

WIP: Practical Applications for Students With Autism Spectrum Disorders in the Freshman Engineering Curriculum

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Work in Progress: Practical Applications for Students with Autism Spectrum Disorders in the Freshman Engineering Curriculum

This Work in Progress focuses on first year engineering students regarding the topic of inclusivity and retention by assisting students diagnosed with an autism spectrum disorder (ASD). Students with ASD have a high systemize to empathize ratio. These characteristics lead many students with ASD to enroll in science, technology, engineering, and math (STEM) curricula in college. Also, more students are receiving a diagnosis and subsequent accommodations in secondary school. Due to these factors, it is becoming more prevalent to have a student with ASD in the freshman engineering classroom. Students with ASD can face many obstacles at the collegiate level. Some students may have issues with socializing, organizing assignments, time management, distractions in the classroom, notetaking, and unknowingly taking over questions/discussions. In addition, at the collegiate level the student must advocate for himself or herself. Some freshmen students may not sign up with a disability resource center, either due to unfamiliarity, or due to limited accommodations offered. The student may choose to self-disclose to the faculty, however some students do not disclose their diagnosis and subsequent need for classroom accommodations. A typical freshman engineering class will utilize teamwork on large design projects. Teamwork can be daunting for a student with ASD in terms of the social aspects and the organization of a large assignment with multiple due dates. However, many ASD students are visual learners and do well with “hands-on” projects, and may just need assistance keeping track of assignments. Faculty members should have direct communication with the students and provide accommodations with guided group work, a consistent format for assignments, breaking projects in to smaller assignments, and making slides/lectures available before class. Currently, a freshman engineering class has implemented these adjustments and accommodations. This work in progress will discuss this innovative practice and provide accommodations requested by ASD students, and comments and feedback from the anonymized student population.

Background

Since autism is a spectrum disorder, the impact on an individual can range from severe to very mild. More recently children and teens have received increased support for this spectrum disorder in elementary, middle, and high school, thus leading to more students with ASD pursuing postsecondary education [1,2]. Students with ASD who have successfully completed high school often face more adversities in college since the student must take more responsibility for his/her educational success, possible changes in living situations, and socializing with new students [3]. Adults with ASD with average and above average intelligence often have difficulties completing college and finding full-time employment [4]. Not finding employment or finishing college can be due to many reasons such as difficulty with the classroom setting or rules, social interactions, faculty with limited understanding of ASD, and lack of assistance during the job search process. When ASD students have success in college courses with rigor, they develop self-esteem and a sense of belonging [5]. With the proper support, an ASD student can be successful in college and finding full-time employment [6].

ASD Students in Postsecondary Education

As more students with ASDs are pursuing postsecondary education, colleges and universities are starting to recognize the challenges related to educating the ASD student [5,7]. More people suffer from milder forms of ASD [6]. Therefore, unless a student self-discloses, most faculty are not aware of a student with ASD in the classroom. Due to slight learning differences, and inadequate understanding from faculty, ASD can be an invisible disorder in the classroom.

Some traits exhibited by a student with ASD may include difficulties with communications, preoccupation with a particular subject, issues understanding some forms of humor, sitting away from people, not making eye contact, having anxiety in social settings, difficulty taking notes, rule-based thinking, or difficulty connecting with others [8,9,10,11]. A student with ASD may also have sensory issues with light or sound. There is a wide range of traits since ASD manifests itself differently in each individual.

Students with ASD enroll in STEM areas of study at a higher percentage than other groups with disabilities and the general population [11,12,13,14]. This is explained by students with ASD typically having a very high systemize to empathize ratio [12,15]. To systemize is to have a rule-based system to interpret the surroundings, whereas to empathize is to have emotional connections to other peoples' thoughts and feelings [12]. The high ratio of systemize to empathize help characterize ASD [15]. Success in the STEM fields rely more heavily on being able to systemize rather than to empathize, thus leading many ASD students to these fields.

Postsecondary Disability Resources

A public institution cannot discriminate against individuals with disabilities according to the Americans with Disabilities Act (ADA). Colleges and universities must conform to the ADA, but not the more rigid Individuals with Disabilities Education Act (IDEA) that pre-college education must meet [16]. The Free and Appropriate Public Education (FAPE) legal doctrine guarantees the right of a child to be educated [6]. IDEA then maintains that a child with a disability can not be excluded and has the right to supportive services so that they may keep their placement in public school [6].

ASD-specific programs exist at some colleges and universities, and as the ASD student population increases, the number of ASD-specific programs will grow [16]. The ASD college student must take more responsibility and self-advocate for their educational success [5,8]. Part of self-advocacy is reaching out to a disability resource center (DRC) at the college or university. First-semester students may not be aware of these resources, or may simply choose not to seek them out. Therefore, many times students eligible for support may not receive it until later in the semester. Also, the student may need to talk with the individual faculty about modifications they may need beyond the resources offered through a DRC [5,8]. A student with ASD may have sensory issues or other needs that are not addressed by these accommodations, such as organizing assignments, time management, and peer mentoring [3].

However, due to difficulty with social interactions or individual reactions to autism, many ASD students do not identify or discuss their disability [17].

