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Exploring the Engineering Classroom Experiences of Students with Non-Apparent Disabilities

Darby Rose Riley, Rowan University

Darby Riley is a doctoral candidate pursuing her third consecutive degree at Rowan University (Glassboro, NJ). Her research focuses on identity development in engineering education—specifically, how engineering students construct their sense of self through their academic journey and how personal identities shape this process. As a disabled researcher, she brings both academic and lived experience to her work, with a particular interest in how students with disabilities navigate the engineering field.

Heather Malino, Rowan University
Miss Cara Mawson, Rowan University

Cara is a graduate student pursuing her Ph.D. in Experiential Engineering Education (ExEEd) at Rowan University.

Cassandra Sue Ellen Jamison, Rowan University

Cassandra (Cassie) Jamison is an Assistant Professor in the Experiential Engineering Education Department at Rowan University (Glassboro, NJ). Her research interests focus on understanding and improving the learning that occurs in experiential, out-of-class activities for engineering students. Cassie previously received a B.A. in Engineering Sciences at Wartburg College (Waverly, IA) and her M.S. and Ph.D. degrees in BME from the University of Michigan (Ann Arbor, MI).

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Abstract

In this WIP research paper, we explore the engineering education experiences of students with non-apparent disabilities (NADs), centering the classroom as a terrain of struggle and a site of possibility.Students discussed disabilities impacting their learning, mental health, development, or cognition in semi-structured interviews. Previous research indicates that a lack of understanding and accommodation from engineering professors contributes to the mental health challenges of students, while faculty members seek support to improve their disabled students' experiences. This study focuses on the external barriers to success that students face in the classroom, addressing three key questions about the challenges students with NADs face in engineering classrooms, the elements of a classroom that contribute to those challenges, and the instructor strategies students recognize as supportive. The results represent the experiences of six undergraduate engineering students with various cognitive and emotional disabilities. These students reported challenges in managing their NADs while taking a full course load, navigating disclosure considerations, and interacting with others. The analysis captured the diverse needs and preferences of students regarding coursework and course structure and highlighted both positive and negative perceptions of multiple academic practices (e.g., group work). Preliminary themes about the qualities of supportive professors were also identified. Overall, this study presents themes that capture the experiences of students with cognitive or emotional NADs in engineering courses. It suggests that students observe indirect cues from professors indicating their willingness to support NADs and emphasizes the importance of professors making a proactive effort to voice support for accommodations. The diversity of the six students' experiences highlights the need for further research and concrete actions to support students with NADs in engineering education.

Introduction

Creating an inclusive environment for all students, including those with non-apparent disabilities (NADs), is an ongoing challenge in engineering education. NADs—such as autism, ADHD, learning disabilities, and anxiety disorders—can impact learning and mental health, while often remaining “invisible” to instructors and fellow classmates. Research shows that student-professor interactions significantly affect the educational experiences of students with NADs [1]-[2]. However, while STEM faculty generally express a desire to support these students [2], there still exists a gap in understanding for these instructors which can exacerbate the challenges faced by students with NADs [1]. Given that one in five students has at least one disability [3], understanding and improving the educational experiences of disabled students in engineering is essential. This study uses semi-structured interviews and inductive thematic analysis to explore the experiences of students with NADs in engineering education. It addresses three key questions: *(1) What challenges do students with NADs face in engineering classrooms? (2) What classroom elements are associated with these challenges? (3) What strategies do instructors use that benefit students with NADs?*

Background

Despite the rising presence of Diversity, Equity, and Inclusion (DEI) initiatives in engineering education spaces, these initiatives often fail to fully include disabled students [4]. There is a need for a critical analysis of DEI efforts to address the needs of disabled students better. Inclusive campus design, language, and faculty training are essential to foster a sense of belonging and reduce dropout rates [5]. Comprehensive DEI initiatives should reflect the needs and experiences of disabled individuals; however, students with disabilities may have vastly different—or even contradictory—needs. For example, prior research has found that testing accommodations and supportive environments are particularly effective in closing the achievement gap for students with learning disabilities in higher education [6]. Conversely, other research in the field has found that presuming student competence and encouraging students to self-advocate can improve sense of belonging, and therefore retention [7]-[8]. Therefore, it is important to examine disabled students not as a monolith, but rather as a diverse population with greatly varying needs.

