SeaTulane App

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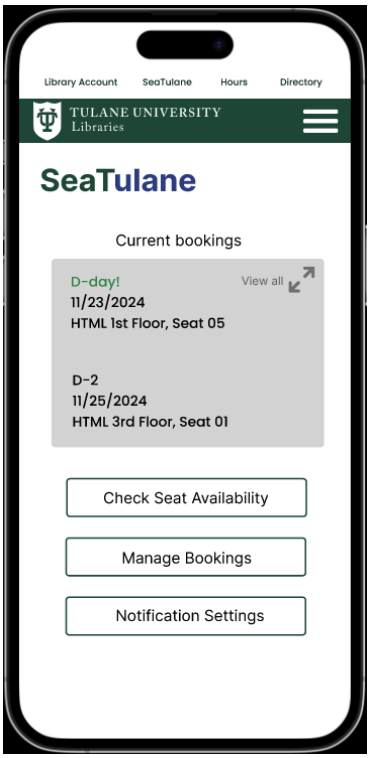

Alternative text: A smartphone screen displaying the 'SeaTulane' interface for Tulane University Libraries. The 'Current bookings' section shows two entries: 'D-day! 11/23/2024, HTML 1st Floor, Seat 05' and 'D-2, 11/25/2024, HTML 3rd Floor, Seat 01.' To the right of the section, a 'View all' icon with an arrow is visible. Below, three buttons are displayed: 'Check Seat Availability,' 'Manage Bookings,' and 'Notification Settings' for user actions.

ABSTRACT

The goal of our project is to create an app that will allow Tulane students to track, and reserve available seats in study spaces around campus, primarily Howard Tilton Memorial Library. The application will allow users to view a capacity tracker, view available seats through a seat map, and reserve potential seats. We interviewed and conducted a survey among the Tulane community – 31 participants total – to determine pain points. The themes conceptualized in the interviews serve as the foundation for the application design and use cases. Furthermore, we will explore ways to expand the system in future research to better accommodate the specific needs of individuals looking to study on campus.

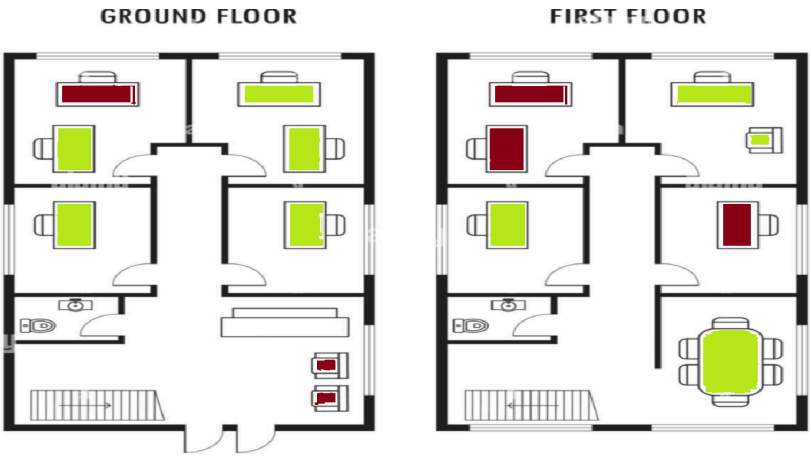

Figure 1. An example of what the seat availability UI design may look like. The available seats will appear in green, while occupied seats appear in red.

Alternative text: An illustration showing seat availability maps for a ground floor and a first floor. The layout features a white background with black outlines representing the desk and chair arrangements in a schematic format. Seat availability is visually indicated: available seats are highlighted in green, and occupied seats are highlighted in red.

GETTING THE RIGHT DESIGN

1. USER RESEARCH PROCEDURE

1.1.1. Method 1: Interviews

Participants

To recruit interviewees, we asked acquaintances who have spent at least two semesters attending Tulane as an undergraduate student whether they would be available to interview. We then set a date and time and met in-person at the established location (or online.) The interviewees were then asked a list of predetermined questions, with follow-up questions asked as necessary. The interviewee's demographic information can be found below:

1. P1: Fourth-year student living off-campus. Student at the school of liberal arts.
2. P2: First-year student living in the dorms. Student of Political Science at school of liberal arts.
3. P3: Fourth-year student living off-campus: studying accounting in the A.B. Freeman School of Business. Lived on campus for the first two years and off campus starting in the third-year (was not at Tulane for fall of third-year due to study abroad).
4. P4: Fourth-year student living off-campus: studying neuroscience in the School of Science and Engineering. Lived on campus for the first two years and off campus starting in the third-year.
5. P5: Third-year student living off-campus. Studying mathematics, Italian, and computer science. Lived on campus for the prior two years.
6. P6: Third-year student living off-campus on the pre-med track. Lived on campus for the prior two years.
7. P7: Fourth-year student living off-campus, studying public health and biology.
8. P8: First-year PhD student living off-campus. Student at Department of History.

Protocol

The interviewee was approached and asked whether they would like to be interviewed regarding seat availability in the library. If they verbally consented to the interview, we would then set a date and time to meet in person or over Zoom. Before conducting any interviews, all four group members convened to assemble a list of appropriate interview questions about experiences with campus study spaces.

Upon meeting at the agreed time, we inquired whether the interviewee was okay with being recorded – if so, the interview would then be recorded for later transcription purposes. The participant was then asked the predetermined questions (Appendix A). The interviews took approximately 11-18 minutes from beginning to completion. If the interviewer determined any additional or follow-up questions would be helpful, they would ask these in addition to the pre-planned question.

1.1.2. Method 2: Survey

Participants

To recruit participants for our survey, we sent the survey link to our communities via text messaging, Slack channels, and Canvas. Any student attending Tulane was qualified to take the survey, and we received 27 participant responses. Our participants were majority undergraduate seniors (59.3%), with the remaining students in their sophomore, junior, and graduate years. All but one participant attends Tulane's uptown campus (as opposed to downtown), with 74.1% living on their respective campus. Participants belonged to the following schools: School of Science and Engineering (44.4%), A.B. Freeman School of Business (33.3%), School of Liberal Arts (18.5%), and School of Public Health and Tropical Medicine (3.7%).

Protocol

Similarly to preparing for interviews, we met as a group to generate appropriate survey questions and formulate them, along with demographic questions, into an easily accessible Google form, which is linked below in Appendix B. Google forms with shareable links allow anyone with access to a screen-based device to participate in surveys, and is extremely easy for survey formulation, hence our choosing of the platform. The

duration of the surveys was not monitored, but we anticipated (and informed participants) that completion should only take about 5 minutes.

Participants were informed that all responses were anonymous: no personal or identifiable information, such as name, student ID, or email, was collected with survey responses. Participants were also informed of the subject topic – campus study spaces – and that the data was going to be contributed towards a course project.

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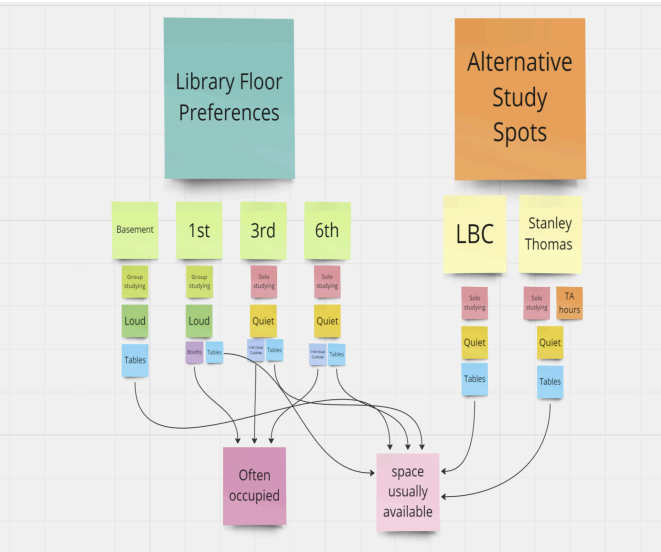
2. ANALYSIS METHOD

2.1.1. Interviews



Alternative text: A diagram showcasing axial coding for library floor preferences and alternative study spots. The left side, titled "Library Floor Preferences," includes labeled cards for "Basement," "1st," "3rd," and "6th" floors. Each card notes specific attributes such as "Group studying" or "Solo studying," "Loud" or "Quiet," and "Tables." Lines connect these attributes to broader categories like "Often occupied" or "Space usually available" at the bottom. On the right, titled "Alternative Study Spots," cards labeled "LBC" and "Stanley Thomas" also detail attributes like "Solo studying," "Quiet," and "Tables," linking to the same broader categories at the bottom.

The interviews were transcribed using auto-transcribe tools such as those available online, and built-in text-to-speech features in Zoom, and Meet. The survey results were compiled in the form of a spreadsheet form. Each group member conducted and analyzed two interviews after which the individual analyses were combined. The interview transcripts were first carefully dissected through open coding. Patterns conceptualized between resulting codes gave rise to unique categories, otherwise known as axial coding. The categories were then sorted under larger theme buckets based on their connections. The themes suggested by

each member were then analyzed together. Overlapping themes were combined to form three coherent major themes across the interviews.

2.1.2. Survey

The survey was designed to obtain clear, and concise answers to significant questions pertaining to the campus study spaces. Surveys were second to interviews, and had two purposes: 1) act as supporting material that we could incorporate in our analysis and resulting findings. 2) provide supporting information that can help us in specifying the design of the tool. i.e., important information such as average study session duration, and frequency of weekly visits.

2.2. Findings

We interviewed eight and surveyed twenty-seven Tulane students to explore and understand the landscape surrounding dedicated study spaces on campus and the implications of the current situation on the student body. Our analysis resulted in seven themes which can be further categorized into three major themes. Three major themes (with multiple sub-themes each) emerged from our interviews and survey results with participants: 1. Limited availability of dedicated study spaces; 2) Unequal access to resources; 3) Students' behavioral adaptations to cope with the situation.

1. Limited availability of dedicated study spaces

We define a 'dedicated study space' as an area that is primarily designed to facilitate students' studying outside the classroom. The interview highlighted the scarcity of dedicated study spaces around campus and the associated challenges. We also found that students use alternative spots for studying when they fail to find a spot in a dedicated study space.

1.1. Limited study spaces and resources within

Tulane campus has two primary study buildings: Howard-Tilton Library and Newcomb Hall (business center). There is a high demand for spots in these spaces as they are frequented by students who wish to study on

campus. The library has open access to the entire general body, while access to the business center is limited (discussed in 2.1), This leads to an increased dependency on the library alone to accommodate the student body at large, as P1 mentioned: “I think all of the library is for everyone that's not in the business school and it's, like, a lot of students.” Multiple aspects of our interviews support the idea that the library, specifically, is an important place for students to study and complete work. The library offers a unique “level of focus” that other campus study spots, such as the business school (“The B School”) do not. According to P3, “people come up and talk to [you]” so you “get no work done [and] it’s a problem”. The library is a “quiet” place where people keep to themselves and don’t talk (unless in common spaces), which is important for students who need peace and quiet to complete their work/studying. This is also supported by the survey results: about three-fourths of the total participants indicated using the library, and 63% of the total using school buildings. 48% utilize the library as the primary study spot.

