demonstrates whether students know how to access these accommodations. Roughly 65.7% of students reported being aware of how to request academic accommodations, and only 2.7% mentioned being unaware.

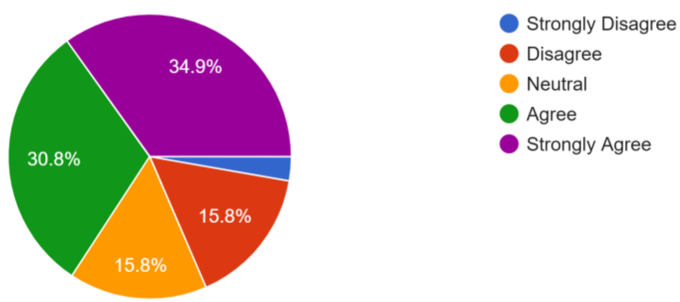

Figure 16. Requesting Accommodations

Figure 17 shows whether students believe that their classrooms and laboratories are physically accessible. About 76.7% of students believe that the school's STEM facilities are accessible, while the remaining students are neutral on this topic.

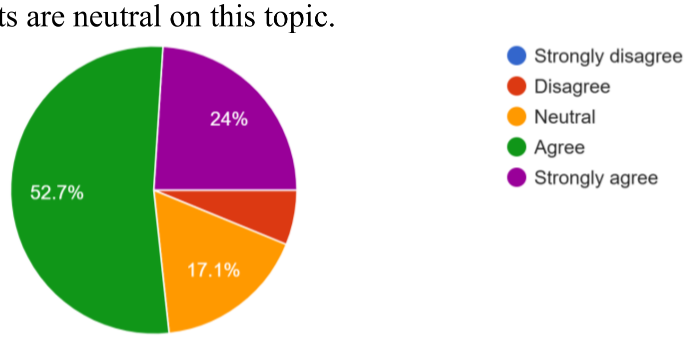

Figure 17. Laboratory and Classroom Accessibility

Figure 18 analyzed whether students with disabilities face more challenges in STEM courses. 43.2% of students believe that students with disabilities are likely to face more academic challenges in STEM courses than others. Roughly, 26.7% of students remained neutral on this topic.

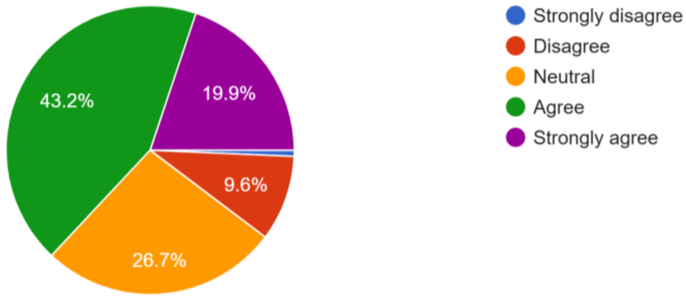

Figure 18. STEM Courses vs Others

Figure 19 depicts whether students know the purpose of academic accommodation. Most students (91.8%) mentioned that they understand the purpose of academic accommodations, meaning the program is well known across the university campus.

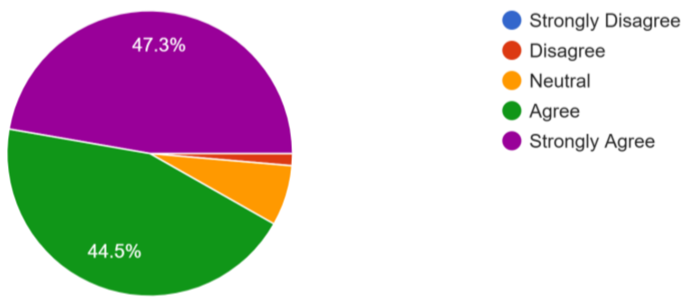

Figure 19. Purpose of Academic Accommodation Knowledge

Figure 20 depicts whether the student believes that their department can support students with disabilities. The majority of students (80.2%) felt confident that their respective departments would be able to meet the needs of students with disabilities.

