Work in Progress: Development of Customized Application for Neurodiverse Engineering

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Abstract

Engineering college students with autism spectrum disorder (ASD) face unique challenges beyond the rigor of the curriculum. Students with ASD may have sensory issues, communication deficits, and executive functioning challenges such as assignment organization and time management [1]. At Arizona State University we have developed a program for engineering students with ASD that offers peer mentoring to help with the transition to and engagement in college life. The mentors offer guidance in honing executive functioning skills, identifying essential resources, fostering social connections, developing self-advocacy skills, and effectively navigating the campus environment. Through an undergraduate research initiative, undergraduate engineering researchers have immersed themselves into this program, conducted research on neurodiverse learning and communication skills, and developed a prototype application specifically for the peer mentoring program. Initially the student researchers developed surveys to determine the needs and interests in a customized application. Using the survey results, they developed a prototype application, and received user feedback on the prototype. This work in progress will detail the communication strategies designed for neurodiverse students, offer insights from the survey outcomes, and present feedback received during the evaluation of the application prototype.

Introduction

The growing trend of increased enrollment of students with autism spectrum disorder (ASD) in college, particularly within engineering disciplines, underscores a noteworthy shift in the educational landscape of higher education [2-4]. ASD manifests uniquely in each individual, contributing to diverse challenges and strengths among students [5]. Students with ASD often display exceptional technical knowledge and proficiency. However, the academic hurdles they encounter are frequently linked to executive functioning skills, including aspects like assignment organization, time management, following instructions due to language processing differences, and maintaining focus [1,6]. Despite these challenges, students with ASD can thrive academically when provided with support and guidance in developing these crucial skills. Communication difficulties represent another facet of ASD adversities, with some students grappling with nuances such as understanding sarcasm or interpreting non-verbal cues in written communication, such as emails [7]. These challenges may contribute to a sense of isolation among students with ASD in a college setting. The importance of fostering a sense of community becomes evident, as students often express that belonging to a supportive community positively influences their mental well-being [8,9]. Recognizing and addressing the unique needs of students with ASD is integral to creating an environment conducive to their academic success and overall well-being [8,10]. In particular, improving self-advocacy skills are linked to positive retention rates in college for students with disabilities [11]. Implementing targeted support mechanisms, such as assistance with executive functioning skills and promoting community-

building initiatives not only facilitates academic success but also enhances the overall college experience for individuals with ASD.

EASE Program

ASU has developed a free program, Employment Assistance and Social Engagement (EASE), that is a comprehensive individualized program designed specifically for engineering students with ASD [8]. This pioneering program is a collaborative effort between the Fulton Schools of Engineering (FSE) and the College of Health Solutions (CHS), aimed at providing tailored support in the form of peer mentoring, social engagement, and career readiness. When engineering students enroll in the EASE program and begin their college education at ASU, they are paired with two peer mentors, one from FSE and one from CHS. The mentors first focus on the transition to college by helping their mentees find relevant resources. Then, the mentors start prioritizing assignment organization, planning, and other executive functioning skills. The students will have peer mentors throughout their tenure at ASU, adapting to their evolving needs. As they progress in their degree program the focus of mentorship shifts towards refining essential career readiness skills. Recognizing the challenges associated with timely communication, the EASE program provides various communication channels, including email, text, and social media. To enhance communication efficiency, a forward-thinking suggestion has been proposed: the development of a personalized application tailored specifically to meet the needs of the EASE program.

Application Research and Surveys

The EASE directors decided to enlist the assistance of the Fulton Undergraduate Research Initiative (FURI) at ASU for the development of the application. Two students were selected through the FURI program under the research theme Education. The student researchers immersed themselves into the EASE program by attending mentor meetings and meeting a few of the students in the EASE program. Through application research and their experience in the EASE program they were able to develop two comprehensive surveys, one for the EASE mentees and one for the EASE mentors. The EASE mentees were asked about academic and social challenges. They were also asked about the broad features of the application. The mentors were asked similar questions but focused on their perceived needs of the mentees. They were also asked additional questions regarding communication and engagement with their mentees. Portions of the surveys with the results from twelve respondents are shown below.