Our interviews also highlighted the frustration of commuting students coming to campus only to find no available seats, as P1 expresses “It's very annoying to get to the library, and there's nowhere to be.” This situation can be avoided if the students can track the available capacity in study spaces. There is a desire to know in advance what seats are available to avoid wasting time circling around. 67% of survey participants indicate a struggle to find an empty seat and 50% indicate that they have wasted time looking for an empty seat. Students just want to sit down and get to work when they enter the library, without wasting minutes – that could have been spent studying – circling for a study spot. Those minutes add up. While talking about a mitigating strategy, P1 says “I wish there was a way to check how many seats were available.” P7 also expressed interest in a system that would provide real-time updates on seat availability, noting that it can be frustrating to walk around multiple floors and sections just to find a spot. “I would love to know which areas have seats available,” P7 said, explaining that this would save them a lot of time and effort. About 75% of participants in the survey indicated that having a way to check capacity would help them decide if they should go to the library. This would save students time by prompting them to make alternative plans, instead of wasting time looking for a seat. P7 demonstrated an openness to using technology like mobile apps or QR codes to enhance the study experience. They are already familiar with using QR codes in extracurricular activities and would be willing to use similar tools in an academic setting to streamline the process of finding

available seats. “It sounds easy enough,” they said, emphasizing how a digital solution could make campus life more convenient. About 93% of survey participants also indicated that they are comfortable using QR codes.

While a capacity tracking system could be useful in the short term, the current situation also nudges the university to bring about infrastructure changes by creating more dedicated study spaces on campus. P1 talked about how Tulane (administration) could play their part in helping with this situation: “Tulane could expand study spaces.”

Apart from using shared spaces for studying, students also sometimes book private study rooms due to the privacy, or the additional facilities that are otherwise not available in shared spaces. Recalling their recent experience of using a private study room in Newcomb Hall, P1 said: “And I had, like, a small room rented out or, like, booked for because it had a whiteboard in it.”

1.2. Inadequate alternative spots

The library is not the only study spot on-campus students use. Other locations have their own pros and cons. Considering we want to implement a capacity/seat occupancy tracker, we should consider whether the library is the best location to do this project. Students often use alternative areas for studying, such as Lavin Bernick Center (LBC), when they fail to find a spot in a dedicated study space. Stanley Thomas Hall is a good spot “because there’s a whiteboard and [P5 gets to] to sit on the tables,” while the LBC lounge is a good spot because “it’s really quiet and there’s all the big counter seating,” even though the chairs were reported as being uncomfortable (P5) These areas are, however, not necessarily designed keeping students’ studying needs in mind. Therefore, these alternative spots are inadequate in terms of capacity and do not provide a conducive environment for studying. P1 found alternative spots to be unideal for her studying needs. They state: “for example, in the LBC, people are eating lunch. Meeting people there. Not everyone is studying. There are some people, but not everyone.” P8 reported that a lack of accessible information regarding alternative study spaces on campus contributes to difficulties in finding suitable spots. There are few resources such as community boards or school bulletins that provide information about lesser-known study locations. This limitation forces students like P8 to stick to familiar places, further intensifying the competition for seats in high-demand areas such as the library.

2. Unequal access to resources

Our interview brought forth valid concerns about inequitable access to study spaces among the student body. Some schools at Tulane have exclusive study spaces which are open to students of that school only. This leads to unequal opportunities to secure study spots, and book study rooms in school buildings.

2.1. Restricted Access to Study Spaces

Access to study spaces located within school buildings is usually restricted based on school affiliation, for example, the business center has private study rooms and shared study spaces available for business students. However, not all school buildings have study spaces which leaves a portion of the student body with access to fewer spaces. P1 is a student at Tulane's liberal arts school. According to P1, there are no study spaces in the liberal arts buildings. "-I'm technically in the school of liberal arts, and there's no study spaces in any of those buildings. I know for some of the sciences, like, the new, like, Paul Hall, like, they have some study spots, but, like, none of the liberal arts buildings have any dedicated places to, like, sit and do work.", they added while speaking of their concerns about lack of study spaces in the liberal arts buildings.

Students in schools with no dedicated spots have to rely entirely on the library. Our survey indicated that a majority of participants frequent their usual study spots from 12 PM to 10 PM. This makes up for a large portion of the student body, contributing to overcrowding and lack of seating during rush hours, as P1 highlighted "...all of the library is for everyone that's not in the business school and it's, like, a lot of students." and "...most of my friends who aren't in the business school stick to the library only."

2.2. Inability to Reserve Study Spaces

Students are also interested in utilizing private study rooms, which come with the benefits of privacy, more space, and at times, additional amenities. While students can book private study rooms on campus, it is often limited by their school affiliation. An online portal is available to reserve these private spaces located in school buildings, to which access is limited to affiliated students, for example, the business school has private study rooms that can only be reserved by business school students. Students have to rely on their friends who go to

that school to gain access to these spots, with P1 expressing their frustration: “I think it's hard because, like, for example, I'm not in the business school and I have to book out like, I have to get my friend who's a business student to book out rooms.”

3. Behavioral adaptations among students

Our interview helped us identify behavioral patterns among students, some of which have been developed in response to the limited availability of seats and resources in current study spaces. These behavioral patterns range from strategies to maximize the chances of securing a seat, reserving private study rooms for specific needs, and tactics employed by off-campus students.

3.1. Seating preferences, and strategies

Different floors of the library are suited to different purposes. The first floor and the basement are suited to group work because participants “-can talk to [my] friends” and “there are a lot of open tables with multiple seats at them.” The third and sixth floors are better for individual work, as “it’s completely quiet and nobody’s talking” (P5) Generally, the floors of the library get quieter the higher you go, so it makes sense that the upper floors are better for independent studying while the lower floors’ louder volume allowance suits group work. P7 prefers spaces that are quiet but not completely silent, striking a balance between calm and productivity. For example, they often choose the second floor of the library because it’s quieter than the first floor but not as intense as the higher levels, where the atmosphere tends to be more stressful. “The second floor is just calmer and more relaxed,” P7 explained, making it their go-to spot when they want to focus without feeling overwhelmed. P3 is “always on the second floor, that’s a guarantee”, and “hopefully next to a window”, because that’s what works for them. If no seats are available where a student wants to sit, they may just “give up and leave”.

Data from our interviews support that students value where they sit when they study. Of the different kinds of seats (booths, tables, and individual study cubbies,) the booths are the most popular to use. There often aren’t any available to use in the library, P5 says: “The booths in the library are filled quite often, most of the time”. However, the individual study desks are also popular- “during finals season they’re never empty”

(P5.) P7 has developed a consistent routine when navigating the library, following the same path each time. Upon entering, they head straight to the stairs, go up a flight, and turn left through a set of double doors. From there, they make their way to the back left corner of the floor, where they prefer to study. “So I go inside, and I walk to the stairs, and I go up the flight. Then I need to turn left and go through these double doors. I usually go straight to the back, turn left, and go to that back left corner,” P7 explained. This area typically has a cubicle section with four tables, and P7 always tries to pick a table where no one else is seated yet, reflecting their preference for a quiet and private study environment. Additionally, P8 mentioned that they prefer sitting where there is no direct eye contact with others and avoid sitting next to someone even if a seat is available, highlighting that layout and ambiance matter just as much as seat availability. When selecting a study space, P7 prioritizes access to power outlets because their laptop often runs low on battery. They also prefer spaces with plenty of available tables, so they don’t have to “fight over a desk,” as P7 put it. They gravitate toward locations like the library or private study rooms at Paul Hall and the Hub, which offer individual cubicles and private rooms that make it easier to focus.

Students appear to strategize to navigate the challenges surrounding the study spaces. P3 outlined a few separate issues with the current library, including hours of operation and space. The library is not open early in the morning on the weekends, which is problematic for “people that wake up early” and want to get a head start on schoolwork. Seating is limited and therefore competitive, specifically for students like P3 who have strong seating preferences. The amount of students flocking to the library increases as the day goes on, which can cause students to “walk laps for 25 minutes and still [not] find an open seat”. According to P3, opening the library earlier would solve that problem and make finding a seat “really easy” (for early-comers).

Recounting their experience, P1 noticed that students also tend to leave their belongings on the seats during less crowded hours. Our survey results indicated that 92% of the participants had previously left their belongings to save seats. P7’s study sessions usually last about an hour before they feel the need to take a break. They leave their belongings—like a water bottle or notebook—at their table, then take a quick walk around the building or refill their water to recharge. This routine helps them avoid burnout from sitting too long while keeping their study momentum going. For P7, these regular breaks are essential to staying focused and productive. P1 mentioned that during rush hours and finals, students choose to remain in their seats at all

times to keep their spots. Naturally, it is harder to find a seat in the library during busier hours of the semester as more students tend to flock to the library which is something P1 experienced as well: “-during finals or if I'm there a little bit later in the morning, it's harder to find a seat.” P7 often finds it difficult to secure a seat during peak times, such as finals or midterms, when the library gets crowded. They anticipate facing this issue again as midterms approach, recalling how hard it was to find a spot last year. The cubicles are separated by dividers, making it impossible to see all available seats at once, which only adds to the challenge of finding a place to sit during busy periods.

Another strategy that seems to help is going early in the day, which increases the likelihood of one finding a desirable spot in the study spaces. P1, who tends to arrive early, is able to find a cubicle which during later hours are more difficult to find, “I think in the library, I'm, like, an early morning person, and I think I wake up earlier than the average undergrad. So I usually am able to find, like, a cubicle…”

3.2. Off-campus students

Commuting students also rely on study spaces on campus for their studying needs outside the classroom. Their choice to go to the campus for the primary purpose of studying depends on how much time they intend to dedicate to that particular study session. A shorter study session prompts commuters to not go. In the case of P1, the study session needed to be at least two hours long: “-if I'm going on campus because I live off campus… I'm gonna stay there for at least 2 hours. If it's something less, I probably won't, like, go somewhere.”

Frustrations associated with a scarcity of study spaces show that off-campus students are at a greater disadvantage as they risk coming to campus only to find no seats available.

3.3. Reservation-based study spaces

Students have also been shown to utilize private study rooms for various reasons. For instance, P1 had reserved a private study room for solo studying and needed to utilize the large whiteboard available in that space. These study rooms require reservation ahead of time as they are often located in certain school buildings which makes them inaccessible for students who do not belong to the school. To gain access to these places,

students either accompany their friends or have their friends book these rooms, as P1 recounts “-so my friend actually booked it for me because she's in the business school.” This falls under the infringement of school rules; however, it highlights a need among students for private study spaces. Such private study spaces can be particularly helpful in simulating testing conditions, carrying out group discussions, or using whiteboards for visual learning.

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3. MODELING DATA

3.1. Modeling Approach

We arrived at our user and environment’s characteristics through analysis of our interviews and surveys. Since the majority of students interviewed were working on their undergraduate degree or graduate degree and had not taken a break from high school to university, we decided to narrow the age range down to 18-26 (where 18-22 is the average age range for Tulanians completing an undergraduate degree, and 22-26 is the average age range for Tulanians completing a graduate degree.)

We decided to note whether the student lived on-campus or off-campus, as that would likely impact their preferred study location. Students living on-campus would be looking for a quiet space to study, while off-campus students would have to consider the amount of time it would take them to commute to campus and back to study.

For this study, considering that we are focusing on an 18-26-year-old age demographic, the majority of our users will be technologically adept enough to use our product with ease (assuming a relatively simple method of access e.g., searching for and clicking on the SeaTulane website.)

