10/4/2018

P1: User Research and Design Alternatives

{Team #1} {CS 3750}
GEORGIA INSTITUTE OF TECHNOLOGY

P1A: Project Proposal

The Initial Approach

Students at Georgia Tech often have distinct study needs that are normally satisfied from study spaces on campus. There are various methods for studying: preparing for exams in large groups, locating a silent setting to learn a new language, or utilizing physical necessities needed for studying (whiteboard, electrical outlet, etc.). Although there are many resources available on campus, students might be unfamiliar with the study spaces and therefore fail to fully utilize them. Furthermore, study spaces vary in size, location, and equipment available. Those who need a space for a particular purpose (e.g., discussing CS3750's project) often do not know which study space suits their needs and when the study space will be available.

A potential user group is students or faculty on campus in need of study space. An important characteristic of our potential user group is their diverse and evolving needs for study spaces. Different student demographics (e.g., class level, graduate, transfer, international, foreign language speakers, course level, athletes, project groups, solos, etc.) may have different needs for study spaces (e.g., practice exams, projects, homework, research, etc.). Furthermore, as a student assimilates to the pace of college, adjusts to the course load rigor, and form study groups, their study habits might change, resulting in a changing needs and preferences for spaces to work, learn, and discuss. The questions below can be a simple guideline to prompt some forward thinking on the subject at hand:

- Do freshman only study at locations introduced to them at FASET?
- Are foreign language students more prompted to study at the Communication Center?
- Are upperclassmen less like to study at central campus locations?
- Do research graduate students study more in their TA offices?
- Can we find athletes only studying with other athletes of the same sport due to a tight and uniform student athlete schedule?
- How do students with disabilities locate a space to study, and when they do, is it accommodating?

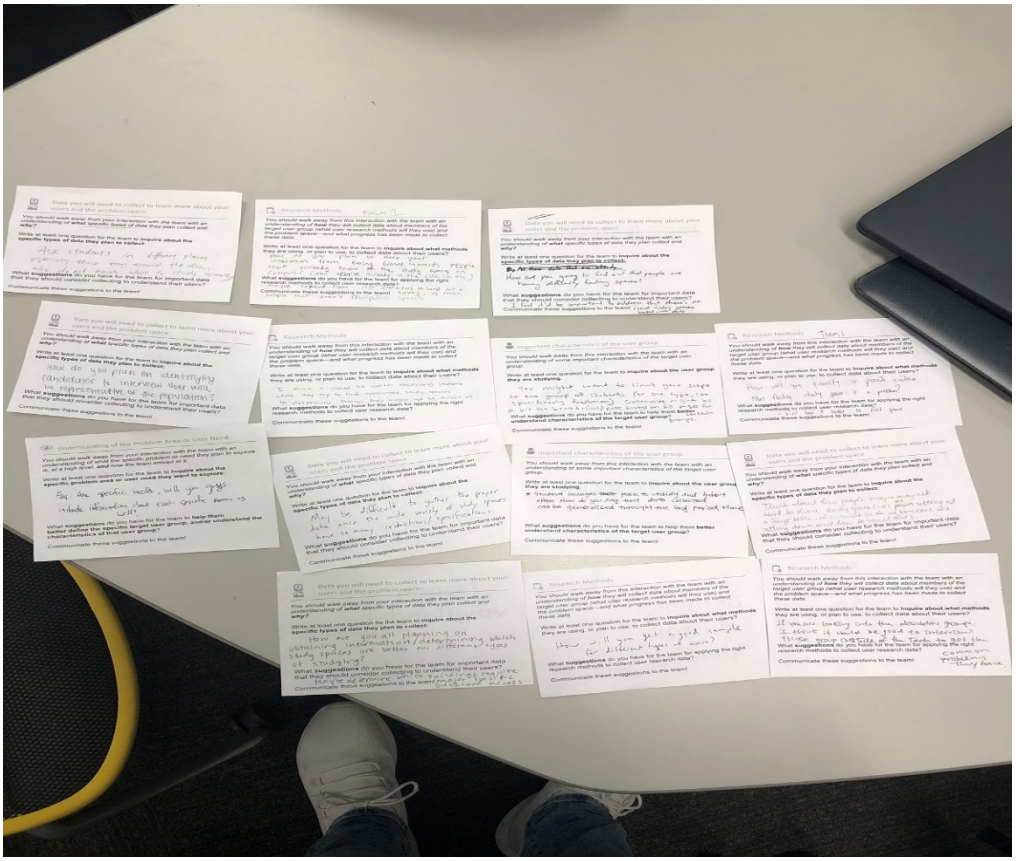
We plan to collect data through interviews and observations. For an initial exploration of students' needs, we are particularly interested in two student groups: 1) students who use the rooms that require reservation at Clough and 2) those who work and study in the open spaces in Clough and in the library. Both groups of students demonstrate needs for space to work, learn, and discuss. To get a holistic understanding of the students' needs, through the interviews, we would like to answer a series of questions:

- What do students reserve a room for?
- What tools do students currently use to research a room?
- How large a room do students need?
- Where do students often go when they need a place to study or discuss?
- What were the pain points students encountered while they try to reserve a room?
- Do different student groups (e.g., freshman vs. senior) differ in their needs for study spaces?

A New Approach: A Narrowed User Group

After presenting our initial presentation to our peers, TA, and professor, we received a significant amount of feedback. Based on student commentary, it appeared there was a general concern about the representativeness of the user group. Our peers believed interviewing students at Clough and the library alone was not enough. Some classmates suggested to limit the scope of our problem or user group. Then, the professor and the TA suggested to focus on people with mobile disabilities as the new targeted user group, while interviewing without assuming finding study spaces is a problem in the first place.

Based on these suggestions, we will focus on the students with mobile disabilities and interview people who work closely with our target user group to understand their needs. It will become apparent that navigating campus in general, rather than finding study spaces, is a major portion of the challenges students with disabilities encounter on campus. So, we focus on the navigation challenges encountered by those with mobile disabilities instead. While there are some resources available for this user group, there is significant room for improvement in current accommodation methods.

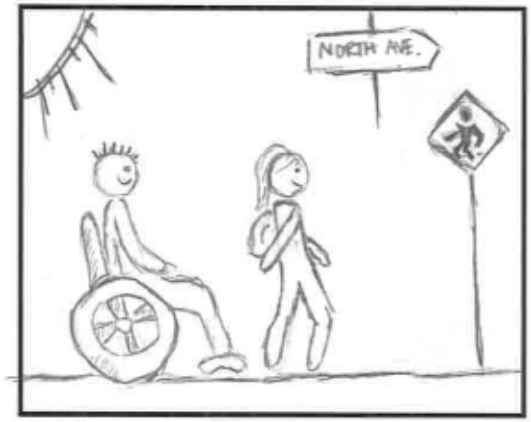


1. Task Narrative

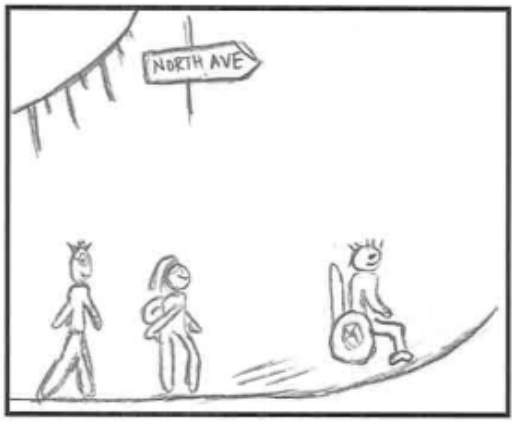
Storyboard Template

Name:

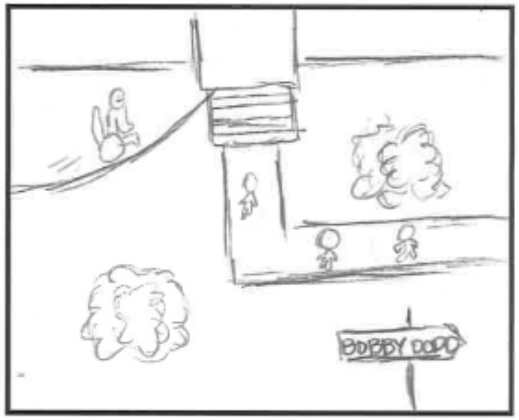
Project:



Our user is interested in studying on campus, so he will head to Clough Undergraduate Learning Commons from North Ave Street.

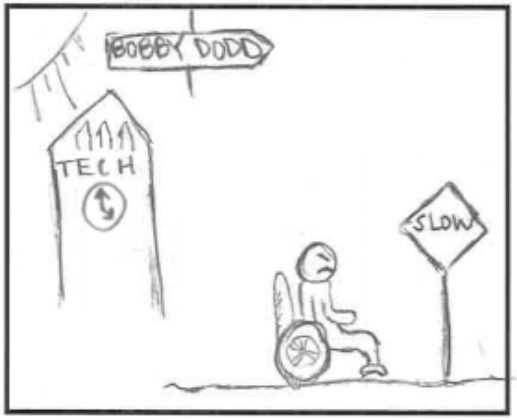


The user will take his normal path, which first begins up an elongated hill on North Ave.



NOW, the user has arrived at the top of the hill. Instead of taking the stairs, he will use the handicap ramp.