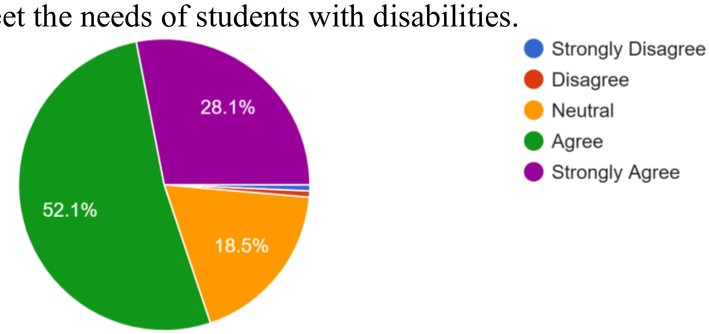

Figure 20. Department Confidence

Figure 21 demonstrates whether students believe that students with disabilities experience more difficulty in lab sessions. 69.9% of students believe that students with disabilities experience more hardships and the remaining 21.9% remained neutral on the topic.

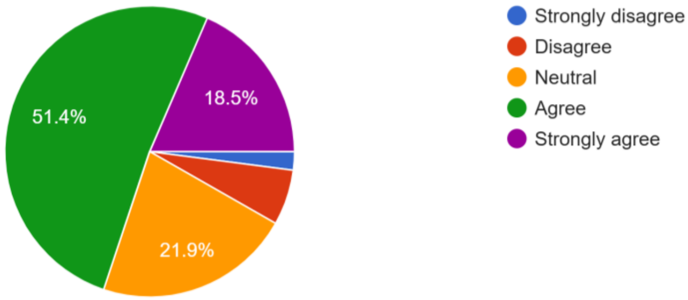

Figure 21. Student Hardship in Laboratories

Figure 22 analyzes student opinions on the exam format in STEM classes. 63.8% of students believe that the exam formats are equally fair for students with and without disabilities. Roughly 27.4% of students remained neutral on the topics, while the remaining students believed that the exam formats were not equally fair to all students.

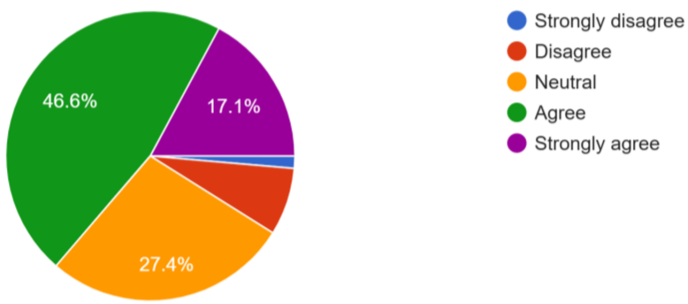

Figure 22. Exam Format

Most students did not express specific changes to make STEM classes more inclusive. There were general suggestions for the professor to allow more accommodations or increase group participation. However, many responses indicated that they believe the classes are accessible in their current form.

Accessibility Experiences in STEM for Students with Accommodation Needs

The disability-focused accessibility block revealed meaningful patterns among students who reported accommodation-related experiences. Students generally rated classroom physical accessibility positively, suggesting that the basic infrastructure of instructional spaces is reasonably functional for students with mobility limitations. However, responses became more mixed as questions shifted from physical spaces to instructional and institutional practices. Course material accessibility received comparatively positive ratings, indicating that many instructors provide usable slides, notes, and digital learning materials. Still, variation in responses suggests that accessibility practices are not uniformly implemented across departments or courses.

One of the most important findings emerged in responses related to laboratory accessibility. Compared to lecture settings, laboratories were rated with greater variability and lower mean scores. Students' perceptions suggest that labs present unique barriers, which may stem from tight spatial layouts, fixed lab equipment heights, procedural requirements, limited flexibility in task completion formats, or lack of accessible alternatives when tasks require physical manipulation. In addition, lab participation often involves real-time collaboration and safety requirements that can constrain accommodation implementation. Perceptions of faculty awareness also varied. Some students indicated strong support and high accessibility awareness among instructors, while others gave neutral or negative responses. This suggests that student experience depends heavily on individual instructors and course structures rather than standardized departmental practices. Support from teaching assistants and lab personnel appeared moderate, again reflecting inconsistency and the possibility that many TAs are not formally trained in inclusive teaching practices or accommodation protocols. Overall, results from this block suggest that while the university may provide meaningful structural accessibility support in many contexts, laboratories and instructional practices remain areas where barriers persist and where more consistent training and redesign may yield improvements.