3.2. User Profiles

	Group 1 Characteristics	Group 2 Characteristics	Group 3 Characteristics	Group 4 Characteristics

Age	20-26	18-20	19-24	18-26
Residence	Off-campus apartment or house	On-campus residence hall	Residence hall or off-campus apartment	Residence hall or off-campus apartment
Study preferences / culture	Minimal commute to study space	Minimal commute to study space	Quiet	Long study sessions
Needs	Change of scenery for studying, motivation to do so	Studious environment (dorms are not that)	A fully quiet environment	A study location where they can stay for hours / all-day
Attitudes	Will use it to determine whether there is room to study on campus before leaving home.	Likely to use app due to living on-campus	Less likely to use- product tracks seat capacity, not loudness levels.	May use depending on workload and proximity to campus (if living off-campus.)
Technological abilities	Adept	Adept	Adept	Adept

Alternative text: A table summarizing user profiles categorized into four groups based on various characteristics:

- **Group 1 Characteristics:** Age 20-26, lives in off-campus apartments or houses. Prefers minimal commute to study spaces. Needs a change of scenery for studying and motivation to study. Likely to use the app to check room availability on campus before leaving home. Technologically adept.
- **Group 2 Characteristics:** Age 18-20, lives in on-campus residence halls. Prefers minimal commute to study spaces. Needs a studious environment, as dorms are not conducive to studying. Likely to use the app due to living on-campus. Technologically adept.
- **Group 3 Characteristics:** Age 19-24, lives in residence halls or off-campus apartments. Prefers quiet study environments. Needs a fully quiet environment. Less likely to use the app as it tracks seat capacity but not noise levels. Technologically adept.
- **Group 4 Characteristics:** Age 18-26, lives in residence halls or off-campus apartments. Prefers long study sessions. Needs a study location for extended periods or all-day use. May use the app depending on workload and proximity to campus if living off-campus. Technologically adept.

3.3. Personas

To create the personas, each member of our group took one user profile and created a persona accordingly. One example of this is Dormitory Danny. Danny is a personification of Group 2- he is twenty years old, lives in a residence hall on campus, and prefers to study in quiet environments. He is also proficient with his Macbook. We have included four personas below as personifications of the above user profiles:

Campus Commuter Cathy

“It’s Mardi Gras in this house everyday!”

Alternative text: A digitally generated image of a professional woman with short hair. She is wearing round glasses and hoop earrings, dressed in formal business attire.

Who

- Age: 24
- Gender: Woman (she/her)
- From: New Orleans, Louisiana
- Year: 1st-year graduate student
- Occupation: Part-time works at a local newspaper
- School: Tulane, School of Liberal Arts
- Major: Political Science
- Lives: off-campus, in Garden District
- Personal computer: Dell

Context

Cathy is a highly motivated individual. She is a resident of the city of New Orleans and is pursuing a Master's degree in Political Science at Tulane University. She lives at home with her family. Her house is like any southern home: rowdy and loud. Cathy drives to campus to attend classes or access campus facilities when she needs quiet time to study. However, Cathy must depend on her friends to assess the crowd situation on campus before deciding to drive there.

Goals

- Budget time for studying efficiently so that she does well in her classes.
- Have a productive study environment away from home.

Needs

- A quiet place for studying.
- Planning ahead, and saving time.
- Ability to check if vacant seats are available in study spaces before driving to campus.

Behaviors

- Mostly works from home.

- Averse to wasting time.

Preferences

- Having a plan in place so that she doesn't have to waste time on the fly.
- Enjoys peaceful spaces for work.

Pain Points

- Noise and distraction at home.
- Reliance on friends to check campus status.
- Having no certain plan of where she'd be studying for the day.

Silent Suzy

"Finally some peace and quiet."

Alternative text: A digitally generated image of a female student wearing a green sweatshirt with the words "Tulane University" printed on it. She is wearing bluetooth earphones and appears to be meditating with her eyes closed.

Who

- Age: 21
- Gender: Woman (she/her)
- From: Salt Lake City, Utah
- Year: Junior
- School: Tulane University, School of Science and Engineering
- Major: Psychology

- Lives: off-campus, near Garden District area
- Personal computer: MacBook Air 13. She usually uses her personal computer to access Canvas. Her studies primarily involve reading.

Context

Silent Suzy is a focused and determined junior at Tulane University, majoring in psychology and balancing her studies with a part-time job at a downtown café. Originally from Salt Lake City, Utah, she now lives off-campus apartment near the Garden District, sharing a house with three other students. Grace has always been drawn to quiet, introspective activities like reading and meditation, which help her recharge amidst the demands of her busy schedule. However, studying at home is often difficult due to household noise, so she spends most of her time in the library, seeking out peaceful, isolated spots to fully concentrate on her work. With exams approaching, finding a quiet, consistent place to study has become her top priority, motivating her to search for a better way to secure these spaces in advance.

Goals

- Secure a quiet, distraction-free space to focus on studies.
- Use a reservation system to guarantee a consistent study spot at the library or on campus.

Needs

- A noise-free, personal study space with nearby power outlets for long study sessions.
- A system that helps her avoid distractions and stress when looking for available spots.

Behavior

- Arrives early at the library to secure a spot and plans her study schedule for the day.
- Wears earphones to block out noise and often plays white noise for better focus.
- Rarely engages in group study.

Preferences

- Favors the second floor of the library, particularly spots by the window or those with partitions.
- Avoids sitting in places where she might notice or be noticed by others.
- Studies alone most of the time and values personal, quiet environments.

Pain Points

- During exam periods, the library becomes overcrowded, making it stressful to find a study space.
- Feels frustrated having to walk around searching for available seats.
- Experiences inconvenience when there are no power outlets nearby, and avoids seats where she might be distracted by others.

Dormitory Danny

"It's hard to study at home when my roommate is so loud!"
Alternative text: A male student with short hair is sitting in a public space, holding a pencil and writing something while looking at a laptop screen.

Who

- 18 years old.
- First-year attending Tulane.
- Currently lives in Monroe.
- Chemistry major wants to continue to graduate school.

- Has an Apple computer that runs MacOS.
- Originally from Dallas, TX.

Context

Although Danny likes his new roommate, Loud Lou, it is often too loud to study in their shared room as Lou is always watching shows without headphones or bringing friends over. This has led Danny to search the campus for comfortable and convenient study locations.

Goal

Identify a quiet study place fairly close to his dorm.

Needs

- A quiet study space.
- A non-crowded study space (so he isn't fighting to get a seat.)

Behaviors

- Often goes to the library after classes to review his notes.
- Occasionally studies on the LBC mezzanine if he gets lunch in the LBC.
- If he really needs to get work done, he will go to Willow Pjs for breakfast and do his work in the morning.

Frustrations

- The inability to find a seat he likes in the library (and the time he wastes as a result of looking for a seat.)
- How noisy his roommate Loud Lou is.

Locked-in Lucy

“Don’t bother me”

Alternative text: A student is studying in a cubicle, with a book open beside them and a laptop screen in front. They are writing notes, wearing a headset, and dressed in a short-sleeved shirt. Their bag is placed on the desk next to their materials.

Who

- Age: 21
- Gender: Woman (she/her)
- From: Long Island, New York
- Year: Senior
- School: Tulane, A.B. Freeman School of Business
- Major: Legal Studies
- Lives: off-campus, on Freret Street by Empanola
- Personal computer: MacBook Pro 16 inch, finds bigger screen more useful for studying and schoolwork

Context

Locked-In Lucy is an overachieving senior at Tulane preparing to take the LSAT in hopes of going to law school. From a young age, Lucy wanted to become a lawyer to follow her father’s footsteps, but in high school, she realized she is a really good arguer and would truly succeed as a lawyer. Throughout college, she has pursued this passion by completing the legal studies major and now studying for the LSAT – which requires many lengthy study sessions. Since she is not applying to law schools until next year, she is going to get her masters in the gap year between undergrad and law school.

Goals

Achieve straight As this semester and at least a 170 (out of 180) on the LSAT in December.

Needs

Find study spaces where she can hunker down for the day, uninterrupted, to study for the LSAT and other current classes.

Behaviors

- Overachieving (in a commendable, hardworking way): Takes at least 18 credit hours per semester, began studying for the LSAT last year, gets master's degree in the gap year between undergrad and law school
- Designing a semester's schedule to have all "timed" events (class, meetings, clubs, etc.) on MWF, leaving Tuesday and Thursday to "lock in" and study all-day
- Early riser/morning person: "locked-in" days begin at 7 am

Preferences

- Have at least one weekday with no plans – for "locking in" (to studying/working)
- Study for long periods of time: get as many tasks done in one sitting as possible

Pain Points

- When hours of operation of campus study spaces do not align with her personal schedule
    - E.g. moving the study setup from home to the library when it opens at 9 am on Sunday is disruptive to her workflow.

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4. TASK SCENARIOS

4.1. Analysis Approach

Analysis from our user research procedures and team discussions helped us create a better view of the different kinds of students at Tulane that could or would use the SeaTulane app. We gained a wider view of students from different schools within Tulane, different needs depending on the kind of work or studying students need to complete, and experiences with campus study spaces. We used this information to formulate each of the four types of task scenarios based on our user personas.

The themes in findings provided the basis for the creation of these personas and tasks. We created scenarios as a means to address the users, the problems they face, their end goal, and means to reach the goal.

4.2. Task Scenarios

4.2.1. Problem Scenarios

I. Campus Commuter Cathy

One morning, Cathy is feeling the pressure of her upcoming Political Science exam. The noise from her household makes it nearly impossible to concentrate. In the past, she often relied on her friends to check the campus crowd levels before deciding to drive over. Unfortunately, this usually meant sending a quick group message, waiting for responses, and frequently discovering that the library was packed. On one occasion, she drove to campus only to find all the study rooms full, forcing her to retreat home without accomplishing her study goals.

II. Silent Suzy

When she arrived at the library, most of the large tables and window seats were already taken or had belongings placed on them, indicating someone had claimed the spot. Silent Suzy felt especially frustrated today by people leaving their things behind and not returning for a long time. Since there were no spots available in her usual preferred cubby section, she had to check each of the hidden cubby seats one by one to

find a place. It took her 20 minutes just to find a seat. She began to feel exhausted carrying her heavy bag and going up and down multiple floors. Finally, she found a seat, but she would have had to sit uncomfortably close to another person, so she decided to study at home instead. Feeling tired and frustrated from her failed attempt to secure a spot, Silent Suzy was in a bad mood on her way back home.

III. Dormitory Danny

Danny's roommate Loud Lou has decided that he wants to watch the newest Superhero movie in their shared dorm. Lou lost his earbuds and Danny cannot focus on his gen chem homework with all the explosions and dramatic music in the background. He decides to go to the library to study but finds that all his favorite spots are taken. He is relegated to a table seat on the first floor, which is barely quieter than his dorm.

IV. Locked-in Lucy

After waking up before 7 am to study for an upcoming exam, Lucy makes her 15-minute walk over to the library around 7:30 to be faced with locked doors. In the business of studying for her midterms this weekend, she forgot that the library doesn't open for at least another hour. She debates going home and coming back when it is open, but realizes that will waste at least 30 minutes of study time, not including time to set up her study space and focus / "lock in". Frustrated with her next best option, she retreats to the LBC food court tables, which are open and quiet enough at this hour, but not conducive to locking in for the day.

4.2.2. User Stories

I. Campus Commuter Cathy

Cathy is a 24-year-old graduate student in Political Science at Tulane University. She is a determined and highly focused individual who splits her time between her academic responsibilities and a part-time job as an editor at a local newspaper. She lives in New Orleans with her large, noisy family. She often finds herself struggling to find the quiet time she needs to concentrate on her studies.

II. Silent Suzy

Silent Suzy, a busy university student majoring in psychology, has an exam coming up next week. She has three exams just next week alone, so she came to the library to focus and study. She often goes to the library because it provides a quiet environment for studying. Carrying three textbooks, her laptop, and writing materials in her backpack, she made her way to the library. Determined to secure a quiet, distraction-free seat to get through all her study materials for each subject today, she quickened her pace. It seemed like other students also had exams approaching, as the library felt a bit chaotic today.