The user is minutes away from his destination. He cuts through campus near Bobby Dodd to reach CULC.



As the user approaches his destination, he suddenly encounters an issue.

The user's path is blocked due to construction. There are stairs to continue forward, but no ramp.

Storyboard Template

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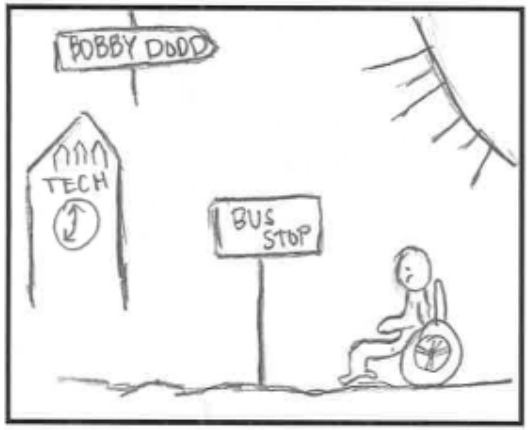
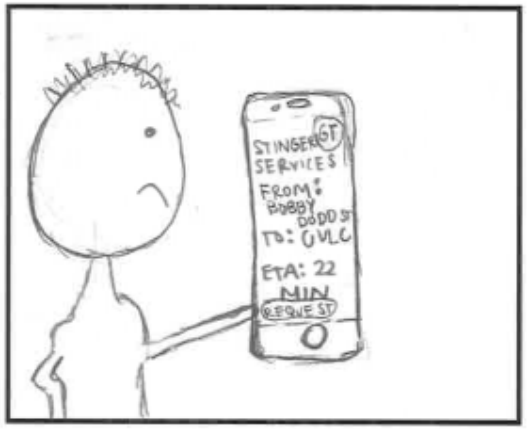
Project:

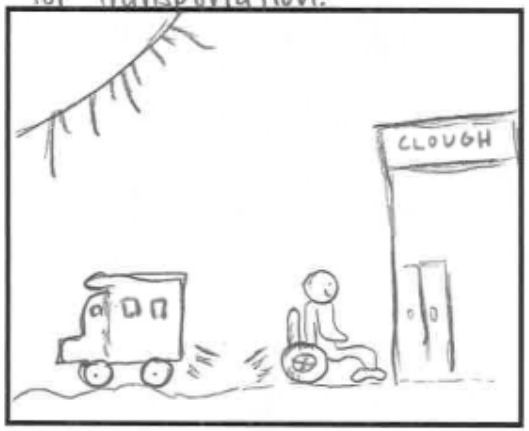


The user does not want to walk all the way around, so he will call a vehicle for the disabled for transportation.

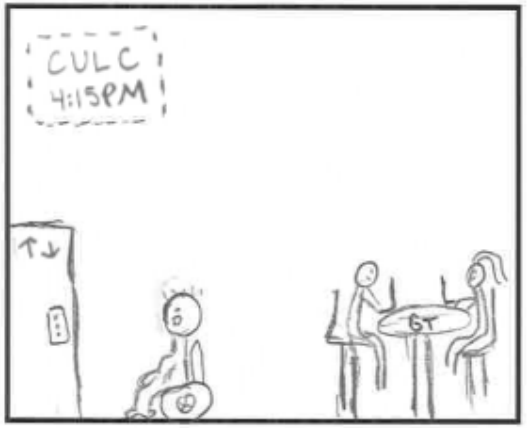


The user calls a stingerette, and waits for arrival.

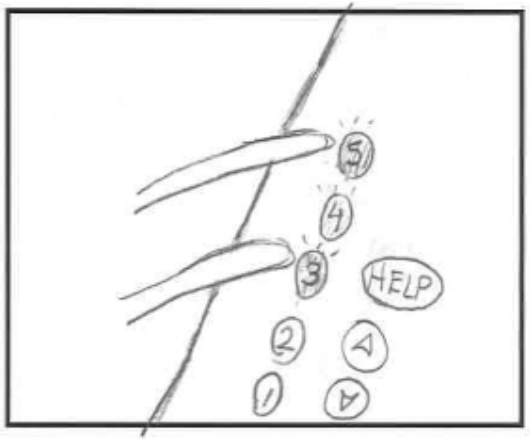
The user is assisted onto the stingerette, a sometimes lengthy process.



The user arrives at his destination about 20 minutes later.



Now, the user must locate a place to study.



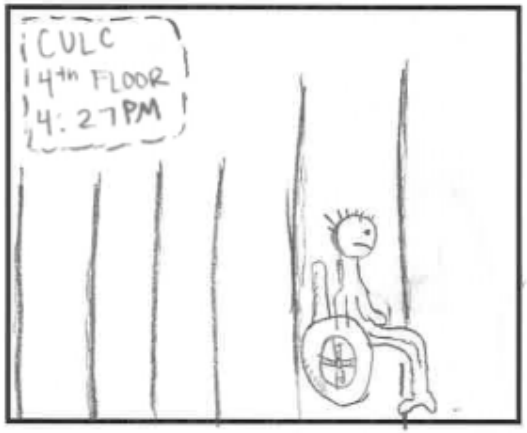
The user normally stops at multiple floors on the elevator to find a space.

Storyboard Template

Name:

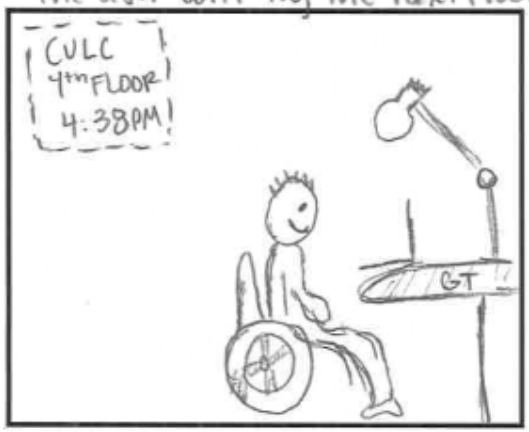
Project:

There are no available seats that are low enough to meet the user at chair level. The user will try the next floor.



The user looks through the fourth floor but has some difficulty navigating through narrow hallways.

The user locates a classroom that accommodates his seating needs, but it is at max capacity.



Finally, the user locates a study space that meets his needs. He now can study.

2. A Few More Details…

A) A core challenge encountered by student with mobiles disabilities is navigating the campus. Students with mobiles disabilities use various mobility devices (e.g., wheelchairs and walkers) to get to classroom or finding studying spaces. Navigation and wayfinding can be challenging because of the terrain (Georgia Tech is hilly) and the crowd (there are a lot of students during day time). Students also need to consider a lot of factors when finding their way to a particular place (e.g., are there any ramps and obstacles along the way? Is the building wheelchair accessible?). Students with mobile disabilities can get anxious at times because too many factors can affect whether they can go to a place safely and on time. Furthermore, some of the factors that affect navigation are unpredictable. An example is the constant constructions at Georgia Tech, as seen in the task narrative. These constructions can suddenly block a pathway that is usually clear, and provide no alternative route for students with disabilities.

Currently, disabled students at the Georgia Tech have the online map in tandem with the Office of Disability Services (ODS) available to them to aid in campus navigation. ODS currently serves as the main hub of information for students with mobile disabilities. For instance, if there is a ramp that is too steep, students in a wheelchair can ask for assistance from ODS. Nonetheless, navigating around the campus (e.g., finding a user-friendly study space) is typically impeded by physical barriers and lack of sufficient institute resources for this specific user group.

B) The strengths within the current approach to the task are centered upon the fact that ODS specializes in helping their students with current problems, and the fact that Georgia Tech's online map highlights a wide breadth of areas. The deficiencies of this approach lie within the fact that some students with mobile disabilities cannot access the online map while they are maneuvering (e.g., because they are using a walking or a wheelchair). Furthermore, ODS cannot account for all the rapidly changing obstacles that may come about when it comes to navigating the campus. For example, if construction at Georgia Tech is occurring in a certain area, neither the map nor the office of disability services can quickly inform students about the change.

The Plan:
We planned to investigate the needs of the students with mobile disabilities at Georgia Tech and the existing resources that are accommodating their needs. In particular, we would like to understand their difficulties in navigating through the campus as well as the challenges they encountered in other aspects of their lives (e.g., their social lives).

The Problem:
Students with mobile disabilities have special needs. Given their physical impairments, many of them are not able to maneuver around the campus like people without disabilities do. They might also have special study needs that require accommodating spaces for studying individually or with their peers.

Technology?

Students with mobile disabilities would benefit from information about different facilities on campus. As they constitute only a small part of the Tech population, a platform for communication among these students can help them gain support from people who have similar needs or experiences. Technology plays an important role in both providing information transparency and connecting students. Additionally, it should be noted that the school as a whole is technologically advanced, and there is a significant gap between resources (i.e apps) that are available for mobile v. immobile students.

Without technology, students can only contact the Office of Disability Services to learn about the available resources on campus to address their needs (e.g., navigation and study). The Office of Disability Services is a small office with limited resources and may not be able to provide adequate support to all students with mobility disabilities.