Awareness and Attitudes Toward Accessibility Across the Student Body

The campus-wide awareness and attitudes block provided broader insights due to its large sample size. Students overwhelmingly reported awareness that the university offers disability services, indicating that the existence of OAA is not hidden from the community. Many students also expressed agreement that they know how accommodations can be requested, suggesting that procedural knowledge is fairly widespread. However, awareness does not automatically translate into engagement, and the low OAA registration rate implies that other factors influence whether students formally seek accommodations.

Students also expressed general agreement that STEM spaces are physically accessible, although responses were less concentrated at the highest agreement levels, suggesting that many students perceive accessibility as moderate rather than fully effective. A substantial portion of respondents believed that students with disabilities face additional challenges in STEM environments, particularly in laboratory sessions. This is a meaningful finding because it indicates general recognition among peers that disability-related barriers exist. Such recognition may support campus efforts aimed at institutional culture change and the normalization of accessibility as a collective responsibility.

Perceptions related to fairness of exam formats were more mixed. Some respondents agreed that exam formats are equitable, while others disagreed or selected neutral responses. This suggests that assessments may not consistently provide accessible pathways for students with different learning needs. In STEM courses, where exams often emphasize time pressure and procedural fluency, fairness perceptions are particularly relevant to educational equity and inclusive pedagogy.

Composite Index Findings

To improve interpretability of the Likert-scale results, a composite index was created using the survey's campus-wide accessibility awareness and attitudes items. All Likert responses were first converted into a numeric scale ranging from 1 to 5, where Strongly Disagree was coded as 1 and

Strongly Agree as 5. For each respondent, the composite index was calculated as the mean value across the eight items, producing a final composite score that retained the original Likert interpretation (values closer to 5 indicate stronger awareness and more positive attitudes toward accessibility and accommodation-related support). The composite findings indicate generally positive awareness and attitudes across the sample. Students registered with the Office of Access and Accommodation reported a higher composite score (mean = 4.26) compared to non-registered students (mean = 3.94). This suggests that students who directly engage with accessibility services tend to report greater awareness and more positive attitudes about accessibility processes and support structures, likely due to lived experience navigating accommodations and interacting with instructors and institutional systems.

Item-Level Comparisons (Awareness and Attitudes Items)

Item-level analysis revealed meaningful variation across the accessibility awareness and attitudes questions, with some domains showing consistently strong agreement and others showing greater uncertainty. The highest agreement was observed for awareness and conceptual understanding items. Students strongly agreed that the university offers accessibility and accommodation services (mean = 4.44) and that they understand the purpose of academic accommodations such as extra time, note-taking support, and accessible lab settings (mean = 4.37). These results suggest that students broadly understand the services and the general rationale behind accommodations.

In contrast, items related to operational knowledge and perceived fairness produced lower mean scores. Students reported weaker agreement when asked whether they know how to request accommodation (mean = 3.80), indicating that procedural knowledge is less consistent than general awareness. Several items also reflected uncertainty about STEM learning conditions and assessment structures. Students were less likely to strongly agree that students with disabilities face more academic challenges in STEM (mean = 3.71) and that exam formats in STEM classes are equally fair for students with and without disabilities (mean = 3.70). Perceptions related to laboratory difficulty were slightly higher but still not strongly affirmative, with students agreeing that students with disabilities may experience more difficulty during lab sessions (mean = 3.78). Together, these item-level results suggest that while accessibility services are widely recognized and accommodations are generally understood in principle, students show less certainty regarding implementation processes, fairness of assessment formats, and the extent of STEM-specific barriers, particularly those associated with exams and laboratories.

Discussion

This study examined accessibility-related experiences and perceptions among university students, with a focus on learning conditions in STEM programs. The results provide several meaningful insights about current strengths and continuing gaps in institutional accessibility. A key strength observed in the findings is the high level of general awareness and positive attitudes toward accommodation among the student body. Most respondents reported awareness of the university's accessibility services and indicated that they understood the purpose of academic accommodations. This suggests that disability services are visible on campus and that accommodations are generally recognized as legitimate mechanisms to support learning rather than as exceptions to academic standards. From an educational perspective, this awareness is important because a supportive peer environment can improve students' willingness to seek accommodations and normalize accessibility as part of standard learning design. This finding is consistent with prior work by Reinholz and Ridgway [1], who argued that normalizing access talk in STEM contexts is essential to disrupting ableist norms, and with Landgren and Borrego [5], who similarly found that students in engineering programs recognize the value of accommodations even when institutional structures fail to deliver them consistently. The present study confirms this pattern and extends it by documenting the specific institutional domains, particularly laboratory settings and faculty training, where normalization of accessibility remains incomplete.