III. Dormitory Danny

Danny's roommate Loud Lou has decided that he wants to watch the newest Superhero movie in their shared dorm. Lou lost his earbuds and Danny cannot focus on his gen chem homework with all the explosions and dramatic music in the background. He wants to go to the library to study without having to make the trek all the way there but has no way to do so, so he walks across the Monroe quad and studies in the Business School instead.

IV. Locked-in Lucy

Locked-in Lucy, an extremely academic pre-law student at Tulane, is up at 7 am on Sunday for a long study day. She makes breakfast and heads to the library to find a corner cubicle where she can remain for the day, uninterrupted, and takes out her entire Apple ecosystem, multiple books, a water bottle, pencils, and headphones to set up on the desk. She is studying to get at least a 170 on the LSAT in December, as well as in all of her classes this semester. These goals require Lucy to "lock-in" and study for lengthy sessions on days like today. She puts on her noise-canceling headphones, pulls out her LSAT practice book, and begins a practice test.

4.2.3. Activity Scenarios

I. Campus Commuter Cathy

Last week, a friend told Cathy about a new app made for students. It gives real-time updates on how full study spaces are on campus and even lets you reserve a seat in advance. Curious, Cathy decides to try it out. Feeling relieved, she grabs her laptop, textbooks, and notes, and heads to campus, confident she knows exactly where she's going. When she gets to the study room, it's quiet and well-lit, just what she needs to focus on. She settles into her reserved seat and starts going over her notes. The app has not only saved her time but also taken away the usual stress of finding a spot to study. Cathy no longer has to depend on her friends for updates; now she has more control over her study sessions. With this new routine, she's able to boost her productivity and focus fully on her academic goals.

II. Silent Suzy

After she failed to find a study spot, on her way home, Silent Suzy thought it would be great if there were an efficient seat reservation system. She also wished for a system that could show the availability of seats throughout the library. When she got home, Silent Suzy discovered there was an on-campus app that offered real-time seat tracking and booking. She installed it and easily logged in using her Tulane ID. The next day, before arriving at the library, she used the app to check available seats. In the seat tracking menu, she could see the occupancy status of seats on each floor of the library. Occupied seats were marked in red, while available ones were marked in green, making it easy to understand at a glance. Although her favorite spot was already taken, she saw that a cubby seat in a hidden spot was available.

III. Dormitory Danny

Finals season has arrived, and Danny has decided to get an early start on studying. However, he only gets about an hour of studying in before his roommate, Loud Lou, wakes up and starts playing his music loud enough that Danny can’t focus. He leaves for breakfast in The Commons and checks to see whether his favorite seats in the library are available over his plate of eggs and bacon. They appear to be empty, but by the time he arrives at the library, they are all taken. Danny wishes he could reserve his favorite seats in advance, instead of just checking and hoping they stay unfilled. He goes to the LBC and finds a table tucked away on the mezzanine instead.

IV. Locked-in Lucy

While walking to the LBC after facing locked doors at the library, Locked-in Lucy wished there was a useful resource available to her that would naturally aid her in planning out realistic, full study days on campus. Because she is always carrying her phone, a mobile planner to help her keep track of hours of operation would be beneficial. Of course, she could Google the library hours of operation, but that requires effortful remembering and an explicit search/ask, which is not always realistic on mornings like today. When Lucy arrived at the LBC, she somehow was faced with a non-empty food court and did not have her first pick of seating – a.k.a., corner seats were not available. Frustrated yet again, Lucy wished she could know where she could sit before leaving to go to a study space. She thought maybe this idea of a mobile planner could incorporate a feature to help with that.

4.2.4. Interaction Scenarios

I. Campus Commuter Cathy

She unlocks her phone and taps the app. It opens up to a list of all the study spots on campus. Cathy taps "Check Availability," and right away, the app shows her how full each space is—libraries, study rooms, quiet lounges. It's color-coded too, with red meaning a place is full and green showing where there's still space. The library is packed, so she checks out a nearby study hall that still has seats open, marked in green. She clicks on it, and a window pops up with details like seating options and how noisy it tends to be. Liking what she sees, Cathy taps "Reserve Seat," picks how long she wants to stay, and confirms her booking. A confirmation pops up right away, giving her all the details—where the study room is, what time she reserved it for, and even her seat number. She also gets a handy notification reminding her about the reservation 30 minutes before her session starts.

II. Silent Suzy

To reserve a hidden cubby seat, Silent Suzy clicked on the table icon. A pop-up appeared, asking, "Do you want to reserve this seat?" along with a note that the seat could be reserved for four hours. Grace clicked the

"OK" button at the bottom right of the pop-up, and a new message appeared for three seconds saying, "Booked!" To ensure her reservation was successful, Silent Suzy went to the "My Reservation" section, checked the seat number, and reserved time in her list of current reservations. She was happy that she could save herself the trouble and time of going around checking each hidden spot for availability. After that, she scanned the QR code at the reserved seat within ten minutes to secure it. She anticipated that this system would reduce the number of students who leave their belongings unattended all day, wasting valuable study spots. That day, Silent Suzy was able to study efficiently all day in a quiet and private study space, feeling less stressed and more focused. This positive experience led her to trust the app and be willing to use it regularly.

III. Dormitory Danny

Before leaving his dorm for a study session, Danny wants to check SeaTulane to determine how full the library is. He opens the app and enters his credentials, but receives a notification that his password is incorrect. He leaves the room to get away from Loud Lou's music and tries entering his password again, only to find it is truly incorrect. He then clicks the "reset password" button on the screen and is prompted to check his email to receive instructions on how to reset his password. Danny follows these steps and is then successfully able to log into SeaTulane and view the seats in the library.

IV. Locked-in Lucy

The night before a full study day, Locked-in Lucy opens the SeaTulane app to plan for tomorrow. The goal is to secure a corner table on the 3rd floor of the library, so she opens the capacity tracker page to look at the floor map with all available seats and tables. She spots the table she wants, checks the booking time options, and goes to bed. The next morning, on her way to the library, she opens the app again, locates the same table, and reserves it for the next 4 hours. Lucy happily continues on her way to the library knowing exactly where she will sit, and that the library will be open upon her arrival, without wasting any unnecessary time.

5. LOW-FIDELITY DESIGNS

5.1. Designs

To create our low-fidelity prototype, we began by meeting at the library together to discuss the design. We decided to trace our phones to create the basis for our screen since SeaTulane will primarily be a mobile app. From there, we collaborated to ensure we standardized the app design across all our pages. We tried to keep the design cohesive by using the same taskbar across all screens, as well as deciding on where to permanently place some important functions (like the profile and booking options.)

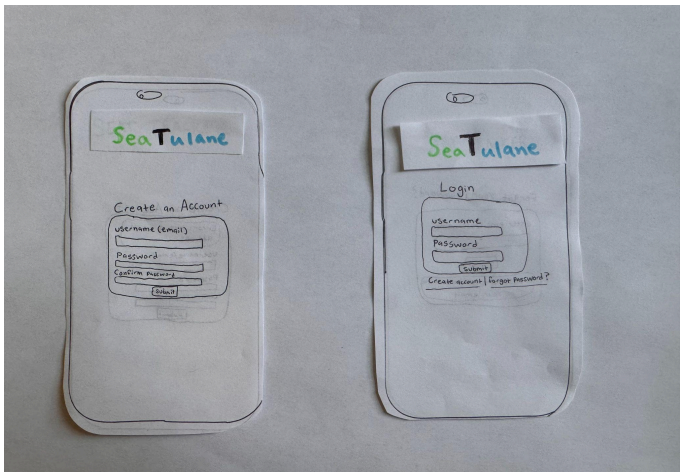
During the design process, several alternatives were considered, particularly regarding the navigation and how seat availability is displayed. The decision to use color-coding for available and taken seats came from our focus on ensuring ease of use. We also decided to keep the navigation bar at the bottom to allow users to quickly switch between booking, profile, and settings without losing context. Ultimately, our choices were guided by the need for clarity and simplicity, making the user experience as seamless as possible.

For the sketches, we created rough designs to explore different ways to present the four features. These sketches included:

1. A **login screen** with a simple, clear input area for username and password.
2. The **homepage** shows quick links to seat tracking, booking, profile, reservation lists, and settings.
3. A **capacity tracker** that uses a color-coded map of the library's current availability, allowing users to visually check for open seats.
4. The **booking interface**, where users can select a seat, view its availability, schedule a booking, and confirm their booking with a single click.

1. **Login Screen**
    a. **Main design of create account and login screen**

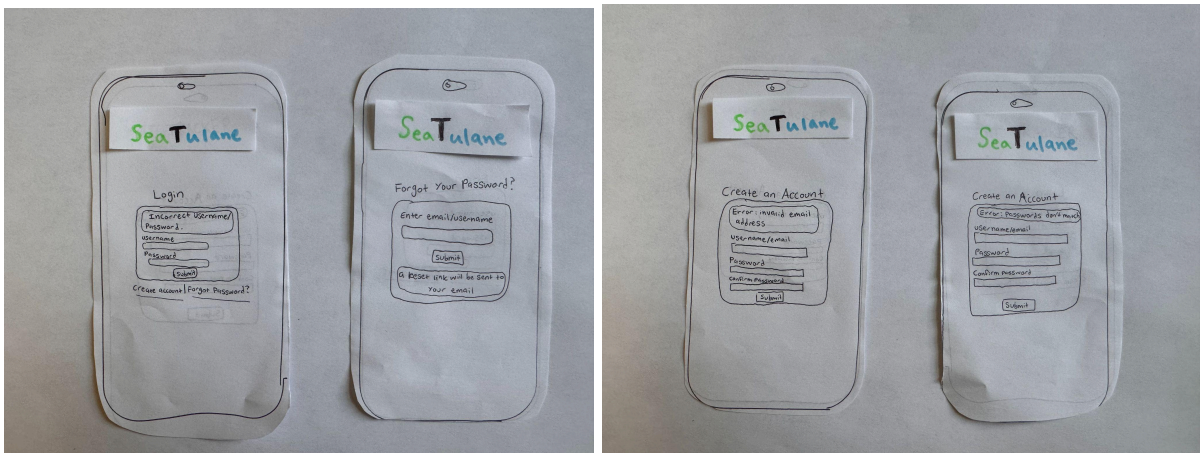
The first sketch depicts the login screen, where users can either create a new account or log in using an existing one. Key elements like the username/email, password, and confirmation fields are clearly presented to avoid confusion.



Alternative text: A hand-drawn low-fidelity prototype of an app interface labeled “SeaTulane” at the top as a logo. The sketch includes pages for “Create Account” and “Login,” showcasing basic design elements for user input.

b. Exception designs for handling user error

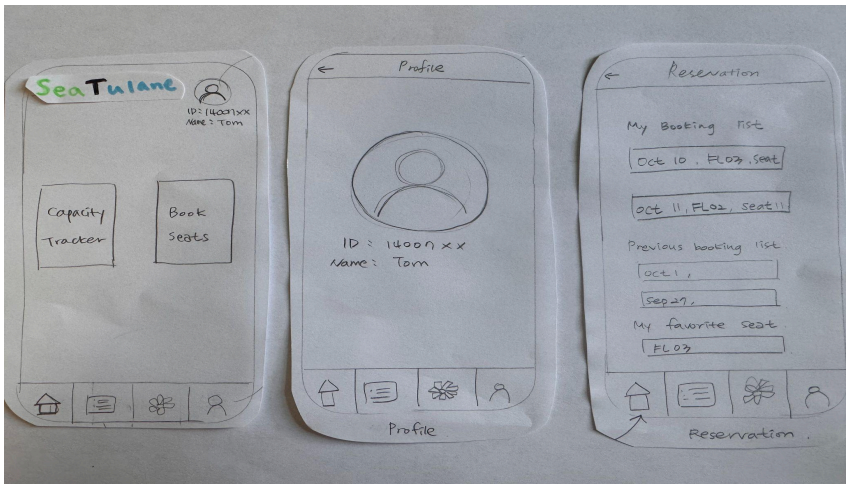
Error messages such as “Invalid email” and “Passwords don’t match” are included for cases where the user input is incorrect, providing clear feedback for error handling.