However, users will not adopt the technology if it is poorly-designed, so improvements will be stagnated, and we risk wasting time and resources. Furthermore, poorly designed technology might amplify the problem (e.g., students with disabilities arrive at a study space that fails to meet their needs). If high quality technological designs are implemented, the problem can potentially be solved, greatly enhancing the wellbeing of students with mobile disabilities.

C) Sources and Research

Source title	Source URL	Dates of access (list all)	Informative ?	If informative, why?
Georgia Tech Disability Accommodation	https://admission.gatech.edu/visit/disability-accommodations	9/17/18	Yes	This site gave us some new facts pertaining to disability services that we did not previously know. For example: Georgia Tech offers wheelchair accessible tour routes
University System of Georgia Accessibility Web Site Information	https://www.usg.edu/siteinfo/accessibility	9/17/18	Yes	The website offers several avenues for finding information pertaining to accessibility and standards from congressional acts and board initiatives. There is a summative guideline list which covers a general breadth for those unfamiliar with accessibility protocol.
Center for Assistive Technology and Environmental Access	https://catea.gatech.edu/	9/17/18	Yes	Multiple research labs under the Center for Assistive Technology and Environmental access have been developing assistive technology for users with various disabilities and needs. For example, the Accessible Workplace Lab is an initiative geared toward helping disabled members in the Georgia Tech community to have sufficient workplace accommodations
Family Housing for Graduate Disabled Student	https://www.reddit.com/r/gatech/comments/35oz3w/family_housing_for_graduate_disabled_student	9/17/18	No	N/A
Transition of Students with Disabilities to Postsecondary Education	transitionguide.html	9/17/18	Yes	This article outlines ways that high school educators and colleges & universities can better prepare the students with disabilities as they transition through a pivotal point in their life. The site articulates on self-identification, admission process, advocacy, and preparation that students, parents, faculty, and staff alike can learn from.
Office of Disability Services	https://disabilityservices.gate	9/18/18	Yes	This website tells us what resources are currently available at Georgia

	ch.edu/			Tech to students with mobile disability. We are aware that they offer a testing center for students who want to take tests but were not aware of resources that support the other learning needs of students with mobile disability.
AMAC Accessibility	http://www.amacusg.org/	9/18/18	Yes	AMAC is a research center that collaborates with several departments at Georgia Tech to develop assistive technology for people with different disabilities. Their website documented some assistive technologies they or their partners have developed. Their YouTube channel (https://www.youtube.com/channel/UC65STjDF8QvhyZnh3EUrqjg) has videos that demonstrate some success stories of using their assistive technologies.
Center for Advanced Communication Policy	http://www.cacp.gatech.edu/node/17	9/18/18	Yes	This website provides information about some research projects research labs at Georgia Tech are undertaking to help people with disabilities.

Related Solutions

1.
   a. Name: Georgia Tech Campus Map
   b. Found at: http://map.gatech.edu
   c. What it provides: The campus map contains information about campus accessibility. After selecting the "Universal Access" option, information about where are the ADA route, stairs and accessible parking are provided. However, the information is not complete (there is no information on some part of the campus) and not up-to-date (it is not updated when there is a new construction site blocking a pathway).
   d. Target "customers" or "users": For people with mobility issues or those who want to drive a person with mobile disabilities around the campus.

2.
   a. Name: Georgia Tech Division of Student Life Accommodations Guide
   b. Found at: http://disabilityservices.gatech.edu/content/accomodations-1
   c. What it provides: Accommodations at Georgia Tech are a set of tools offered by the Office of Disability Services to address the needs of disabled students in classrooms. Students need to register for accommodations in order to use the service.
   d. Target "customers" or "users": These services are designed for registered disabled students at Georgia Tech. The page prompts these disabled students to log onto a portal that can help them further access the aforementioned resources.

3.
   a. Name: WheelMate
   b. Found at: https://itunes.apple.com/us/app/wheelmate/id515277627?mt=8
   c. What it provides: WheelMate provides an overview of the wheelchair-friendly toilets nearby and parking spaces on an interactive map. The information is provided by crowdsourcing: other wheelchair users add and verify whether the toilets and parking space is wheelchair-friendly.
   d. Target "customers" or "users": It targets wheelchair users.

4.
   a. Name: Tohme from the University of Maryland
   b. Found at: https://dl.acm.org/citation.cfm?id=2647403
   c. What it provides: Their project is a research prototype that uses crowdsourcing and computer vision to identify sidewalk accessibility problems that make navigation difficulty for wheelchair users. Using their technique, better routes can be designed for wheelchair users. We envision that their approaches can be enhanced to help people with physical disability to find the best route by avoiding places with accessibility problems.
   d. Target "customers" or "users": Wheelchair users.

5.
   a. Name: Tobii Gaze Interaction Software
   b. Found at: https://www.tobiidynavox.com/en-US/software/windows-software/windows-control/
   c. What it provides: Gaze interaction software enables computer access through eye tracking. It is not directly related to navigation. However, it allows students with physical impairment to have access to information about campus accessibility and various disability services on campus.
   d. Target "customers" or "users": It is designed for people with more severe mobile impairments such as those who cannot use their hands and fingers.

- **Strengths of existing products, services, or prototypes**

Many existing products for people with mobile impairments aim to provide better information access to users. For example, WheelMate and the Georgia Tech campus map offer information about the places that are wheelchair-friendly; Tohme offers insights into what technologies can be developed to help wheelchair users navigate through campus to find study spaces.

Devices for people with mobile impairments also seems to be very mature and well-developed. People who cannot use their hands can have computer access using gaze interaction. As demonstrated by RoboDesk, physical surfaces can be attached to a wheelchair to serve as a mobile study space for students with mobile disability.

- **Gaps in existing products, services, or prototypes**

An obvious limitation of these products (e.g., the Georgia Tech campus map) is that they are not complete and not up-to-date. As mentioned above, they don't have information about some parts of the campus. When a pathway is suddenly blocked due to a construction, accessibility information on the map is not dynamically update.

Another issue that these products may not address very well is people's needs to commute a longer distance. With all the information about where the wheelchair-friendly study spaces are located and what is the best route, disabled students still need to figure out how to get there with their wheelchairs. Paratransit at Georgia Tech seems to address part of this issue but conceivably, due to limited resources, Paratransit can only help a small number of students to move around the campus. With limited access to such services, students with mobile disability would rather stay at home to study, limiting their social and learning opportunities.

- **Suggestions as to which areas/dimensions of prior work to focus on and/or ignore**

Naturally, we should ignore areas where a substantial amount of work has been done and marginal increases will be insignificant. For example, because GT already has a guide, we will avoid replicating the information that already exists. Rather than creating an alternative version of that guide as a solution, we could simply link it or provide it as a resource.

3. Larger Social and Technical Systems and Context

Larger systems that relate to the issue we are facing are already being implemented at other institutions. In terms of the university conversations that need to be had, they should include administrative empowerment, budgeting, technology, accessibility, and infusion in all aspects on campus with input from students and specifically students with mobile disabilities.

Concerning finding study spaces on campus, an example of a prototype at large that has already been launched can be found at UCL. UCL launched a project that will let students quickly locate free study spaces around campus through the UCL library services website. They are relying on technologies that "…are small devices that have been placed under all of the desks in the libraries that uses infra-red to detect whether a space is in use or not." Moreover, an eventual prototype would eventually need to work for buildings and facilities on campus that are mainly used for study space only. Obvious locations are libraries and learning commons. If the prototypes are successful for the spaces where the masses of students are looking for study spaces for a multitude of reasons including exam preparation, tutoring, group project meetings, student organization meetings, ands help desk. Then the prototype can be expanded to more specific and minute locations such as major buildings where after instructional hours the classrooms are open to students.

Technologies such as GPS will be used to integrate this technology to make it effortless for students to locate a place using a mobile device. The technology would need to rely on GPS and an internal service that provides information on room availability such as a student telling the system they have booked a room. That way the system outputs that there is a room in use to other students searching for study space. The technology should be a 24 hour service since students are up late nights in needs of spaces. To make sure the application is working well and in accordance with the students with disabilities, there will be feedback section on the application on the space availability tool; whether a student had used it, what they expect from the app, would floor plans of library levels be useful, etc.

Development can begin as a web application available to students on a university centralized server. Then once the service can be available via mobile web application that way it more accessible to students on and off campus as they are constantly on the go. The process of traveling from room to room or building to building simply to come to the realization that no study spaces are available is a waste of time. Additionally it will be important to feature terrain, traffic and other obstacles for students, especially those with disabilities. In the application buildings with assists technologies and accessibility standard requirements should be highlighted for easy recognition. Further updates and modifications can be made throughout the development process after considerable feedback has been gathered.

4. User Research Report

A) User Research Methods

Our group has used three research methods for understanding the needs of students at Georgia Tech who have mobile disabilities: interview, observation, and content analysis.

Interview has two core advantages over research methods like survey. First, it allows us to create a thick description of the user group being investigated. People we interviewed either have been working closely with people with mobile impairments or themselves have mobile impairments. As they have a strong feeling about the issues related to mobile impairments, they are motivated to describe the challenges they saw. Interviewing them offers a deeper insider's view of the issue under investigation. Survey, on the other hand, might only allow us to gather shallow responses. Second, we can ask follow-up questions during the interview for clarification. It would have been difficult to ask for clarification if survey was used.