The EASE mentees were asked what aspects had been the most academically challenging about their college experience to date. The answers were averaged and listed from most challenging to least challenging below.

- Time management (for example, being on time for class and turning in assignments on time)
- Using ASU resources (for example, tutoring)
- Talking with professors or teaching assistants
- Prioritizing tasks

- Working with others in group projects

The EASE mentees were asked what had been the most socially challenging aspect about their college experience. The answers were averaged and listed from most challenging to least challenging below.

- Making friends and meeting new people
- Joining groups/clubs
- Being in crowded places
- Living situations (if applicable, living with a roommate)

The EASE mentees were asked to rank the broad feature categories of the desired application. They are listed from most important to least important below.

- Easier access to your EASE peer mentors
- Calendar of upcoming events from EASE and ASU
- Links to applicable ASU and ASU-affiliated resources
- Tools to aid organization

While time management, using ASU resources, and joining clubs were challenges for the EASE students, the main feature they wanted on the application was easier access to their peer mentors. The students mentioned that having reminders to reach out and check-in with their mentors would be helpful.

The mentor survey asked the following questions with a few anecdotal responses listed below.

- What have you found helps increase the response rate of your mentees in terms of your attempts to communicate with them online?
  - “Some mentees just naturally tend to respond more and remain consistent so I don't have to use additional methods. For those that don't respond, however, I remind them of my role and the fact that I am there to help them and our meetings are an opportunity to talk about whatever they need and should not be a source of stress.”
  - “Asking for a "response by" tends to work. Also, I just generally try to insert some positive reinforcement in my emails (e.g., not "we should meet this week", but "We had a great meeting last week! I would love to follow up on XYZ to see how it went for you. What does your availability look like next week?")”
  - “Bolding important dates and times tends to help. If I write "please respond to this email", the response rate is higher.”

- How have you gotten your mentees to engage with you in the past?
  - “I tend to have a general structure to meetings and things I know we need to discuss. But beyond that, I let them know that the meetings are for their benefit, not mine, and we can discuss whatever is on their mind and follow whatever structure they are most comfortable with.”
  - “A big one is to ask them about their classes from a technical perspective. I find that the students are generally excited to talk about "what" they're doing in engineering. This helps open up the conversation for us to talk about soft skills. Leading with soft skills can cause them to disengage.”
  - “In order to engage effectively, it is imperative to plan and prepare a "skeleton" of a

lesson plan which enables me to ask the right open ended questions in the correct sequence with follow up questions to supplement. Having an open ended conversation tends to engage the mentees more. Also, I tend to be as objective as possible so the mentees know I am not being judgmental, rather I am providing sound advice that they can choose to use if they believe it will be functional to them. If not, we brainstorm possible ideas that will be more useful. I love to learn so I ask questions about their interests so they engage with me more."

- What would make accessing your EASE peer mentee easier?
  - "Some mentees prefer text, some prefer email, some are good at responding, some aren't, etc. so it would be easier to have access to them all in the same place and in the same way."
  - "A direct line of communication besides email would be nice. Unfortunately, email is so easy to avoid, so if a student doesn't want to respond there is really no way of initializing a conversation."
  - "Having their phone number would make accessing the peer mentees easier because they do not always respond to emails. Responding to texts is easier and more informal, especially when conducting an informal check-in. Texting or calling mentees would also suffice as an opportunity for them to speak over the phone and respond to texts in a timely manner because it is a different form of communication than email."

Both the EASE mentors and mentees were asked specific questions about the application features. The average responses from the mentors and mentees are shown below with the average mentee response highlighted in yellow, the average mentor response highlighted in red, and the average response of both groups highlighted in purple if they were the same.

Table 1. EASE Mentor and Mentee averaged responses to specific application features.