Alternative text: A hand-drawn prototype showing error-handling pages for the login process. The sketches illustrate messages for “Invalid email” and “Password doesn’t match,” providing basic visual guidance for addressing user login issues.

2. Homepage

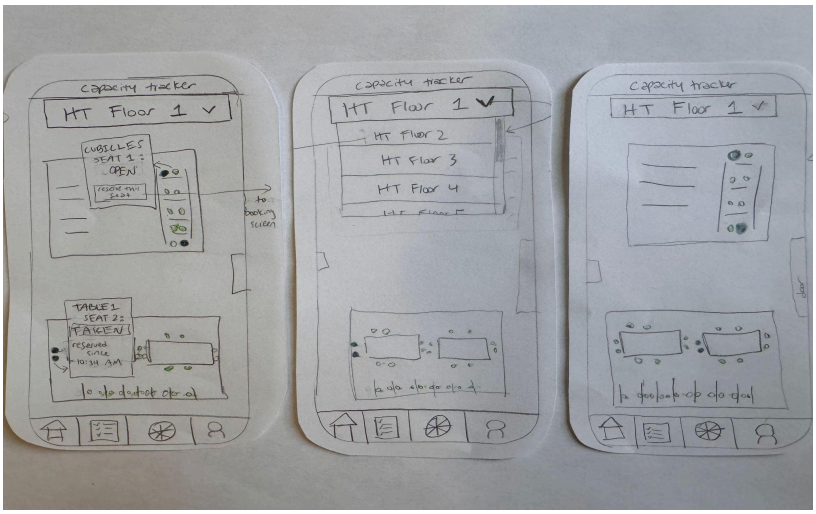
After login, the user can see the prominent display of two key features: “Capacity Tracker” and “Book Seats.” Users can quickly navigate to either feature, allowing them to check the availability of seats or directly book a spot. The layout is simple and accessible, minimizing the cognitive load on users.



Alternative text: Three hand-drawn prototypes illustrating different app screens. The first screen is a home screen showing a “Capacity Tracker” and “Book seats” menu buttons. The second screen features a profile tab, while the third screen displays a booking list. All screens include a bottom navigation bar with icons for Home, Booking List, Settings, and Profile from left to right.

3. Capacity Tracker

The Seat Tracker allows users to monitor seat availability for each floor of the library. Users can select the desired floor, and a detailed floor plan will be displayed. On this floor plan, available seats are highlighted in one color, while occupied seats are shown in another.

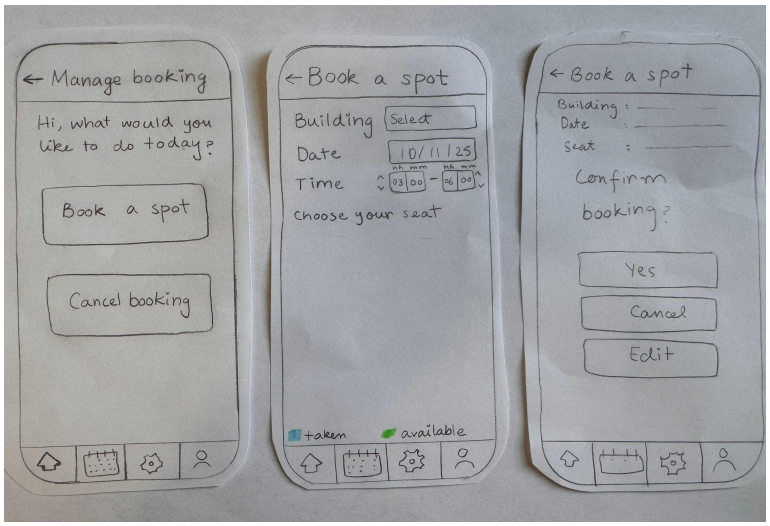


Alternative text: Three hand-drawn app screens illustrating the flow of the capacity tracker feature. The first screen shows pop-ups when user choose available seats. The second screen displays the floor maps of each

level of library, showing seat availability. The third screen allows the user to select an available seats on floor map.

4. **Booking**

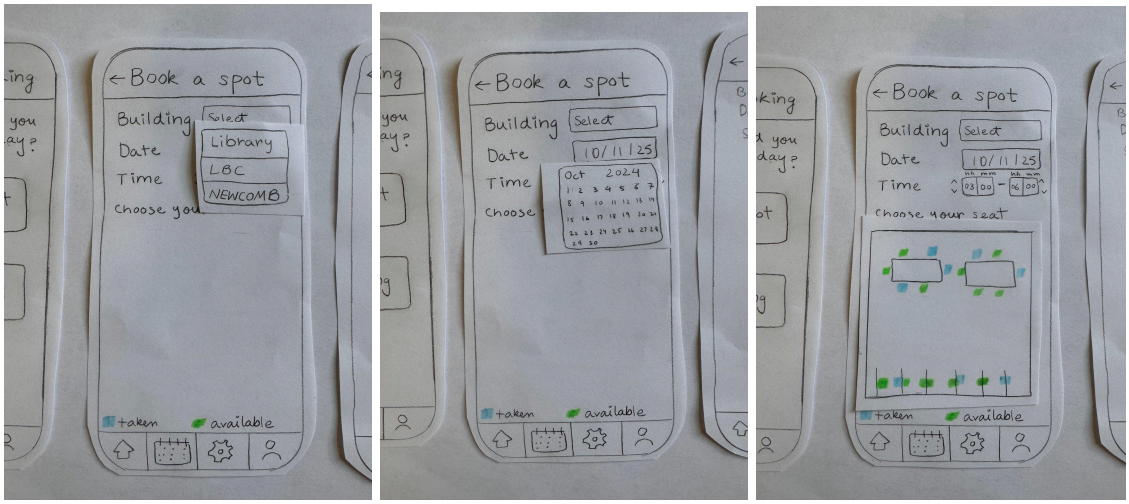
   The first step involves selecting the building (Library, LBC, or Newcomb) and choosing a date and time for the reservation. In the next step, users are presented with a seat map where green represents available seats and blue indicates taken seats. This color-coding makes it easy for users to quickly identify their options and proceed with booking.



Alternative text: Three hand-drawn app screens showcasing the flow of the “Book a Seat” feature. The first screen displays menu options: “Book a Spot” and “Cancel Booking.” The second screen appears after selecting “Book a Spot,” allowing the user to choose the building, date, and time. The final screen is the booking confirmation page, featuring buttons for “Yes,” “Cancel,” and “Edit.” All screens include a navigation bar at the bottom.

   a. **Book a spot process**

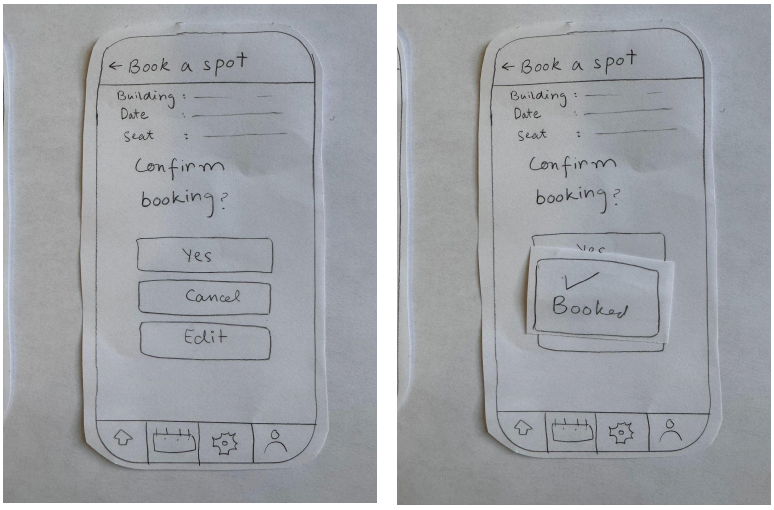
      The building, date, and time for the reservation are displayed in a drop-down menu, and the seat selection appears as a pop-up



Alternative text: Three hand-drawn app screens showcasing the pop-ups for the “Book a Seat” feature. The first screen displays a dropdown menu for selecting a building. The second screen shows a calendar interface after selecting the time option. The final screen presents a pop-up with a floor map, highlighting available seats for selection.

b. Confirm booking

Using a pop-up alert to confirm a successful booking.



Alternative text: A hand-drawn app screen illustrating a pop-up alert confirming a successful booking. The alert displays a pop-up message stating, “Booked”.

5.2. Evaluation

To simulate the dynamic parts of our interface, we conducted a usability test with four group members, rotating roles between “computer” and “facilitator.” We prepared index cards that represented each screen of the

interface, mimicking user interactions in a low-fidelity manner. The facilitator guided the user through each task, while the "computer" responded to the user's input by flipping through the index cards to simulate screen transitions. This setup allowed us to observe user interactions in real time and identify potential points of confusion.

Our test tasks included logging in (with potential password errors or resets), checking seat availability, booking a seat, and verifying the booking confirmation in the "My Reservation" section. These tasks were chosen as they reflect the most common actions users would take in the app. In the seat capacity tracker, if a user clicked on an occupied seat, a "Booked!" message would appear, indicating that the seat had already been reserved. We tested different paths to booking a seat, such as booking directly from the booking menu, booking after checking seat availability in the seat tracker, or viewing the seat tracker and then navigating to the booking menu on the homepage. Regardless of the path taken, we ensured that all routes flowed seamlessly into the final booking process on the booking screen.

The specific four different Tasks:

Task 1: A user without an account begins by creating one. After logging in, they navigate to the Capacity Tracker, browse the floor maps for each floor, and select a seat. If the selected seat is already booked, a warning message appears. The user then selects an adjacent seat, proceeds to the booking page (where the seat details are pre-filled), and sets the time and date to complete the reservation.

Task 2: A user encounters a log-in error and resets their password. After logging in successfully, they go directly to the booking screen, where they reserve a table on the 2nd floor for the current day. To confirm the booking, they check the My Reservation section to ensure their reservation was successful.

Task 3: A user logs in after fixing a password error, and then accesses their profile to review their information. They use the Capacity Tracker to view available seats on the 2nd floor. Go to the Booking menu on the home page, select a seat, and attempt to book it. Before finalizing the reservation, the user changes their mind, modifies the booking details, and completes the reservation. They then verify the reservation in My Reservation.

Task 4: A returning user checks their existing bookings in My Reservation, selects a reservation they want to cancel, and confirms the deletion of the booking.

We recruited four users to perform the tests, all representing a typical college student demographic aged between 21 and 29. Users were instructed to complete tasks such as logging in, selecting a seat, and confirming their booking. We intentionally introduced error scenarios, such as incorrect passwords, forgotten passwords, users with no account, and clicking on already-booked seats, to observe how users would handle these situations.