Observation was used because it gives us a more concrete idea about how things work in a natural setting. This complements interviews in two ways: 1) interviews are often not conducted while users are performing their tasks and 2) some users might have difficulties recalling the challenges they encounter. First, our group is interested in understanding the difficulties encountered by people with mobile impairments while they are finding their ways on campus. Interviewing them while they are finding their way is challenging (imagine interviewing people using crutches while they are navigating the campus). Second, humans are just bad at recalling things. The consequence is that we can miss something if interview was only used as a research method.

We have also conducted content analysis mainly to complement interview and observation. Interview people with mobile disabilities is difficult due to the difficulties in reaching this group of users. Observing them is not easy either – where can I find a person with mobile disabilities to observe while not being awkward? Due to the limited time allotted for the user research, we use content analysis to enrich our findings.

B) Implementation of Methods

Participant / User Group	Number Observed	Number Interviewed	Other (specify)
People who have been working closely with people with mobile disabilities	0	3	We have interviewed two staff at the office of disability services (one of them is blind and got his PhD on universal design). We have also interviewed a research scientist who was a PhD student

			at the School of Interactive Computing. All of them have been working with people with mobile impairments to some degree.
People at Georgia Tech who have mobile disabilities	1	1	We have interviewed a manager at AMAC, which is a research center at Georgia Tech investigating assistive technology. She has muscular dystrophy. We have also observed how a person in wheelchair finding his way to study spaces in a building.
People at other colleges who are in a wheelchair or have mobile disabilities	0	0	We have not interviewed or observed any people from other colleges but we have done content analysis on 6 threads in College Confidential and Reddit (see part d). These threads were posted by people from other colleges who have concerns about their disabilities or the disabilities of their loved ones.

D) Additional Inputs

As we have mentioned above, we have done content analysis on 6 threads in College Confidential and Reddit. The following provides a short description for each.

Title: environment for the mobility impaired
Description: A parent had a daughter in a wheelchair and wanted to find a college with a tone of inclusion, kindness and hospitality for his/her daughter.
Link: https://talk.collegeconfidential.com/centre-college/2052973-environment-for-the-mobility-impaired.html

Title: physical disability and the college search
Description: The person who posted it had a friend whose daughter had mobile disabilities. S/he wanted to know the considerations for college search for her.
Link: https://talk.collegeconfidential.com/learning-differences-challenges-ld-adhd/116698-physical-disability-and-the-college-search.html

Title: Competitive Disability Friendly Colleges
Description: A senior in high school who had mobile impairments wanted to find out the wheelchair accessibility of a couple of highly competitive colleges
Link: https://talk.collegeconfidential.com/college-search-selection/2092410-competitive-disability-friendly-colleges.html

Title: How to get better at wheeling about?

Description: The one who posted it was a “part-time” wheelchair user who could not walk too much. S/he wanted to know how to be better at wheeling about.
Link: https://www.reddit.com/r/wheelchairs/comments/7dqsx3/how_to_get_better_at_wheeling_about/

Title: New to trying to be independent, wheelchair purchasing tips?
Description: The poster was in a wheelchair and wanted to be more independent in college. S/he was considering to purchase a more powerful wheelchair so s/he can be less reliant on other people.
Link: https://www.reddit.com/r/wheelchairs/comments/7kx22d/new_to_trying_to_be_independent_wheelchair/

Title: Question regarding Ramp Ease of Access
Description: A college student in Colorado found that many of the ramps at his/her college were too steep and wanted to know how to circumvent this potential problem.
Link: https://www.reddit.com/r/wheelchairs/comments/508aus/question_regarding_ramp_ease_of_access/

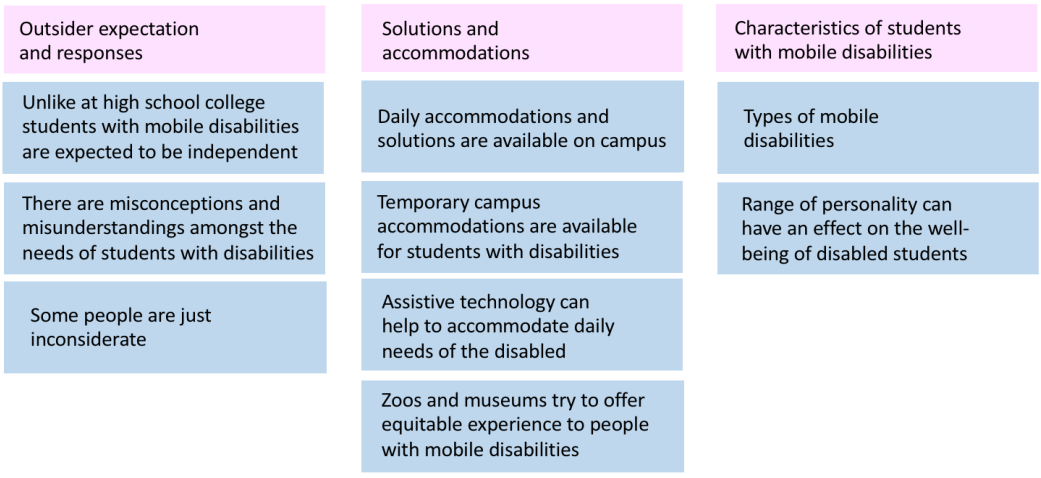
5. Analysis of user research data

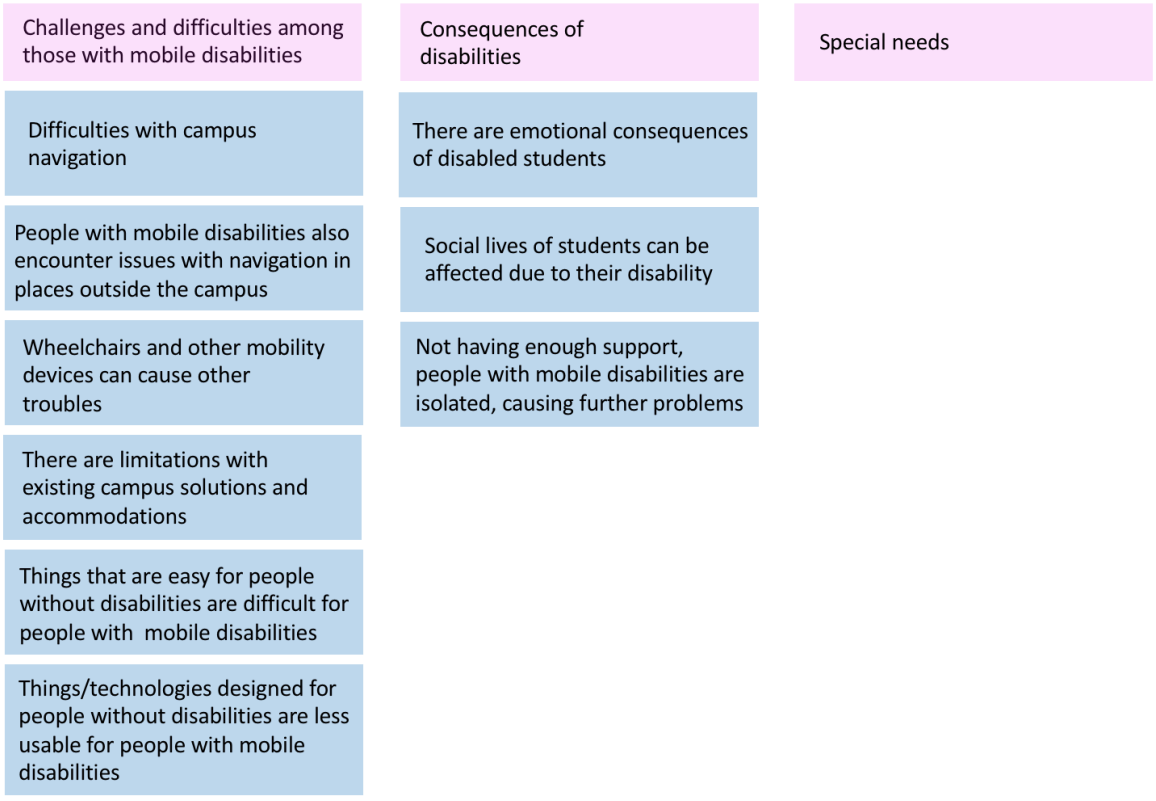
A) Data Analysis Summary

Method (e.g., interview, observation)	Data analysis approach (e.g., affinity diagramming)	Rationale for approach
Interviews with four people who have closely interacted with the target user group: college students with mobile disabilities. There were not many opportunities to interview students with mobile disabilities.	All interviews were audio-recorded and the recordings were transcribed. As a team, we coded the interview transcription, observational notes and forum postings. These codes were used to create affinity notes, each representing one idea. In a bottom-up fashion, we constructed an affinity diagram, as a group, with the affinity notes (see Appendix). This process resulted in 18 blue groups and 6 red groups. We summarize these groups in the following section.	The affinity diagram allowed us to more easily see trends and clusters in the data we collected. The process of constructing the affinity diagram as a team allows all team members (even those who have not participated in interviews) to immerse in the data and get a more concrete idea about our target user group.
We collected observation notes and photos documenting how a student making his way to study spaces at Georgia Tech.		
Reviewed postings on Reddit and College Confidential that were made by physically disabled college students, their friends and parents.		