Of the existing studies regarding disabled students in higher education, few of them focus on engineering students specifically [9]. It has been shown in previous research that the engineering educational environment is unique amongst other college majors, and even amongst other STEM majors [10]. Within an engineering context, systemic ableism presents significant challenges for students with disabilities [11]. Many aspects of engineering culture—such as the normalization of stress, elitism, classroom depoliticization, and rigid exam formats—negatively impact student mental health and exacerbate anxiety [1], [12]. Therefore, it is likely that engineering students with disabilities face different or greater challenges than their non-engineering peers.

Non-apparent disabilities (NADs), such as ADHD, autism, and anxiety disorders, present unique challenges often overlooked due to their "invisibility." Prior work highlights the importance of recognizing and addressing the barriers faced by students with NADs [13]. However, there is still a reluctance of students in higher education with NADs to disclose their conditions due to fears of stigma and discrimination in their academic, personal, and professional pursuits [14]. This non-disclosure negatively impacts academic performance and mental health. A crucial area for creating an inclusive learning environment is building faculty awareness of these students' experiences. Our current research aims to bridge these gaps by exploring the experiences of undergraduate engineering students with NADs. This study delves into the challenges these students face and beneficial strategies, informing inclusive practices in engineering education by using semi-structured interviews and thematic analysis.

Methods

To address our research questions, we conducted 90-minute semi-structured interviews with undergraduate engineering students from a single mid-sized Mid-Atlantic university. Students self-identified as having a non-apparent disability, with no formal diagnosis or other documentation required to participate.

Data Collection

Interview questions were developed to focus primarily on students' experience in engineering classrooms, and were generally grouped based on research question. Interviews began by asking

students to describe where they were in their engineering career (what year, what classes they were taking, etc.). Students were then asked why they chose to volunteer for the study and whether or not they had accommodations. From here, the interview became more open-ended; prompting questions included asking about the most and least challenging classes, most and least supportive professors, study habits, and particular elements of coursework (such as group work, quizzes and exams, and presentations).

Interviews were conducted in-person and recorded using a handheld recorder, then transcribed using Otter.ai. The research team reviewed and corrected the transcripts as necessary.

Data Analysis

Interviews were analyzed using an interpretive analysis [15]. In this analysis style, interviews were reviewed in their entirety and summarized using a common structure focused on the research questions. This summary structure identified the accommodations each student used and their overall opinion of these accommodations, the in-class activities mentioned and each student's overall impressions of each activity, the student's experiences with professors both in and out of the classroom, and any other miscellaneous strengths and challenges the student described. These summaries were composed almost entirely of student quotes, with researchers only providing organizational or contextual text when necessary.

With the summaries composed, a two-cycle inductive coding process began. Researchers reviewed the summaries and proposed possible themes for each of the three research questions. These themes were consolidated and approved by the research team. Then, each researcher returned to two interviews and pulled quotes that matched the proposed codes, as well as any others they found relevant to the research question that were not covered by the proposed codes. For quotes regarding in-class activities, the researchers used magnitude coding to identify positive and negative associations with each activity [16]. For example, a student describing group work as a positive or enjoyable experience would be coded as 'Group Work +', while a student describing group work as challenging would be coded as 'Group Work -'. All code applications were reviewed and discussed by the full research team. Researchers then reviewed quotes by code and developed summaries of common threads (convergent analysis) and any significant, unique experiences (divergent analysis). These summaries were further divided between students with cognitive disabilities and students with emotional disabilities to identify themes exclusive to a particular type of disability.

Results and Discussion

A total of six undergraduate engineering students participated in this research study. Of these six students, three identified as having emotional disabilities (ex: anxiety and depression), and three as having emotional and cognitive disabilities (ex: ADHD and autism). Four of the participants identified as women and two as men. Due to the "small n" concerns [10] and potentially sensitive information included in this study, the researchers have decided to report the demographic data above in aggregate and to not disclose the racial identities of the participants. The remainder of this section highlights key themes observed by each research question.

What are common challenges students with NADs face in engineering classrooms?

Overall, disclosure in and of itself was a source of stress and anxiety for students. Students tended to choose not to disclose their disability to others, often describing a sense of normalcy that was retained in such cases. Students who did disclose shared stories wherein peers and mentors had small, "subconscious" shifts in demeanor or "intensity" towards the student after disclosure: "But like her face… like, I could definitely tell she looked at me completely different [sic]." These changes in behavior likely contribute to students with non-apparent disabilities (NADs) feeling othered—a common phenomenon for marginalized students in engineering which negatively impacts mental health and sense of belonging [17]-[18].