Averaged Responses: Mentee Mentor Both

	Extremely useful	Very useful	Somewhat useful	Slightly useful	Not at all useful
A calendar feed showing upcoming EASE events with an option to RSVP.	❑	❑	❑	❑	❑
A calendar showing upcoming events occurring on the Polytechnic or Tempe campuses.	❑	❑	❑	❑	❑
An expedited process to set up a meeting with a peer mentor.	❑	❑	❑	❑	❑
An option to allow for your peer mentors to send you occasional quick, multiple-choice check-ins so you can update them on how they are currently feeling.	❑	❑	❑	❑	❑
A way to check current number of peer mentor meetings you have attended to ensure that you are meeting EASE requirements.	❑	❑	❑	❑	❑
A time planner so that you can map out your day visually. It would allow you to note your plans for how you are going to spend your time that day. Then, you can reference the planner to stay on track throughout the day.	❑	❑	❑	❑	❑
A time tracker so that you can analyze how you are spending your time to help you make positive changes. You would get reminders throughout the day asking what you are doing so that you can get a better sense of which habits can stay and which should be adjusted.	❑	❑	❑	❑	❑
A feed where your mentors can post news, events, tips, and other interesting information. You would also be able to respond to their posts with private questions.	❑	❑	❑	❑	❑
A simple reminder/task-tracking tool where you can put in all of the different tasks you need to get done during the day, with notifications throughout the day reminding you to work on them.	❑	❑	❑	❑	❑
A system that reminds you to check your email and other school-related communications throughout the week.	❑	❑	❑	❑	❑
A Pomodoro timer, which helps productivity by giving you 25 minutes of work time and 5 minutes of break time in cycles when you need to get work done. The timers would also be customizable to your preferences.	❑	❑	❑	❑	❑

The mentors thought the features pertaining to EASE communications were most important along with the time planners and trackers. The mentees liked all the features except the Pomodoro timer.

Application Prototype and Feedback

After taking time to assess the results from the surveys, the student researchers developed two possible prototypes for the application. The prototypes contained many of the same features and functionality. The prototype in Figure 1 displays the home page in the upper left corner followed by the individual pages for Check-In, Tasks, Appointment Scheduling, Event Calendar, and Resources.