B) Results

Using the interview data, the observational data and postings on Reddit and College Confidential, we created an affinity diagram (see Appendix). There are 18 blue groups and 6 red groups that are summarized by the following figure.





At a high level, our findings are:

1) The characteristics of students with mobile disabilities greatly vary. The type of mobile disabilities (e.g., muscular dystrophy vs broken foot while playing football) people have affect the type and duration of accommodations they need. Personalities also affect how people deal with their disabilities (e.g., people who are shy might feel uncomfortable to ask professors for help).

2) The challenges encountered by people with mobile disabilities vary. However, the biggest challenges for most of them is navigation and wayfinding. Many factors affect how they maneuver to a place. For instance, are there any ramps or obstacles along the way to the building I want go? Is the parking wheelchair accessible? Furthermore, these factors can sometimes be uncertain. Two of our interviewees commented on the constant construction at Georgia Tech. These construction might suddenly block a pathway, causing inconvenience to students with mobility issues.

3) While navigation is the main concerns of students with mobile disabilities, the existing solutions and accommodations are limited. For instance, students cannot reserve Stingerette on demand. It causes inconvenience if there is unexpected rain and students in a wheelchair need to use the service. While the campus map has accessibility information, it is not complete and not up to date. If there is a new construction site that blocks a pathway, people may not know it.

6. User Personas

Sarah

The student with muscular dystrophy

"Technologies like Siri make my life happens."

"Being able to connect to the web, you can travel the world!"

About Sarah

Sarah has muscular dystrophy. Her muscular disease means that she has limited hand control and her condition deteriorates over time.

In spite of her physical disabilities, she is very comfortable using technologies. She uses Siri for "everything", including creating PowerPoints, putting together Excel spreadsheets, and writing documents. Google home and Alexa allow her to use mainstream technology at home (e.g., environmental control).

Needs

Because of her physical condition, she needs to navigate the campus using Stingerette and her power wheelchair. Aside from navigation, she needs extended time for exams and quizzes because she cannot write very well. She also needs note-takers to take notes for her during class.

Frustration

To Sarah, navigating the campus is uncertain. There are places that satisfy the ADA requirements on campus but are still not accessible to her. One such example is her dorm. She is not able to open the door to her dorm because the button was too high. Every time when she go back, she can only wait until someone walk by to open the door for her.

She has a smartphone but her hands also get tired very easily. The only thing she could do is to switch between her right and left hands when she feels tired. Furthermore, because she uses a power wheelchair, it can be harder for her to move around and use her smartphone at the same time.

Anxiety for test and exams is quadrupled for her: she has to worry about the accommodations, getting to the test center for people with disabilities, whether everything is going to be right for the accommodation and above all, the tests.

Jane

The “regular” wheelchair user

18 years old

“I hate the constant construction on campus. One day there is no fence and then all of a sudden there is a fence.”

About Jane

Jane is healthy and her physical disability is stable but permanent. This means that wheelchair becomes a part of her life.

One thing that shocked her is level of independence people expect from her. At high school, her parents and the school take care of her doctor appointments and everything. At college, people with disabilities are considered adult and are expected to be independent. To be less reliant on other people, she is considering to replace her manual wheelchair with a power wheelchair.

Needs

At Georgia Tech, the course load is pretty high and she is taking a lot of classes. The major need she has is navigating the campus.

Frustration

When it comes to maneuvering the campus, the crowd and the terrain are clear headaches.

There are also some unpredictable factors that affect navigation. One of the thing she really hates is the constant construction around the campus. She might need to go one route one day and another the next day without knowing in advance. There is a campus map with accessibility information, but she notices that it is not updated.

She can use Stingerette but it has to be reserved a day before. As students cannot reserve Stingerette on demand, unexpected weather conditions can cause huge inconvenience. For instance, she might get drenched when she go to a classroom on her own using her wheelchair when there is a sudden rain.

7. Research Implications

There were many new insights gained from our target user group. Most of the insights were gained through the interview sessions. We learned about where pain points come from when disabled students maneuver around the campus. We learned about a wide variety of disabilities that we did not previously existed. For example, Liz Persaud stated that she has a print-related disability that makes holding papers and book difficult. This led her to claim that it was hard to even access Georgia Tech's online maps for handicap accessible spaces difficult. There were numerous new insights such as this gained from the interviews and task analysis portion of this project phase.

In addition to the limits that we discovered, there were also some surprising accommodations available for students that our research group found out about. Student with temporary disabilities (e.g., breaks a leg or foot) can use temporary accommodation (e.g., Stingerette). This is helpful in the cause of finding a particular building or study spaces in a more efficient manner. Students who cannot write their notes can get note-taking services. The note-takers are students from the class. Although this is not a direct corollary to navigating the campus, this exemplified some of the surprising facets of Georgia Tech's work done to serve students with disabilities in general.

8. Appendix

A. Interview Questions

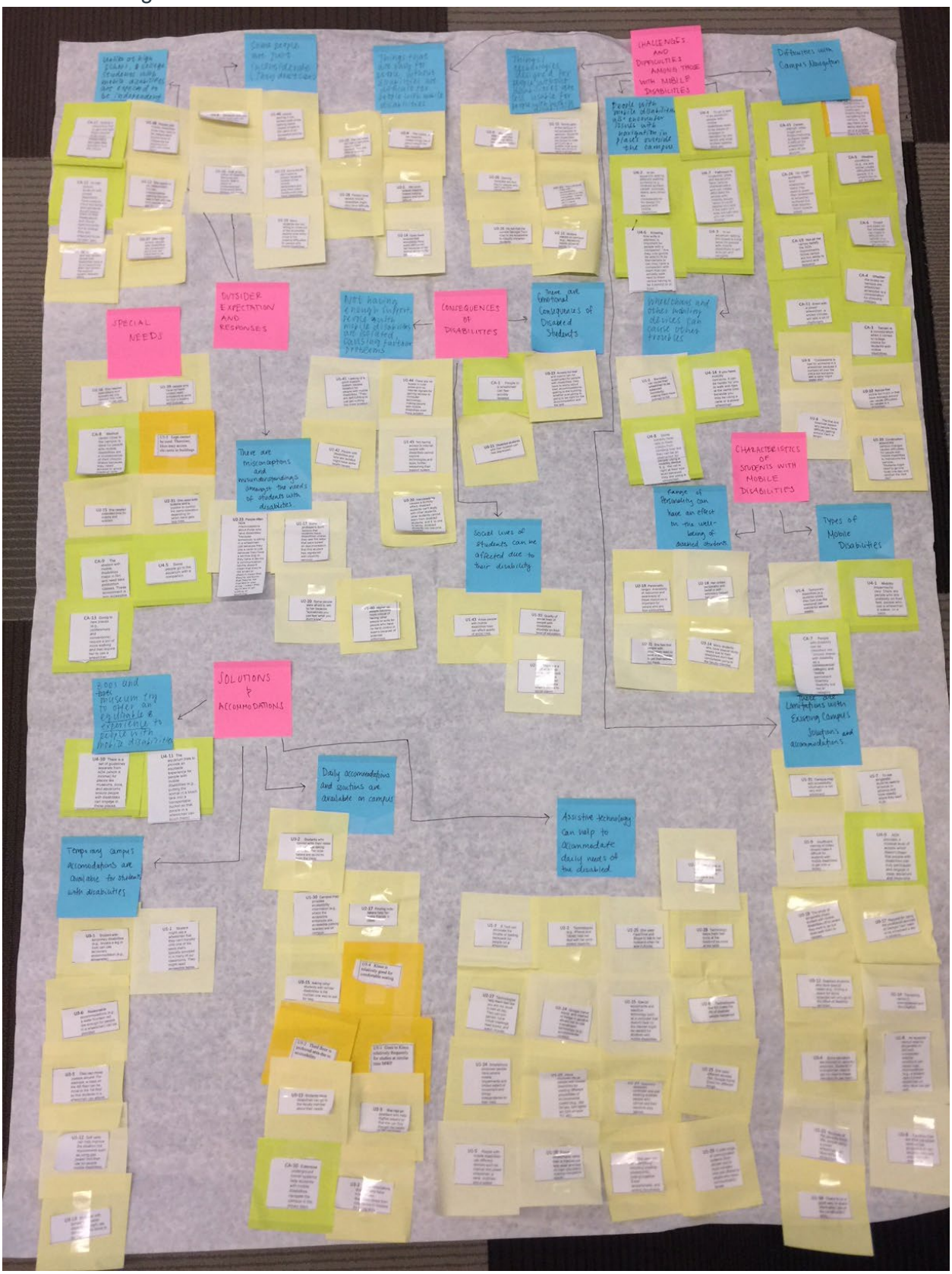
We conducted a semi-structured interview with the participants. There were three main interview questions. We also ask follow-up questions whenever we found an interesting point during the interviews.

Main interview questions:

1. Can you tell me more about your job at [an organization (e.g., ODS, AMAC)]?
2. What are the different types of mobile disabilities you saw?
3. What are the difficulties encountered by people with mobile disabilities while they are navigating the campus?
4. What are the difficulties encountered by people with mobile disabilities in the other aspects of their lives (e.g., their social life)?