At the same time, the study also reveals a meaningful gap between awareness and direct engagement with services. Only 11.6% of respondents reported being registered with OAA. This finding should not be interpreted as a low prevalence of disability in the student population. Instead, it likely reflects broader dynamics documented in prior research, including the under-disclosure of disability, perceived stigma, and uncertainty about the administrative process required to access accommodations [7], [8], [9]. Even in environments where services exist, students may delay formal registration until academic difficulties become severe, which can increase stress and reduce academic confidence. This pattern illustrates a key form of normalized institutional violence: systems that are formally available but structurally inaccessible reproduce exclusion as effectively as systems that never existed. Toutain [9] documented similar barriers to accommodation uptake in higher education broadly, while Munjanja and Hendricks [8] found that institutional messaging and climate significantly shape whether students feel safe disclosing disability status. The present findings confirm these dynamics within a STEM context and underscore that addressing the registration gap requires not only procedural clarification but also an active cultural shift within departments. This gap reinforces the importance of accessible communication and proactive institutional messaging that supports students before barriers significantly impact performance.

Laboratory accessibility emerged as one of the most consistent areas where disability-related barriers remain visible. In the subset of students registered with OAA, laboratory spaces and equipment received lower ratings than many classroom-related factors, demonstrating that physical space and lab design still pose challenges. In the broader student sample, many respondents indicated that students with disabilities experience more difficulty in lab sessions. Together, these results align with the broader literature, which emphasizes that laboratories often pose a unique accessibility challenge due to fixed layouts, equipment constraints, procedural expectations, and safety protocols. In practice, even as lecture environments improve through digital materials and flexible delivery, lab participation can remain limited unless universal accessibility is incorporated into equipment design, layout, and activity structure.

Another important theme in the findings is variability in faculty awareness and implementation of accessibility needs. OAA-registered students did not consistently report that faculty and instructors were aware of their accessibility needs, and a portion of respondents rated this area notably lower than other items. This suggests that accessibility experiences may depend heavily on instructor-level practices rather than standardized protocols. Although many students rated faculty and staff interest in improving accessibility highly, there remains room for institutional improvement in training faculty and teaching assistants on accommodations, particularly in laboratory contexts where accommodations require more active instructional planning. This finding is significant for

STEM programs because small differences in course structure, lab communication, or assessment format can have disproportionate impacts on students who need accommodations. These findings align with Yokota et al. [18], who found that targeted training significantly improved faculty attitudes toward disability, and with Sedláčková et al. [19], who documented that faculty awareness and curriculum flexibility were critical enablers of inclusion for students with physical disabilities in mainstream educational settings. The present study confirms that inconsistency in faculty preparedness is not unique to this institution but reflects a systemic pattern across engineering and STEM programs. Concretely, departments can address this by: (1) incorporating disability inclusion modules into faculty onboarding and annual professional development; (2) establishing clear written protocols for how TAs in laboratory sections should respond to accommodation letters, including procedures for modifying lab tasks, timelines, or partners; and (3) creating a point of contact within each department separate from OAA who can serve as a local resource for faculty with questions about implementing accommodations. These steps would shift responsibility from individual students disclosing their needs repeatedly to each instructor, and toward a more systematic, institutionally supported model of access.

The composite index findings support an additional conclusion: students registered with OAA reported greater awareness and more positive attitudes on the awareness/attitudes scale than non-registered students. This pattern likely reflects the value of direct engagement with the accessibility support system. Students who navigate accommodation processes and communicate with OAA may develop a clearer understanding of institutional procedures and become more confident in their ability to access support. The index results, therefore, suggest that expanding clarity on how to request accommodation could improve overall student confidence, particularly among students who are not yet registered or are hesitant to engage.