It is also important to note that, at the home institution, students must disclose their disability status to their professor to receive support. While there exist small differences in what this process looks like by institution, an accommodations request will always indirectly reveal a student's disability status, even if it does not reveal a specific diagnosis. The nuances of these interactions will be discussed further in research question three, but it is clear that there exists a direct tension between the strong motivation to disclose to receive accommodation and strong motivation to avoid disclosure to maintain privacy.

For some students, however, refusing accommodations had less to do with privacy and instead reflected their desire to prepare themselves for a workforce that might not accommodate them: "I'm trying to prepare for being in the workforce, and I'm still not sure if I want to disclose my disabilities." One student explains their choice not to request accommodations as follows:

> I feel like I'm able to be successful without them… [I]t's not like deadlines aren't gonna exist in the real world. Because that's, from what I understand, what accommodations let happen… So it would feel disingenuous, I guess, to ask for them.

It would appear that students with NADs feel pressured to keep their disability status private following graduation. It is unclear whether this pressure is related to (presumed) engineering workplace culture [19], a personal need to prove independence/competency [7], or some combination of the two.

One student participant explained that disclosure helped them find normalcy as an engineering student. After opening up to a professor about their disability, their professor helped them see that many students and instructors struggle with feelings of anxiety, depression, and imposter syndrome:

> [H]e's seen students come in and out of [engineering] that maybe felt as anxious as me or as low-confidence as me that have succeeded in the field. So that's why I went to him… Like, please tell me that I'm gonna be okay, that this is normal… there's a point where you know that it's normal, but you just need someone else to say it.

These results may indicate that, while the engineering status quo makes disclosure fraught, a positive experience with disclosure can be beneficial for a student's sense of belonging in engineering. This is in alignment with other research in the field, wherein engineering students who had their personal identities and/or needs validated by a trusted peer or mentor saw an increased sense of belonging and a greater likelihood of persistence in the program [20]-[22].

What classroom elements are associated with the challenges students with NADs face?

Our students commented on numerous classroom preferences regarding course structure which highlighted both positive and negative perceptions of academic practices. These preferences spanned long-term projects, group work, quizzes/exams, independent assignments, and assignment frequency. Overall, positive and negative perceptions of course structures varied across disability types (cognitive and/or emotional). One exception was group work, where a strong split was observed between disability types: students with cognitive disabilities found group work to be overwhelmingly positive, while students with emotional disabilities found group work to be overwhelmingly negative (with only incidental positive experiences).

Students with cognitive disabilities explained that the peer pressure associated with group work "forced" them to get work done early, breaking from their typical pattern of procrastination driven by executive dysfunction: "I'm gonna do my stuff right away, that way no one's waiting on me. Kind of like the far end extreme… So that's kind of nice with group work." In this way, the disability is made less obvious both to the student and to the team members, which might contribute to a greater sense of belonging in the engineering-dedicated space [18].

Students with emotional disabilities described group work as directly conflicting with their disability—a lack of energy made contributions more difficult, irritation or other mood fluctuations made peer-to-peer interactions challenging ("being more irritable, it makes me less understanding, I guess… because I'm already so spent"), and some students felt compelled to take on a leadership role they would have otherwise avoided due to lack of effort from teammates:

> If your group members are not fulfilling their duties, and you're struggling with your workload because of anxiety and depression, you should say, 'Hey, please do your work!'… It's hard to stand up for yourself and be confrontational and tell people what to do, and it's even harder when you're anxious about it.

In contrast to the positive experiences of students with cognitive disabilities, it seems that group work makes symptoms of anxiety and depression *more* apparent both to the student and to the student's team members:

> I feel horrible. Because my energy levels are so low, and I can't go out. But that also makes me anxious, because I'm like, what if we don't get this done on time? Like, what if they think I'm a horrible person, because I can't meet right now… I just physically can't.

These feelings of inadequacy likely contribute to the "endless cycle" described by some students where symptoms of anxiety and depression are exacerbated, thereby pushing the student further behind their peers and requiring them to "play catch-up". This may in turn contribute to a decrease in confidence or sense of belonging in engineering spaces [19], [23].

Even so, many students still expressed discomfort with disclosing their condition:

> If I were to show people that I'm struggling, that feels like a place of emotional vulnerability, and when you go to school, that's a professional relationship. I'm not really interested in being emotionally vulnerable in a professional environment.