B. Affinity Diagram

The whole diagram



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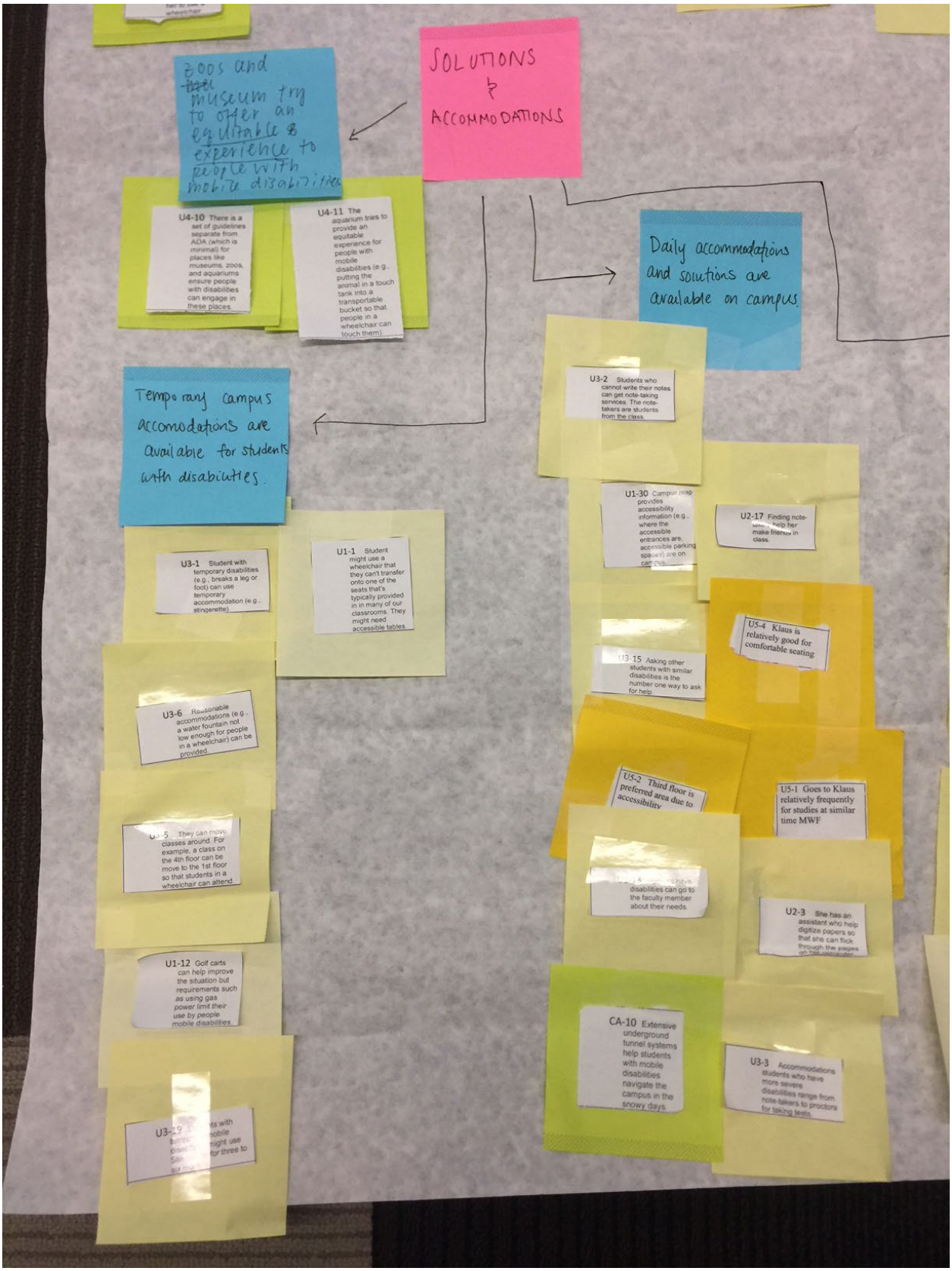
Zoos and museum try to offer an equitable & experience to people with mobile disabilities
SOLUTIONS & ACCOMMODATIONS
U4-10 There is a set of guidelines separate from ADA (which is minimal) for places like museums, zoos, and aquariums ensure people with disabilities can engage in these places.
U4-11 The aquarium tries to provide an equitable experience for people with mobile disabilities (e.g., putting the animal in a touch tank into a transportable bucket so that people in a wheelchair can touch them)
Daily accommodations and solutions are available on campus
Temporary campus accomodations are available for students with disabilities
U3-2 Students who cannot write their notes can get note-taking services. The note-takers are students from the class.
U1-30 Campus map provides accessibility information (e.g., where the accessible entrances are, accessible parking spaces) are on campus
U2-17 Finding note-taker help her make friends in class.
U3-1 Student with temporary disabilities (e.g., breaks a leg or foot) can use temporary accommodation (e.g., stingerette)
U1-1 Student might use a wheelchair that they can't transfer onto one of the seats that's typically provided in in many of our classrooms. They might need accessible tables
U5-4 Klaus is relatively good for comfortable seating
U3-15 Asking other students with similar disabilities is the number one way to ask for help
U3-6 Reasonable accommodations (e.g., a water fountain not low enough for people in a wheelchair) can be provided
U5-2 Third floor is preferred area due to accessibility
U5-1 Goes to Klaus relatively frequently for studies at similar time MWF
U3-5 They can move classes around. For example, a class on the 4th floor can be move to the 1st floor so that students in a wheelchair can attend.
disabilities can go to the faculty member about their needs.
U2-3 She has an assistant who help digitize papers so that she can flick through the pages on her computer
U1-12 Golf carts can help improve the situation but requirements such as using gas power limit their use by people mobile disabilities
CA-10 Extensive underground tunnel systems help students with mobile disabilities navigate the campus in the snowy days.
U3-3 Accommodations students who have more severe disabilities range from note-takers to proctors for taking tests

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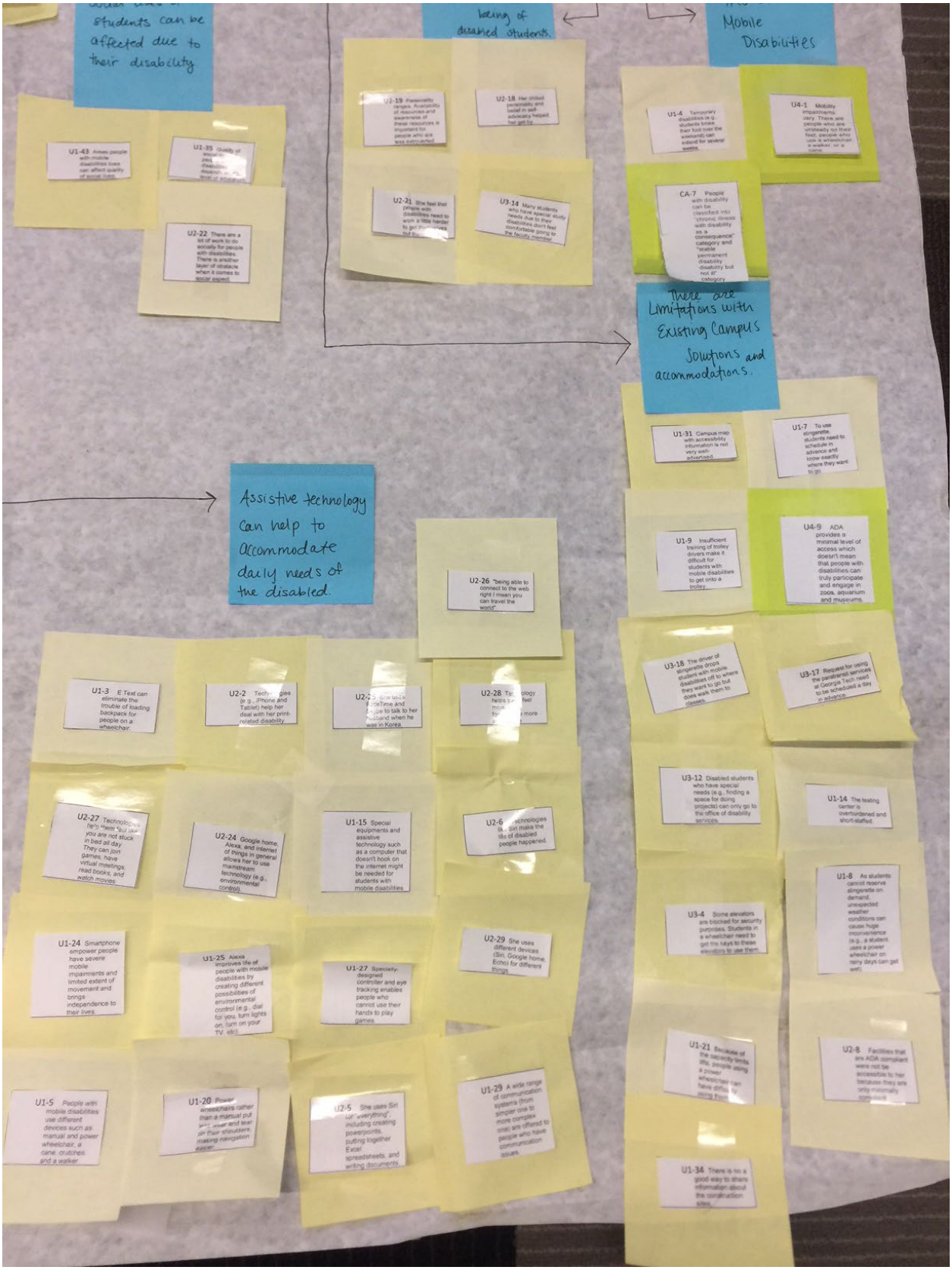