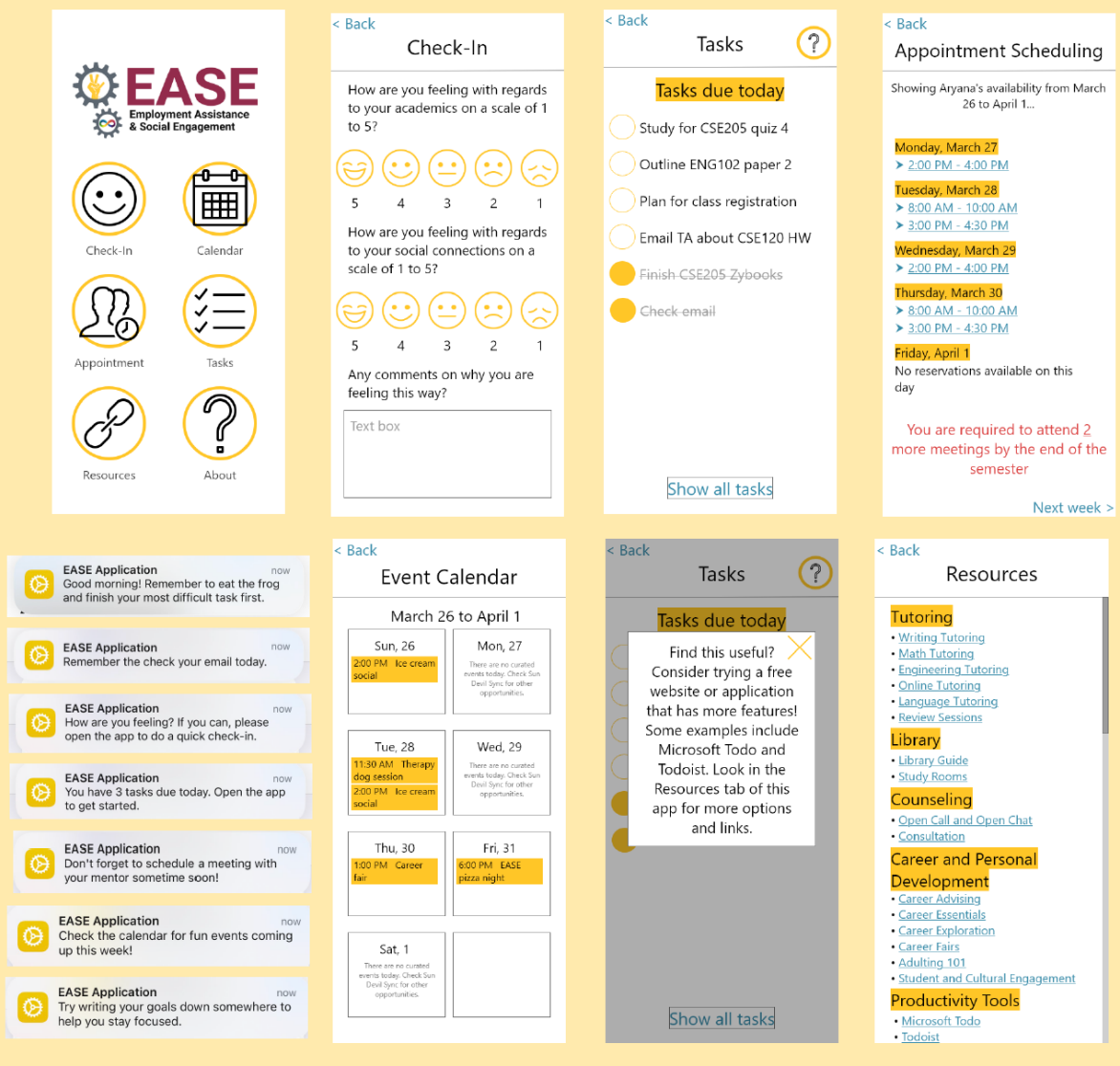

Figure 1. First mock prototype with Check-in, Tasks, Appointments, Event Calendar, and Resources pages.

The prototype shown in Figure 2 shows a login screen with a home page for Schedule, Message Board, Timer, News Feed, and Member Check-in. The last page shows a Current Status page for mentees to check-in with their mentor.