Freshman Engineering Education

Many freshman engineering classes introduce engineering topics and techniques by using individual and group work, “hands-on” projects, oral presentations, and written communications. Engineering employers agree with this type of curriculum by requesting more focus on teamwork, professionalism, and communication skills [11]. When students are involved in an interactive learning environment, they have improved learning results and higher retention rates [11]. During the freshman engineering courses the students are usually tasked with several different types of projects. Some projects are purposely ambiguous, while others are very well defined. Based on these projects craftsmanship, drawing, budgeting, scheduling, and problem analysis are some of the skills necessary in a freshman engineering class. Many students with ASD solve problems with inventive methods [18]. Students with ASD may approach the projects in a unique way. The ambiguous project may be thrilling or daunting, while the more directed project with requirements and due dates may be more appealing. However, a large project, no matter the style, is usually overwhelming if introduced all at once.

Accommodations in the Classroom

A. General Accommodations

There are simple modifications an instructor can make to assist students with ASD. A large-scale project should be split into smaller assignments with due dates reflective of the work completed during that time. The students are still required to meet the rigor of the project by completing all the tasks; e.g. brainstorming, engineering drawing, Gantt chart, bill of materials, proposal, prototype build and test, and final report and presentation. Within this work, a student with ASD may tend towards the details of the design, or the scheduling and documentation. The instructor must help the team with coordinating tasks and keeping everyone involved. Some other academic accommodations the instructor can make are clear and direct classroom expectations, asking precise questions, hands on learning, performing visual demonstrations, giving more time on essay type tests, using task analysis with multiple subjects to build a schedule with individual tasks, and providing positive reinforcement at every opportunity [2,6,10,17,18]. For creating teams, it is important to place students with ASD on a team with an empathetic leader. Such as someone who typically takes on a mentoring role within the class. As a team leader, this person is more likely to listen to everyone’s interests and the role they want to take on during the project. One section of the freshman engineering class in the spring of 2018 was set up as a class to help with executive functioning skills.

B. In-Practice Accommodations

Starting in the spring 2018 semester a first-semester, freshman engineering class made the following modifications with requests from students with ASD denoted by the footnote:

- broke down the syllabus into three parts and discussed the parts of the syllabus over three different classes,

- had a fourth handout with all the assignment due dates and lecture topics that was delivered on the day the first assignment was posted,
- used the same format for all assignments including specific submission instructions,
- made lecture slides available at least 24 hours before class,¹
- directed group work with specific instructions for the class period,¹ and
- made project assignments more concise with specific due dates for intermediate tasks, in lieu of a single final due date for the project report and demonstration.

Due to the success of these modifications, they were continued into the fall 2018 semester for all sections of first-semester and second-semester engineering classes. Through the run of the study, 279 students total received a survey towards the end of the semester regarding these modifications. The survey followed the standard Likert scale with Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree options. The results for each question are given below:

- Did it help your understanding of the class procedures/requirement to break the syllabus into three parts at the beginning of the semester? 76% of the students appreciated (Strongly Agree and Agree) the syllabus broken down into smaller parts and presented over the course of three class periods. This really helped the students understand the grading system, and the rules and expectations of the class.
- Did the handout with assignment due dates help keep you organized? 89% of the students liked (Strongly Agree and Agree) the assignment due date handout to help keep them organized. Many students relied on this handout to stay on track during the semester.
- Was the consistent formatting of the assignments helpful? 88% of the students liked (Strongly Agree and Agree) the consistent format of the assignments. Having similar submission instructions on all assignments helped alleviate many questions regarding assignment submissions.
- Do you look at the slides before class? 44% of the students (Strongly Agree and Agree) viewed the slides on-line before class.
- Do you look at the slides after class? 70% of the students (Strongly Agree and Agree) viewed the slides after class. There were several students that appreciated having the slides available during class to take notes².
- Would you like more direction during teamwork time? 48% of the students would like (Strongly Agree and Agree) to see even more direction during group work time.
- Are the projects broken up into a sufficient number of tasks? 81% of the class (Strongly Agree and Agree) thought the projects were broken down into an appropriate number of small tasks and due dates.

In addition, every class had a reminder slide at the end of the lecture for impending assignment due dates. This was a practice previously put in place for this class. The students often relied on this reminder at the end of every class to keep them organized and found it as one of the most helpful aspects of the class along with the assignment due date handout².

¹ Requested by students with ASD.

² Feedback from students with ASD.

Conclusion and Future Work

Freshman engineering faculty can offer basic modifications, direction, support, and encouragement to first-semester students. Many of the modifications made for this innovative practice not only assisted students with ASDs, but also students transitioning from high school to college. Additional classroom support helps with retention rates within a challenging field of study, and success for first-semester students acclimating to college and learning how to self-advocate for accommodations. These basic modifications of breaking down large projects and documents, and providing direction have been met with positive responses. In continuation, these modifications remain in all sections of the first-semester and second-semester engineering classes with more directed instructions during the project work times. Recent modifications due to online and hybrid learning, include making the slides available at least 48 hours before class, and recorded lecture videos available after class. Future work will follow students with ASD through their college career to assess their success and persistence in the engineering curriculum.

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