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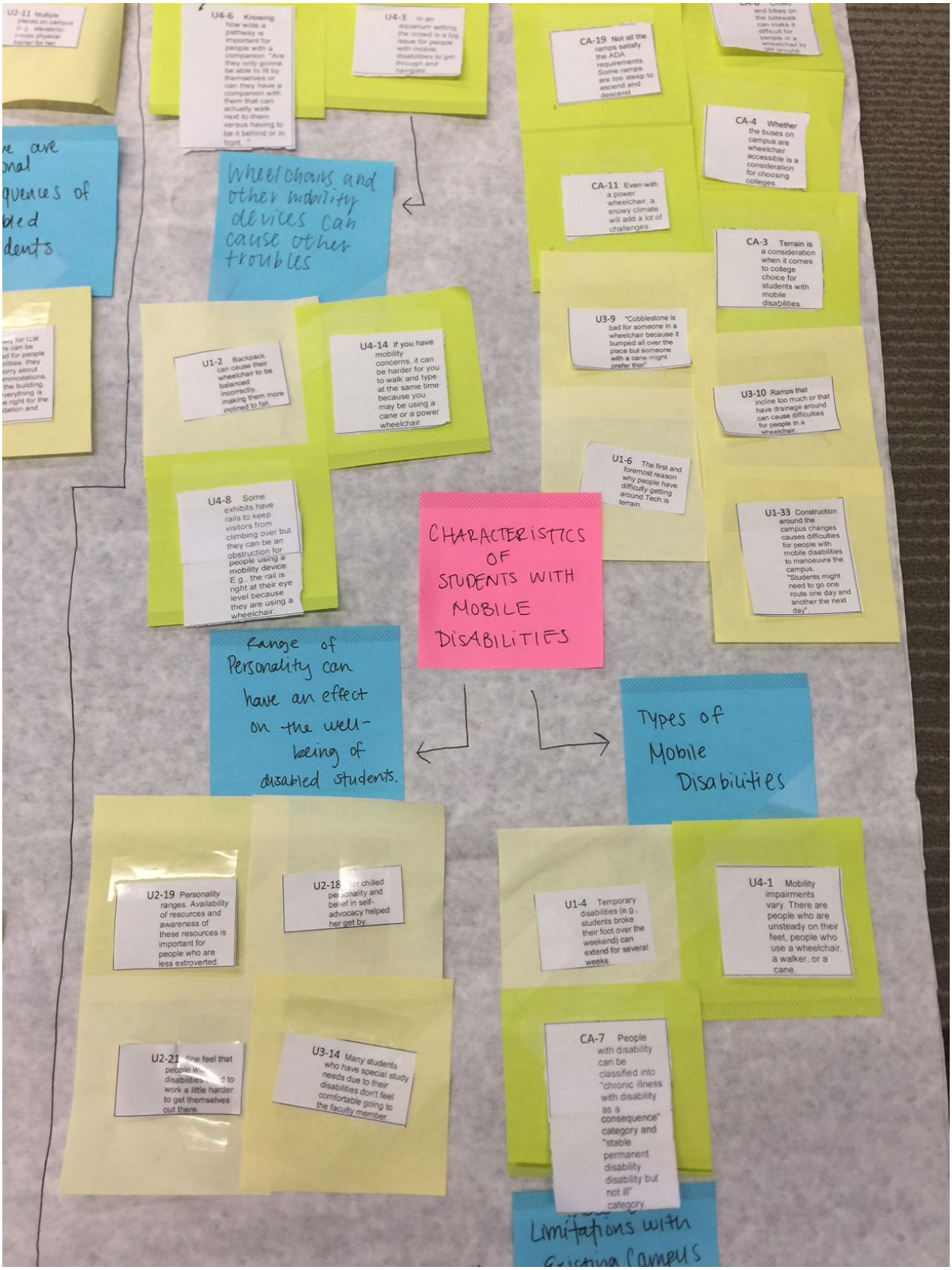

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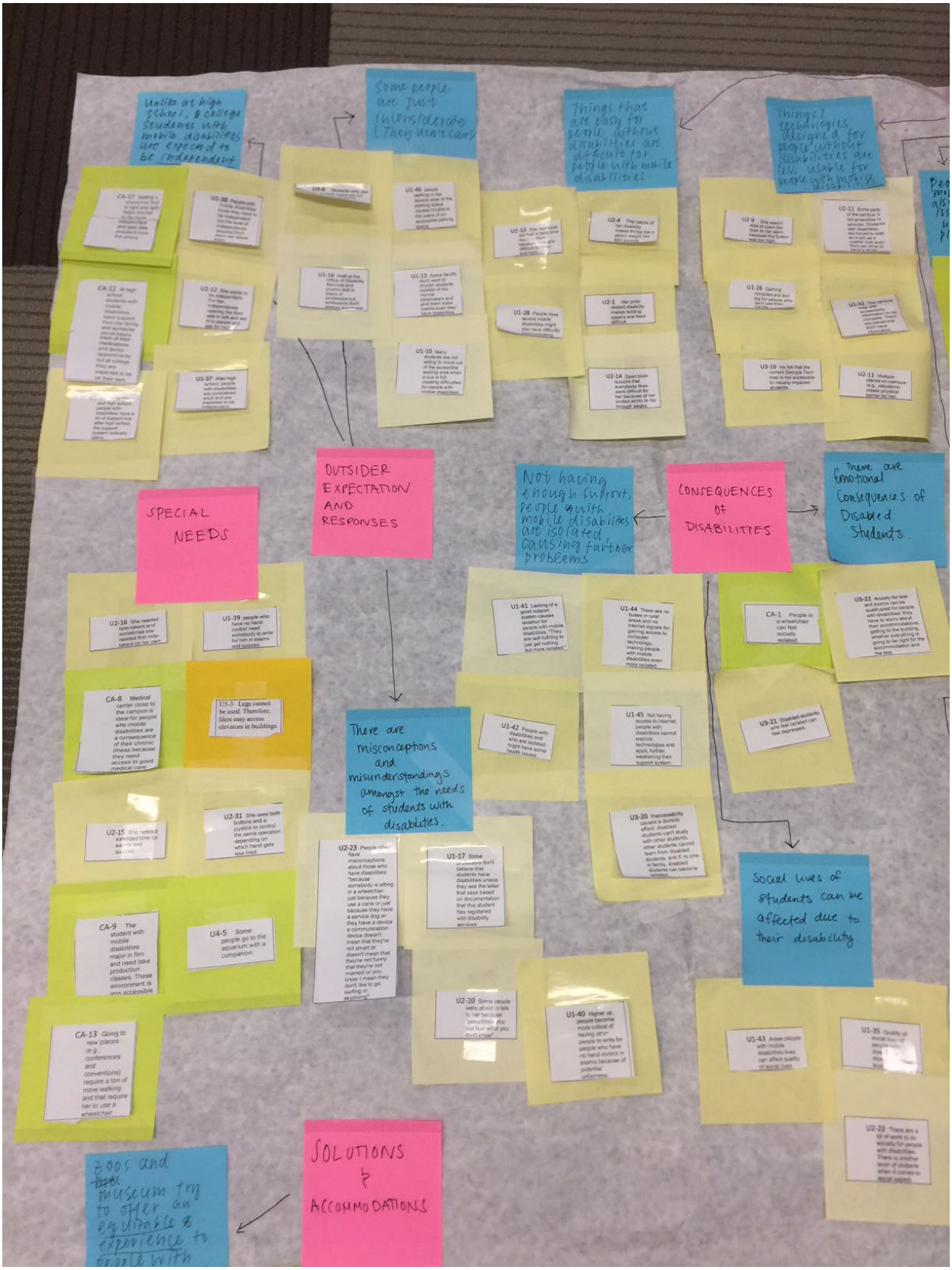
Unlike at high school, a college student with mobile disabilities are expected to be independent
Some people are just inconsiderate (They don't care)
Things that are easy for people without disabilities are difficult for people with mobile disabilities
Things/technologies designed for people without disabilities are less usable for people with mobile disabilities
SPECIAL NEEDS
OUTSIDER EXPECTATION AND RESPONSES
Not having enough support, people with mobile disabilities are isolated causing further problems
CONSEQUENCES OF DISABILITIES
There are emotional Consequences of Disabled Students
There are misconceptions and misunderstandings amongst the needs of students with disabilities.
Social lives of students can be affected due to their disability
SOLUTIONS & ACCOMMODATIONS
Zoos and Museum try to offer an equitable & experience to people with