From our task analysis, we identified several key findings. First, the password reset feature was critical, as users were more likely to forget their passwords than we initially anticipated. Second, users appreciated the ability to quickly confirm bookings in the "My Reservation," but some felt that this feature should be more prominent on the homepage. Lastly, we recognized that we need to further evaluate where pop-ups and drop-down menus would be most appropriate, as well as how to limit booking times to prevent the overuse of resources and ensure fairness.

GETTING THE DESIGN RIGHT

6. HI-FIDELITY PROTOTYPE

6.1. Visual Descriptions

Figure 2. The login screen of the application, where the user can log in with an existing account, create a new account, or change their (forgotten) password.

Alternative text: The image depicts the login screen for SeaTulane. The interface includes the Tulane University logo at the top left and a navigation menu icon on the right. Below, there is the app title "SeaTulane" in bold font, accompanied by a Tulane mascot holding a banner. Two input fields prompt users to enter their email and password. Additional text links allow users to recover a forgotten password or sign up for an account. At the bottom is a green "Log In" button.

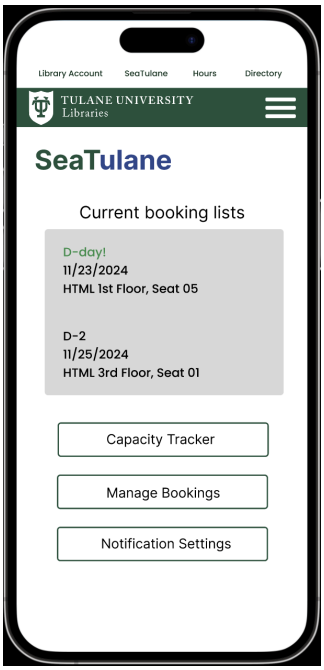


Figure 3. The homepage of the application, displaying the user's current bookings and navigations to other main screens of the application: capacity tracker, manage bookings, and notification settings.

Alternative text: The screen displays the "SeaTulane" app interface with a section titled "Current booking lists." Two reservations are shown: D-day! for "11/23/2024 at HTML 1st Floor", and "Seat 05. D-2 for 11/25/2024 at HTML 3rd Floor, Seat 01", enclosed in a grey box. Below the bookings box are three buttons: Capacity Tracker, Manage Bookings, and Notification Settings. The top navigation bar features options like "Library Account," "SeaTulane," "Hours," and "Directory," alongside the Tulane University Libraries logo.

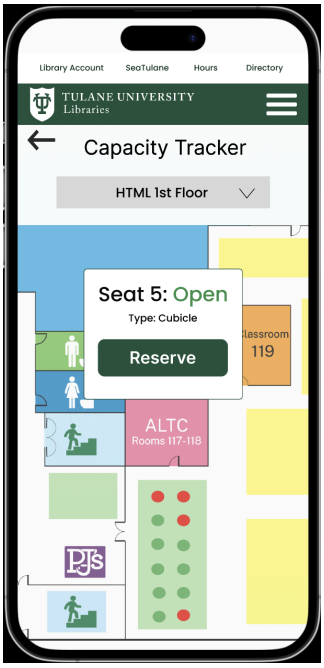


Figure 4. The capacity tracker of the 1st floor of the library, where the user has selected an available seat and is prompted to reserve it.

Alternative Text: The screen displays the "Capacity Tracker". The map highlights the layout of the HTML 1st Floor with labeled areas, including classrooms and study zones. A popup in the center indicates that Seat 5, a cubicle, is available with the status marked as 'Open.' A green 'Reserve' button allows users to book the seat.

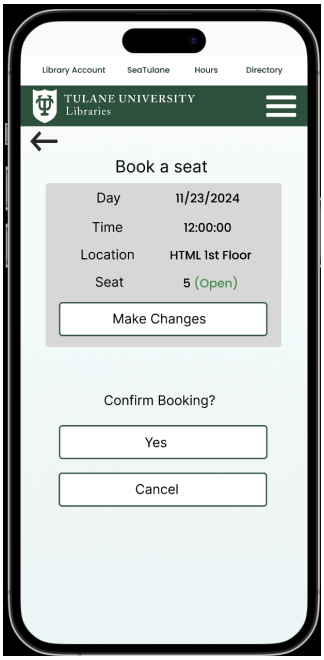


Figure 5. After pressing the “Reserve” button on the screen shown in Figure 4, the user is taken to the booking page, where they can edit, confirm, or cancel the booking.

Alternative Text: The screen displays the ‘Book a Seat’ interface for Tulane University Libraries. It shows the selected booking details, including the date (11/23/2024), time (12:00:00), location (HTML 1st Floor), and Seat 5 with the status 'Open.' Below the details, there are options to 'Make Changes,' 'Confirm Booking?' with 'Yes' and 'Cancel' buttons available for user action.

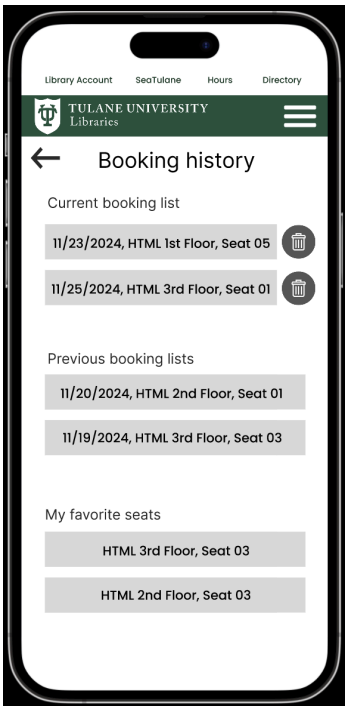


Figure 6. Users can access the booking history that features current bookings and previous bookings through clicking on the list displayed on the homepage.

Alternative Text: The screen displays the ‘Booking History’ interface for Tulane University Libraries. It includes three sections: 'Current booking list,' showing upcoming bookings for 11/23/2024 (HTML 1st Floor, Seat 05) and 11/25/2024 (HTML 3rd Floor, Seat 01), each with a trash icon for deletion. 'Previous booking lists' shows past bookings on 11/20/2024 (HTML 2nd Floor, Seat 03) and 11/19/2024 (HTML 3rd Floor, Seat 03). Lastly, 'My favorite seats' lists HTML 3rd Floor, Seat 03 and HTML 2nd Floor, Seat 03 as preferred choices.

6.2. Adherence to Visual Design

Through creating our high fidelity prototype, we adhered to the Gestalt principles. For example, we followed the Gestalt principle of proximity when designing the current booking lists page, by placing the same type of reservations close together and holding space in between different categories of reservations to highlight which items belong in a group together (see Figure 6). Additionally, we implemented the Gestalt principle of figure/ground on the login screen with a light colored background with everything on top in a darker shade (see Figure 2). Finally, for the Gestalt principle of similarity, the navigation options at the bottom of the home screen are displayed in the same way, to highlight that they are all options of what to do next (see Figure 3).

In addition to Gestalt principles, we prioritized some of Norman’s design principles in our prototype. For example, we adhered to Norman’s design principle of consistency: in all figures above (Figures 2-6), you can see that the navigation bar at the top, along with font and color themes, are the same across the application. Additionally, we implemented Norman’s design principle of constraints: from the capacity tracker screen (Figure 4), only pressing the green dots/available seats results in the “Reserve” button – pressing a red dot/unavailable seat results in a “Select Again” prompt (see Figure 10c in Section 10).

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How To Build a Website

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7. HEURISTIC EVALUATION

7.1. Method

We conducted a heuristic evaluation by following a four-step framework: gather inputs and prepare,

evaluate the system independently, consolidate findings and debrief, and rate by severity. This structured approach ensured a systematic assessment of usability issues. Nielsen's 10 Heuristics were used as the foundational principles for our evaluation, focusing on how the interface adhered to key usability guidelines.

The evaluation was performed on our high-fidelity prototype created in Figma. To simulate realistic user interactions, we divided the tasks into four main processes—home screen/notification settings, capacity tracker, manage booking, and log in/out—and asked users to complete each task.

Each screen of the prototype was reviewed independently against the heuristics. We assessed the interface's alignment with principles such as visibility, clarity, flexibility, and usability, identifying potential issues along the way. After completing the individual evaluations, we consolidated the findings to eliminate redundancy, grouped similar issues, and categorized them under the appropriate heuristics in each screen. This step also involved refining the issue descriptions to ensure clarity and precision for further analysis.

7.2. Findings

Home Screen

Visibility of System Status

- The "Current Booking List" on the homepage does not clearly indicate that it is clickable. Users were unaware they could access additional details by clicking the section, leading to confusion.

Match between system and the real world

- Users expected the "Cancel Booking" and "Current Booking List" to have distinct screens but found them identical. This redundancy undermines the mental model of task-specific navigation.

Help Users Recognize, Diagnose, and Recover from Errors

- Users felt uncertain about their reservation due to the lack of a clear connection between the textual seat information in the "Current Booking List" and the physical seat in the library. This ambiguity could lead to errors in locating the seat.

Capacity Tracker

Visibility of System Status

- Clicking another floor on the dropdown menu doesn't actually refresh the map to a new floor, or result in any action

Match between system and the real world

- Inability to scroll on the floor map

User control and freedom

- (Technically for booking screen but is part of this flow) After user books seat, "seat booked" appears, but nothing happens after that and there is no exit provided to the user
- Back arrow is not functional

Aesthetic and minimalist design

- Floor map is chaotic – lots of different colors that don't align with the general design's theme, doesn't necessarily need to show bathrooms, etc.

Booking management

Consistency and Standards

- The back button on the 'My booking list' page returns to the home page instead of 'Manage Bookings' page.
- The back button on 'Manage bookings' returns to the 'My booking list' page instead of home page.
- Discrepancy in the usage of the word booking. In some places it is pluralized, and in some it hasn't been.

Error Prevention

- The calendar UI doesn't necessarily prevent users from choosing an inapplicable date.

Help and Documentation

- There is no documentation or help associated with the flow or the application in general.

Notification Setting

User Control and Freedom

- Notification settings lacked clarity, and users were unsure about the impact of changes. For instance, users could not distinguish between system alerts and reservation-related notifications.

Flexibility and Efficiency of Use

- Users cannot specify the exact time they want to receive notifications (e.g., minutes or hours before the event), reducing the efficiency of the feature.

Resources
[How to Conduct a Heuristic Evaluation]
[10 Usability Heuristics for User Interface Design]

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8. PROTOTYPE REVISION

8.1. Design Modifications

Based on the findings from all of our heuristic evaluations, we made both minor and significant changes to our prototype. As for minor changes, we fixed some consistency issues relating to language and element placement across screens. Additionally, we slightly lowered the opacity of each floor map's underlying image, to highlight rather than take away from the more important aspects of the capacity tracker.

As for substantial changes to the prototype, we fixed the back arrow navigation to not only be functional, but match the screen flow. For example, on the booking lists page (Figure 7.a), pressing the back arrow will take you back to the homepage (7.b), where the user originally navigated to their booking list. Additionally, we provided the user with an exit after booking a seat reservation: when presented with "Seat Booked" (Figure 8.a), the user can click outside of that box and return to the booking page (8.b), allowing them to return to other app functionality. To further clarify the functionality of Figure 8.b, we added a view arrow at the top, indicating that clicking on the "Current Booking List" will take the user to the relevant section.

The notification settings (see Figure 9) lacked detailed descriptions for each alert, which caused confusion among users. To address this, we added specific explanations for each notification option. Additionally, we grouped related alerts, such as *Remind Reservation*, *Available Seats Alert*, and *Overstay Alerts*, into one category. Below this, we created another category labeled *System Notifications*, which includes options like *Floating Notification*, *Allow Sound*, and *Allow Vibration*. By separating the notifications into these two groups, we improved clarity and made the settings easier to navigate.