It is clear that students with non-apparent disabilities have a complicated relationship with disclosure, and generally avoid disclosing when it is not necessary to the student's success. It is likely that these anxieties related to disclosure complicate these students' peer-to-peer relationships in the classroom—for some, working in teams can more effectively "mask" the disability, and these students have a generally favorable opinion of group work. For others, group work exacerbates these symptoms, leading to a negative association with teamwork.

What strategies do instructors use that benefit students with NADs?

In students' descriptions of in-class experiences with instructors, traits such as organization, clarity, and approachability were identified as positive. In general, students valued an instructor who made expectations clear, both when it came to learning goals and class conduct. Instructor approachability was strongly linked to a student's willingness to request support or accommodations, as demonstrated by one of our participants giving the following advice to instructors:

> If you're trying to make your classroom more accessible, the first step is being approachable and respectful of your students. Because they're not going to ask you for accommodations or try to even use their accommodations if talking to you is a chore.

One student described a particularly supportive professor who went out of their way to accommodate students who did not have official paperwork/documentation with the college: "I think he said, 'even if you don't have accommodations, I will accommodate you.'" While this has an obvious benefit for non-disabled students, this classroom policy also stands to benefit students with NADs who are nervous about disclosure. When all students are accommodated, no student is forced to disclose. This likely has an impact on students' sense of belonging in the classroom, as accommodations are no longer an othering force [24]-[26]—as one student described, "it [the professor's approachableness] made me feel so comfortable and happy."

Negative traits were less frequently described, but included stubbornness, "snarkiness", and a lack of trust in students. Participants spoke often about the way instructors introduced themselves on the first day of class, using this first impression as well as their description of their accommodations policy as a litmus test for their willingness to accept accommodations requests from their students with disabilities. One participant described feeling that their instructors view using accommodations as cheating:

> [Professors] wanna make sure that kids aren't cheating, y'know? And then they look at accommodations as a way for kids to get ahead, pull one over on them… You gotta treat students like they're not lying to you right from the get go.

It is likely that this, too, is related to students' disclosure considerations. When instructors are strict or inflexible with accommodating their students generally, students with disabilities would be forced to disclose their disabilities to receive accommodations—even those which do not necessarily require documentation: "Because this guy had a 'no late work' policy, I didn't even really try."

It is clear that disclosure considerations are not only a concern unique to students with NADs, but also a major facet of the way they interact with their coursework and instructors. As described by one participant:

> When it comes to non-apparent, I really do think a lot about disclosure, and weighing the benefits. But I think that's interesting, because it could be a privilege. Because I get the choice of disclosure. And it's the added mental burden of weighing the benefits and choosing… but it is a choice I get.

Conclusions

This study explores the experiences of undergraduate engineering students with non-apparent disabilities (NADs). We identified key challenges and strategies for accommodating NADs by using 90-minute semi-structured interviews with students from a mid-sized Mid-Atlantic university. Disclosure of disabilities was a significant stressor, affecting students' sense of belonging and interactions with peers. Positive outcomes from disclosure were linked to trusted professors or peers, while negative outcomes included subtle behavioral shifts that contributed to feelings of being othered. Classroom elements like group work and instructor approachability played crucial roles. Students with cognitive disabilities benefited from the structure of group work, while those with emotional disabilities found it exacerbated their symptoms. Supportive instructors, characterized by traits such as organization and approachability, were instrumental in encouraging students to seek accommodations. Conversely, instructor traits like passive-aggression and rigidity relating to classroom policies (i.e., no late work accepted, absences not tolerated, etc.) discouraged disclosure and support-seeking. The findings emphasize the importance of inclusive teaching practices and proactive faculty support; individualized approaches are necessary to accommodate the diverse needs of students with NADs. Creating an inclusive environment requires ongoing efforts from faculty, administrators, and peers. By fostering a culture of understanding and proactive support, engineering programs can work towards a more inclusive environment for disabled students.

Limitations and Future Work

This study is primarily limited by its small sample size and its lack of representation for chronic illness and physical non-apparent disabilities. While the conclusions described above may hold true for emotional and cognitive disabilities, it is likely that students with chronic illness and physical disabilities may have entirely different or contradictory experiences.

This work is part of a larger project investigating the experiences of engineering students with non-apparent disabilities. As such, this paper can be considered an exploratory pilot for a study with a larger and more diverse participant pool. Future work includes incorporating students with physical disabilities and chronic illness, as well as examining intersectional issues (such as non-male disabled students, non-white disabled students, etc.) which might further complicate the issue of disclosure.

Acknowledgments

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