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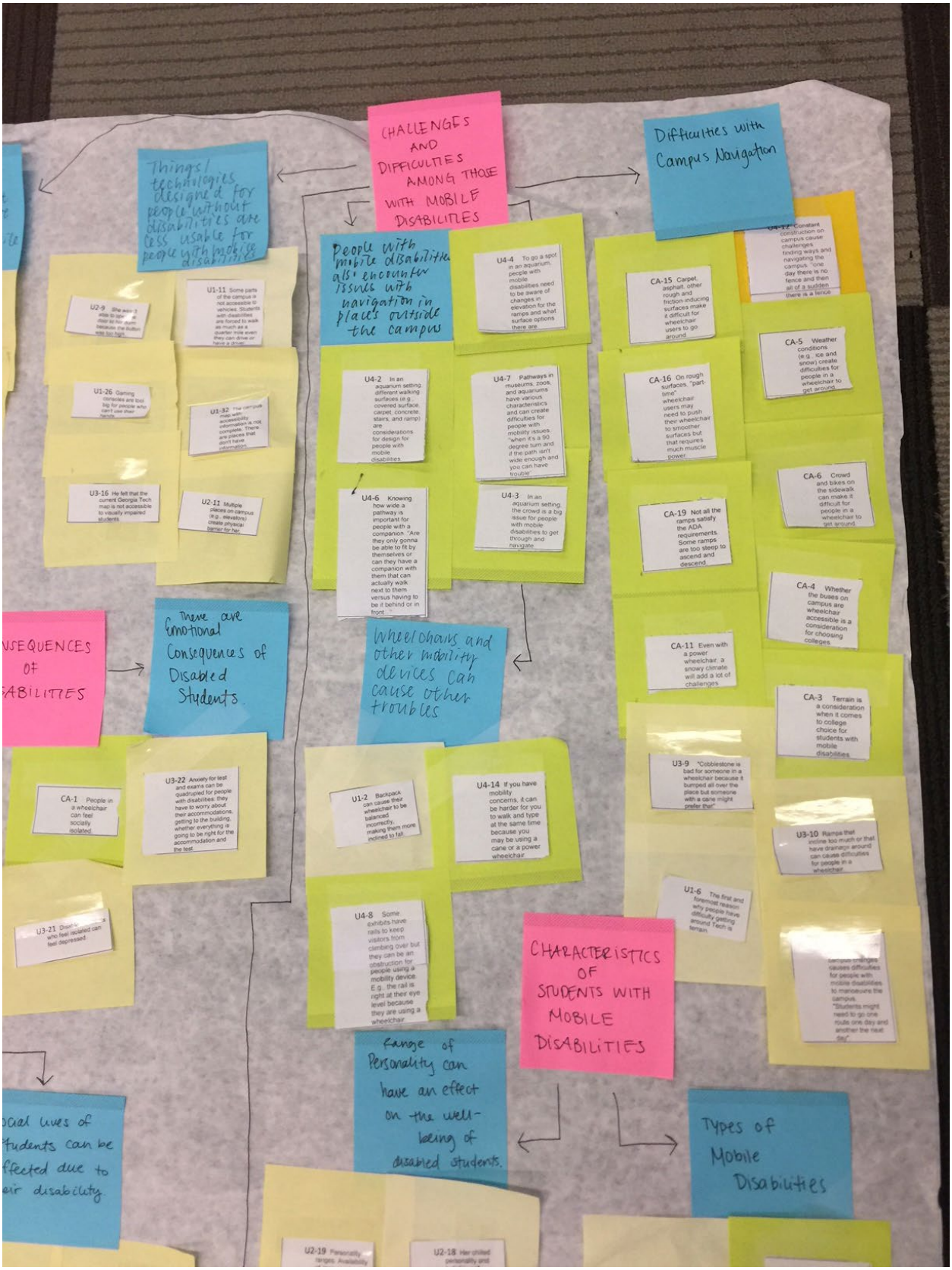

CHALLENGES AND DIFFICULTIES AMONG THOSE WITH MOBILE DISABILITIES
Things/ technologies designed for people without disabilities are less usable for people with mobile disabilities
People with mobile disabilities also encounter issues with navigation in places outside the campus
Difficulties with Campus Navigation
CHARACTERISTICS OF STUDENTS WITH MOBILE DISABILITIES
Range of Personality can have an effect on the well-being of disabled students.
Types of Mobile Disabilities
Wheelchairs and other mobility devices can cause other troubles
There are Emotional Consequences of Disabled Students
U1-11 Some parts of the campus is not accessible to vehicles. Students with disabilities are forced to walk as much as a quarter mile even they can drive or have a driver.
U1-26 Gaming consoles are too big for people who can't use their hands.
U1-32 The campus map with accessibility information is not complete. There are places that don't have information.
U2-11 Multiple places on campus (e.g., elevators) create physical barrier for her.
U3-16 He felt that the current Georgia Tech map is not accessible to visually impaired students.
U4-2 In an aquarium setting, different walking surfaces (e.g., covered surface, carpet, concrete, stairs, and ramp) are considerations for design for people with mobile disabilities
U4-4 To go a spot in an aquarium, people with mobile disabilities need to be aware of changes in elevation for the ramps and what surface options there are.
U4-6 Knowing how wide a pathway is important for people with a companion. "Are they only gonna be able to fit by themselves or can they have a companion with them that can actually walk next to them versus having to be it behind or in front."
U4-7 Pathways in museums, zoos, and aquariums have various characteristics and can create difficulties for people with mobility issues. "when it's a 90 degree turn and if the path isn't wide enough and you can have trouble"
U4-3 In an aquarium setting, the crowd is a big issue for people with mobile disabilities to get through and navigate
CA-15 Carpet, asphalt, other rough and friction-inducing surfaces make it difficult for wheelchair users to go around
CA-16 On rough surfaces, "part-time" wheelchair users may need to push their wheelchair to smoother surfaces but that requires much muscle power
CA-19 Not all the ramps satisfy the ADA requirements. Some ramps are too steep to ascend and descend.
CA-5 Weather conditions (e.g., ice and snow) create difficulties for people in a wheelchair to get around.
CA-6 Crowd and bikers on the sidewalk can make it difficult for people in a wheelchair to get around.
CA-4 Whether the buses on campus are wheelchair accessible is a consideration for choosing colleges.
CA-11 Even with a power wheelchair, a snowy climate will add a lot of challenges.
CA-3 Terrain is a consideration when it comes to college choice for students with mobile disabilities
U3-9 "Cobblestone is bad for someone in a wheelchair because it bumped all over the place but someone with a cane might prefer that"
U3-10 Ramps that incline too much or that have drainage around can cause difficulties for people in a wheelchair
U1-6 The first and foremost reason why people have difficulty getting around Tech is terrain.
U1-2 Backpack can cause their wheelchair to be balanced inconsistently, making them more inclined to fall.
U4-14 If you have mobility concerns, it can be harder for you to walk and type at the same time because you may be using a cane or a power wheelchair
U4-8 Some exhibits have rails to keep visitors from climbing over but they can be an obstruction for people using a mobility device. E.g., the rail is right at their eye level because they are using a wheelchair
CA-1 People in a wheelchair can feel socially isolated.
U3-22 Anxiety for test and exams can be quadrupled for people with disabilities. they have to worry about their accommodations, getting to the building, whether everything is going to be right for the accommodation and the test
U3-21 Disabled people who feel isolated can feel depressed.
U4-12 Constant construction on campus cause challenges, finding ways and navigating the campus. "one day there is no fence and then all of a sudden there is a fence"
U2-19 Personality ranges: Availability
U2-18 Her chilled personality and

C. **Student Survey (Because we only received one response from a non-student, we did not use this as an analysis tool to summarize results, but will include for the report for research ethics.)**

Which campus resources have accommodated you the most (list as many as you'd like)? *

Long answer text

On a scale from 1-10 (1 being the most difficult and 10 being the easiest), please rate your ability to find a study space on campus that is both comfortable and accommodating. *

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

Where on campus are you most like to study and why? *

Long answer text

Provide a story of a time where you felt uncomfortable or unable to find a space while studying here on campus. *

Long answer text

Provide a story of a time when you felt comfortable and easily able to find a space here while studying on campus. *

Long answer text

Results:

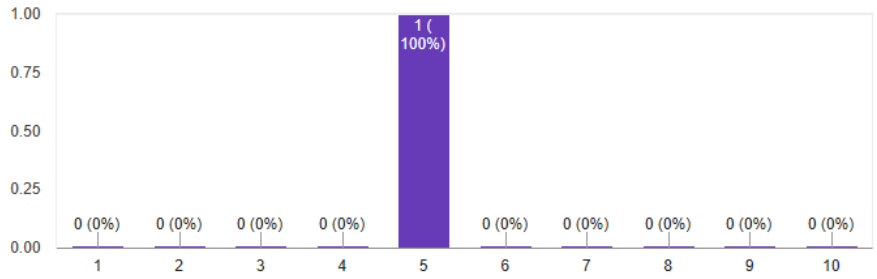
Which campus resources have accommodated you the most (list as many as you'd like)?

1 response

bus system

On a scale from 1-10 (1 being the most difficult and 10 being the easiest), please rate your ability to find a study space on campus that is both comfortable and accommodating.

1 response



Where on campus are you most like to study and why?

1 response

I am not a student but i did rehab at University of Iowa hospitals

Provide a story of a time where you felt uncomfortable or unable to find a space while studying here on campus.

1 response

was not a student after my disability

D. Task Observation

The user in the wheelchair is finding his way to a study space.