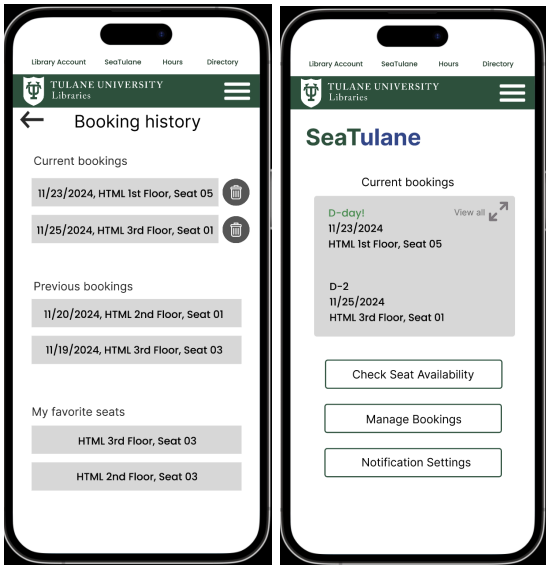

Figure 7.a and 7.b, respectively. Switching back and forth between booking lists page and homepage

Alternative Text: The first screen displays the ‘Booking History’ interface of Tulane University Libraries. It includes 'Current bookings' showing 11/23/2024 (HTML 1st Floor, Seat 05) and 11/25/2024 (HTML 3rd Floor, Seat 01) with trash icons for deletion. The 'Previous bookings' section lists 11/20/2024 (HTML 2nd Floor, Seat 01) and 11/19/2024 (HTML 3rd Floor, Seat 03). The 'My favorite seats' section highlights HTML 3rd Floor, Seat 03, and HTML 2nd Floor, Seat 03 as preferred choices. The second screen shows the 'SeaTulane' interface, highlighting 'Current bookings' with the first entry marked as 'D-day! 11/23/2024, HTML 1st Floor, Seat 05' and the second as 'D-2, 11/25/2024, HTML 3rd Floor, Seat 01.' Below, options include 'Check Seat Availability,' 'Manage Bookings,' and 'Notification Settings' for further user actions.

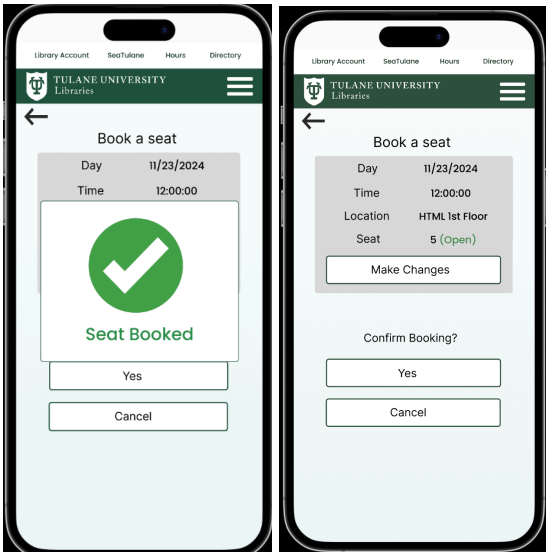

Figure 8.a and 8.b, respectively. Exit process from successful seat booking

Alternative Text: The first screen shows the 'Book a Seat' interface for Tulane University Libraries. The details include the date (11/23/2024), time (12:00:00), and location (HTML 1st Floor). A large green checkmark is displayed with the message 'Seat Booked.' Below, there are 'Yes' and 'Cancel' buttons for confirmation. The second screen also displays the 'Book a Seat' interface, showing booking details: date (11/23/2024), time (12:00:00), location (HTML 1st Floor), and Seat 5 marked as 'Open.' A button labeled 'Make Changes' is below the details, followed by 'Confirm Booking?' with 'Yes' and 'Cancel' buttons for user actions.

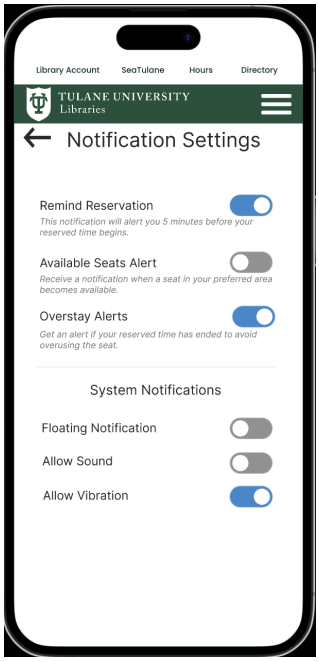

Figure 9. Grouped notification settings with categories for reservation alerts and explanation.

Alternative Text: The screen displays the 'Notification Settings' interface for Tulane University Libraries. Three notification options are listed with toggle switches: 'Remind Reservation' (alerts users 5 minutes before their reserved time begins, toggled on), 'Available Seats Alert' (notifies when a preferred seat becomes available,

toggled off), and 'Overstay Alerts' (alerts users when their reserved time has ended to avoid overstaying, toggled on). Below, 'System Notifications' includes options for 'Floating Notification' (off), 'Allow Sound' (off), and 'Allow Vibration' (on).

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9. USER TESTING

9.1. Method

We designed seven scenarios for participants to complete during the user testing session. These tasks were formed as a result of the heuristic evaluation process. The scenarios cover the core functionalities of our application and evaluate usability across different features:

Scenario 1: Create a new account.

Scenario 2: Log into an account.

Scenario 3: Check the homepage and view booking lists.

Scenario 4: Compare availability between the 1st and 3rd floors.

Scenario 5: Customize notifications.

Scenario 6: Book a seat on the first floor.

Scenario 7: Delete a booked seat.

Before starting the testing, participants were asked to complete a **pre-survey** (Appendix C) to gather background information, such as their prior experience using booking applications and how comfortable they were with mobile apps in general. This survey helped us understand the participants' familiarity with similar systems, which informed our analysis of their behavior during testing. All participants were college students. During the testing session, we assigned specific roles to team members to ensure a structured and efficient process:

- **Facilitator:** Guided participants through the tasks, offering explanations when participants appeared confused. The facilitator aimed to provide minimal guidance to avoid influencing participant behavior unnecessarily.

- **Note-taker:** Observed participants and recorded key metrics, including:
    - Completion time for each task.
    - Number of misclicks participants made.
    - Number of times participants asked for help
    - User comments were noted.

Participants were asked to think aloud while performing the scenarios, providing insights into their thought processes and any confusion they experienced. This allowed us to better identify pain points and areas for improvement in the user interface.

9.2. Findings

Pre-test survey:

The pre-test survey indicated that all users had at least once used a booking app. Moreover, 80% of the users indicated that they were very comfortable using mobile apps. This data helped us in post-test evaluation where we attempted to see probable connection between issues that came up during user-testing with either users lack of experience or usability failure.

Scenario performance data:

The raw data pertaining to users performing scenarios was collected and used to calculate averages for each of the three measurable categories (completion time, number of clicks, number of times help needed) for the seven scenarios. The table below shows the results for each scenario.

Scenario	Average completion time (sec)	Average number of misclicks	Average number of times help needed
1	12.67	0.5	1
2	5.52	0	0.25
3 (Check homepage)	43.38	3.25	0.25
4 (Compare availability between the 1st and 3rd floors)	40.79	6	0.5

5	20.44	0.25	0.25
6 (Book a seat)	42.18	3.5	0.75
7	16.98	0.67	0

Alternative Text: A table summarizing the usability metrics for seven scenarios, including average completion time (in seconds), average number of misclicks, and average number of times help was needed. Scenario 1 shows an average completion time of 12.67 seconds, 0.5 misclicks, and 1 instance of needing help. Scenario 2 has 5.52 seconds, 0 misclicks, and 0.25 instances of needing help. Scenario 3 ("Check homepage") has 43.38 seconds, 3.25 misclicks, and 0.25 instances of needing help. Scenario 4 ("Compare availability between the 1st and 3rd floors") records 40.79 seconds, 6 misclicks, and 0.5 instances of needing help. Scenario 5 shows 20.44 seconds, 0.25 misclicks, and 0.25 instances of needing help. Scenario 6 ("Book a seat") has 42.18 seconds, 3.5 misclicks, and 0.75 instances of needing help. Scenario 7 records 16.98 seconds, 0.67 misclicks, and no instances of needing help.

The noteworthy figures are highlighted in color for being significantly higher than other scenarios. These scenarios were analyzed to find usability issues. Users brought up issues during the think aloud process that may align with corresponding numbers. For instance, issues 6 and 7 listed in the table of severity evaluation correspond to scenario 3, 4 and 6.

Issues gathered from comments, and observation:

Issues that were verbalized by the users during the think aloud process were jotted down in notes. The issues were marked on Nielsen's severity scale:

0 = Not a usability problem

1 = Cosmetic problem only

2 = Minor usability problem

3 = Major usability problem

4 = Usability catastrophe

The findings are listed below.

Issue #	Description	Severity (1-4)
1	"Current Booking List" on the homepage appears as plain text, making its clickable nature unclear.	3

2	Reservation list screen uses library location and seat numbers that may not be intuitive for new users.	2
3	Notification settings screen does not show how notifications will behave, leaving users uncertain.	1
4	Notification settings screen lacks customization for notification timing (e.g., minutes or hours before events).	2
5	Issues with the back button.	4
6	Unable to navigate to the home screen after registration.	3
7	Language inconsistency.	2
8	Login page does not appear after signing up.	1

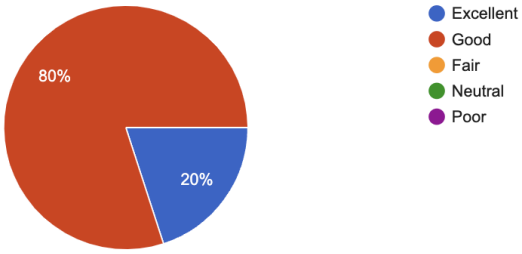
Alternative Text: The table identifies eight issues in the system with their descriptions and severity levels (rated 1-4, where 4 is the most severe). First, the “Current Booking List” on the homepage appears as plain text, making its clickable nature unclear, with a severity level of 3. Second, the reservation list screen uses library locations and seat numbers that may not be intuitive for new users, rated with a severity level of 2. Third, the notification settings screen does not show how notifications will behave, leaving users uncertain, with a severity level of 1. Fourth, the notification settings screen lacks customization for notification timing (e.g., minutes or hours before events), which has a severity level of 2. Fifth, there are issues with the back button, which is the most severe with a rating of 4. Sixth, users are unable to navigate to the home screen after registration, with a severity level of 3. Seventh, language inconsistency is noted, rated with a severity level of 2. Lastly, the login page does not appear after signing up, which is considered the least severe with a level of 1.

The team decided to address all the issues in the final version except issue 3.

Post-test survey

The user responses from the post-test survey are outlined below.

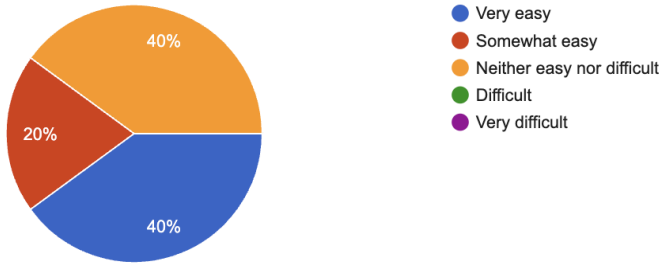
1. How would you rate your overall experience with the app?