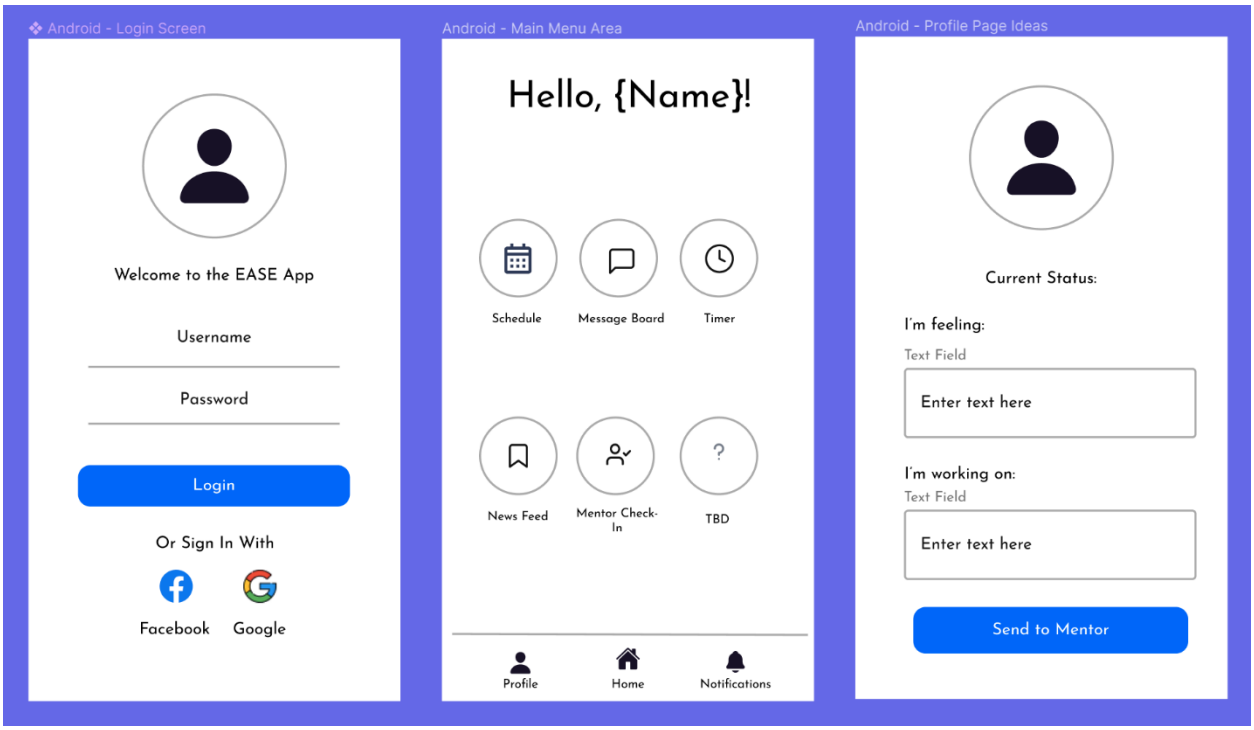

Figure 2. Second mock prototype with Login, Schedule, Message Board, Timer, News Feed, Mentor Check-In, and Current Status pages.

The prototype from Figure 2 was placed in Figma, a user interface simulation software, and sent to the EASE mentors and mentees for feedback. The feedback questions and several examples of responses are shown below.

- What did you like?
  - "I liked the simple and easy to navigate UI. The items are easy to access and arranged in a very straight forward way."
  - "I like the simplicity of the design."
  - "I liked the simplicity, there were very few things to click to contact your mentee."
  - "Interface is visually-pleasing. Buttons/features are intuitive to use and navigate."
  - "I liked that it was easy to view mentee contact information."

- What did you dislike?
  - "I disliked the lack of content. The app seemed to be empty and lacking resources."
  - "This is due to the early prototyping phase I'm sure, but I didn't see any organizational tools for the mentees (also could be because I am a mentor). Nevertheless, it would be nice as a mentor to see what's on my mentee's calendar when I click on their name."
  - "I wish there was a way to view certain mentee tasks so that we can track goals together."
  - "There is not anything that stands out that I dislike."

- What does the prototype do well?

- “I think the prototype accomplishes ease of access extremely well. It only takes a couple of clicks to access the mentors and the button placement is very good.”
- “The prototype is very simple and easy to use.”
- “Keeps everything simple, there are no unnecessary buttons.”
- “Navigation looks really straightforward.”
- “I think that it is easy to use!”

Suggestions for improvements included adding links to ASU resources and having an interface for texting, calling, and emailing. Adjustments made to the prototype included more visuals with page details and program flow shown in Figure 3 with mentee profiles containing contact information (phone, email, messaging), a mentor check-in, calendar feed, task tracker and EASE checklist.

Figure 3. Updated Application Prototype.

The development of the application highlighted the importance of design simplicity and the mentor/mentee connections as indicated by user feedback. The application is undergoing further refinement based on ongoing user communications. The application is not currently in use as development continues. However, a functional prototype should be available for the fall 2024 semester.

Conclusion

The collaboration between the EASE program and FURI at ASU has resulted in an innovative approach to address communication challenges and enhance support mechanisms for students with ASD. The development of a customized application, guided by the insights gained from surveys, aimed to address these concerns. The application prototypes underwent an evaluation process involving both mentors and mentees. The feedback highlighted the importance of a simple and intuitive user interface and emphasized ease of access and navigation. The overall response was positive regarding the prototype’s simplicity and functionality.

Improvements were made based on the feedback received, incorporating features such as mentee profiles with contact information and mentor check-in. As the development of the application progresses, it is crucial to maintain an iterative approach, continually seeking input from the EASE program participants to ensure that the final product aligns closely with their needs and preferences. The collaborative efforts between the EASE program and FURI researchers exemplify a commitment to fostering an inclusive and supportive environment within the scope of engineering education. By addressing the unique challenges faced by students with ASD, education institutions contribute to creating an environment that nurtures the success and well-being of all students.

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