Finally, the study provides practical insight into the most frequently reported barriers by students with disabilities in STEM programs. Students identified difficulty concentrating or understanding instructions as key barriers, along with communication challenges and health-related constraints. These findings highlight that accessibility is not solely physical; it also involves clarity of instruction, course structure, and communication systems. Improving accessibility may therefore require a combination of physical space improvements, instructional design refinement, and consistent faculty training to ensure that accommodations are implemented smoothly and effectively. These barriers, cognitive overload, unclear communication, and lack of flexible instruction, are not random or incidental. They are the predictable outcomes of institutional structures in STEM education that were designed around a narrow norm of the "standard" student, leaving disabled students to navigate environments that were not built with them in mind. Confronting and redesigning these structures is not merely a matter of compliance or accommodation; it is an act of institutional accountability. This study contributes to that project by naming the specific points of friction in labs, faculty training, and procedural clarity where structural reform is most urgently needed.

Overall, the results indicate that the campus environment demonstrates meaningful strengths in awareness and general attitudes toward accommodations, but persistent barriers remain in laboratory access, procedural clarity, and consistency in faculty preparedness. These issues reflect challenges that are common across STEM education, suggesting that accessibility improvements should focus on the highest-impact learning spaces (labs) and on the systems that support consistent implementation of accommodations across courses.

Conclusion

This study investigated perceived accessibility barriers and support conditions experienced by students with disabilities in STEM learning environments, using survey responses collected during Fall 2025. A total of 147 valid student responses were analyzed, including both students registered with the Office of Access and Accommodation (OAA) and students not registered with OAA. The results indicate that students generally show strong awareness of disability services and high understanding of the purpose of academic accommodation. In addition, many students expressed confidence that academic departments can support students with disabilities. Despite these strengths, several areas require continued improvement. Engagement with OAA services was limited in the sample, with only 11.6% of respondents indicating formal registration, highlighting that disability support systems may still be underutilized even when awareness is present. Laboratory environments also emerged as a key accessibility challenge, as both OAA-registered students and the broader student body expressed concerns about lab difficulty and accessibility.

These findings suggest that lab design, lab instruction, and support protocols should be prioritized in STEM accessibility planning. Variability in responses regarding faculty awareness and instructional support further indicates that accessibility experiences may depend on course-level implementation rather than on consistent institutional practice. To improve accessibility for students with disabilities in STEM, institutions should consider strengthening communication about accommodation procedures, enhancing training for faculty and teaching assistants in implementing disability support, and adopting more accessible laboratory design principles. More specifically, actionable recommendations for faculty and departments include: (1) Faculty should review accommodation letters at the start of each semester and develop a written implementation plan for their specific course format, rather than waiting for students to repeatedly self-advocate; (2) Departments offering laboratory courses should conduct annual accessibility audits of lab spaces and equipment and identify at least one structural modification per cycle; (3) Teaching assistants should receive structured disability inclusion training before leading lab sections, covering how to maintain safety protocols while honoring accommodation needs; (4) Departments should designate an accessibility liaison who can support colleagues in navigating accommodation implementation; and (5) Accommodation procedures should be proactively communicated through course syllabi, department websites, and advising meetings to reduce the information burden placed on disabled students. These steps represent a shift from a reactive, student-driven accommodation model toward a proactive, institutionally embedded approach to inclusive STEM education, one that directly confronts the normalized structural barriers this study has documented. Future research should expand this work through multi-institutional data collection, larger student sample sizes receiving accommodations, and mixed-method approaches, such as interviews or focus groups, to better capture the lived experiences behind survey responses. Future studies should also incorporate faculty and administrator perspectives, to identify gaps between student-reported experiences and institutional intentions, and to investigate what conditions enable consistent accommodation implementation across courses and departments. Overall, this study demonstrates that accessibility in STEM education involves both physical and instructional dimensions, and that continued effort is needed to ensure learning environments support student success across diverse disability-related needs. More broadly, this study is an exercise in interrogating and confronting the institutional structures of engineering education, structures that have long normalized ableist assumptions about who belongs in STEM and what constitutes a “standard” learning environment. Achieving genuine inclusion requires not just accommodating individual students within existing structures, but critically examining and redesigning those structures so that exclusion is no longer their default outcome.

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