Alternative Text: A pie chart representing a distribution of ratings. The chart is divided into two segments: a red segment labeled '80%' representing 'Good,' and a blue segment labeled '20%' representing 'Excellent.' A legend to the right lists categories: 'Excellent' (blue), 'Good' (red), 'Fair' (orange), 'Neutral' (green), and 'Poor' (purple), though only 'Excellent' and 'Good' are present in the chart.

Designers' comment: We attribute the non-optimum quality of user experience to the usability issues that the users encountered during the testing.

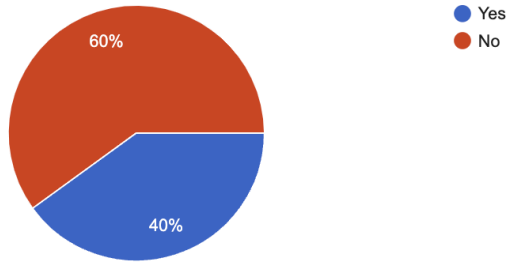
2. Was the app easy to use?



Alternative Text: A pie chart showing the distribution of responses regarding task difficulty. The chart is divided into three segments: a blue segment labeled '40%' representing 'Very easy,' an orange segment labeled '40%' representing 'Neither easy nor difficult,' and a red segment labeled '20%' representing 'Somewhat easy.' A legend to the right lists categories: 'Very easy' (blue), 'Somewhat easy' (red), 'Neither easy nor difficult' (orange), 'Difficult' (green), and 'Very difficult' (purple), though only the first three are present in the chart.

Designers' comment: About 60% found the app to be not 'very easy' to use despite the simplicity of use cases. We attribute these responses to the difficulty users face due to usability issues.

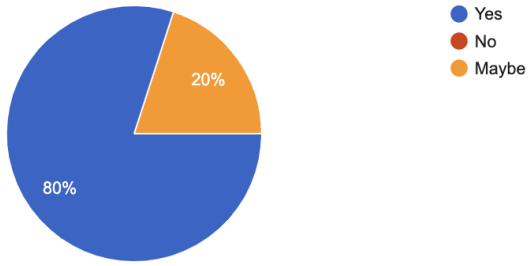
3. Did you encounter any technical issues while using the app?



Alternative Text: A pie chart showing the distribution of responses to a binary question. The chart is divided into two segments: a blue segment labeled '40%' representing 'Yes,' and a red segment labeled '60%' representing 'No.' A legend to the right identifies 'Yes' with blue and 'No' with red.

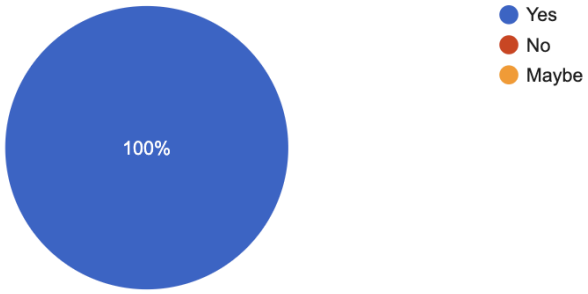
Designers' comment: The scenario performance and observational data collected indicate that most users faced technical issues while completing scenarios.

4. Overall, the app achieved its purpose.



Alternative Text: A pie chart showing the distribution of responses to a question with three options. The chart is divided into two segments: a large blue segment labeled '80%' representing 'Yes,' and a smaller orange segment labeled '20%' representing 'Maybe.' A legend to the right identifies 'Yes' with blue, 'No' with red, and 'Maybe' with orange, though 'No' is not present in the chart.

5. Would you recommend this app to other students/faculty?



Alternative Text: A pie chart showing the distribution of responses to a question with three options. The entire chart is a single blue segment labeled '100%' representing 'Yes.' A legend to the right identifies 'Yes' with blue, 'No' with red, and 'Maybe' with orange, though only 'Yes' is present in the chart.
The findings from the user testing phase were holistically analysed and appropriate changes were made to the prototype. The final version of the prototype is appended in the next section.

Resources

Usability Starter Kit

Usability Testing 101

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10. FINAL DESIGN

The figma prototype is ready-to-use and is available at this link. You need a running internet connection and a browser to be able to use the prototype.

Figure 10a-10d. Series of different versions of the capacity tracker screen. The user has navigation options of opening the dropdown menu and selecting any floor in the library, selecting an unavailable seat (red dots), and selecting available seats (green dots) that will prompt them to the screen flow shown in Figure 11.

Alternative Text: Four app screens showcasing the functionality of the capacity tracker. The first screen displays the default capacity tracker menu with the first-floor map of the library. The second screen shows a dropdown menu for selecting different floors. The third screen depicts a pop-up with a red “Taken” message and a “Select Again” button after selecting an already reserved seat (red dot). The final screen illustrates the pop-up that appears when an available seat (green dot) is selected, displaying a “Reserve” button for booking the seat.

Figure 11a-e. This screen flow shows the process of booking a seat. Once a user clicks the ‘Manage bookings’ button on the homepage, they’re taken to the screen shown in Figure 11a ‘Manage bookings’. Figure 11b-11e shows the flow once the user chooses the ‘Book a seat’ button on the ‘Manage bookings’ page. The flow ends once the user clicks the ‘Go to homepage’ button on the ‘Seat booked’ pop up once they successfully book a seat.

Alternative text: Five app screens illustrating the seat booking process. The first screen shows the “Manage bookings” page with ”Book a Seat” and “Cancle booking” button. Clicking it leads to the “Book a Seat” page in the second screen which guides the user through the booking process, including selecting a building, date, and time, and confirming their reservation. The third screen displays a pop-up after selecting a seat, with a “Reserve” button to confirm the selection. Clicking “Reserve” leads to the fourth screen showing the reservation details, and the process concludes with a confirmation pop-up on the final screen, indicating successful booking.

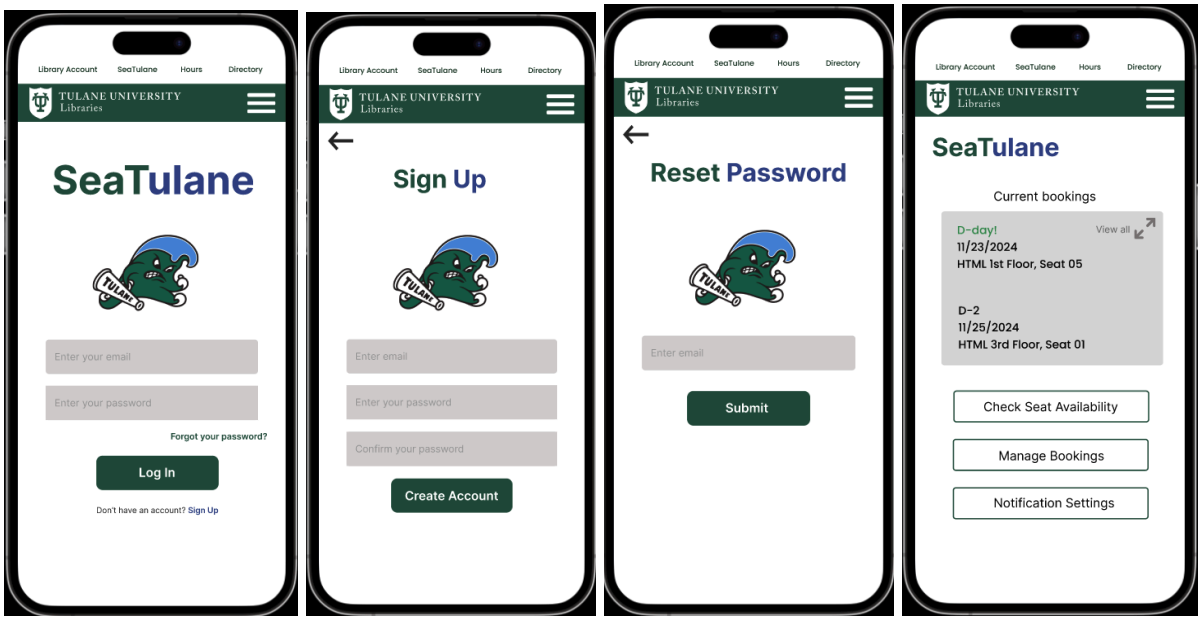

Figure 12a-d. This screen flow demonstrates the process of signing up and logging in. While every Tulane student already has an ID for SeaTulane, students without one or citizens who wish to use the Tulane library can sign up for an account. If a user forgets their password, they can click the "Forgot your password?" link, which redirects them to the Reset Password page. After completing the sign-up and login process, users are redirected to the home screen.

Alternative text: Four app screens showing the process of signing up and logging in. The first screen provides a login page with a "Forgot your password?" link for resetting passwords, the third screen. The second screen displays the sign-up page for users. The third screen allow users to the reset password. The final screen shows the home screen, which users are taken to after successfully signing up or logging in.

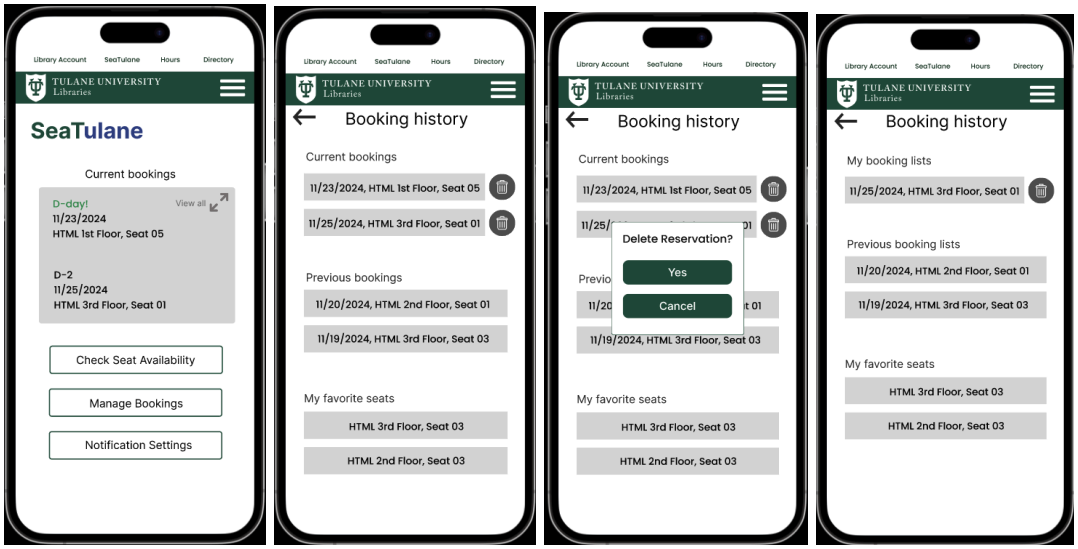

Figure 13a-d. This screen flow demonstrates the process of deleting a reservation. Clicking the gray "Current Bookings" box on the Home screen redirects the user to the Booking History page. This page displays three lists: "Current Bookings," "Previous Bookings," and "My Favorite Seats." Within the "Current Bookings" list, users can delete their reservations by clicking the circular trash bin icon next to each booking. A confirmation

pop-up appears, asking if the user wants to proceed with the deletion. Once confirmed, the reservation is removed from the list.

Alternative text: Four app screens illustrating the process of deleting a reservation. The first screen shows the Home screen with a gray "Current Bookings" box. The second screen transitions to the Booking History page, which includes lists for "Current Bookings," "Previous Bookings," and "My Favorite Seats." In the third screen, a confirmation pop-up appears after the user clicks the circular trash bin icon next to a booking in the "Current Bookings" list, asking if they want to confirm or cancel the deletion. The final screen shows the updated "Current Bookings" list with the selected reservation removed.

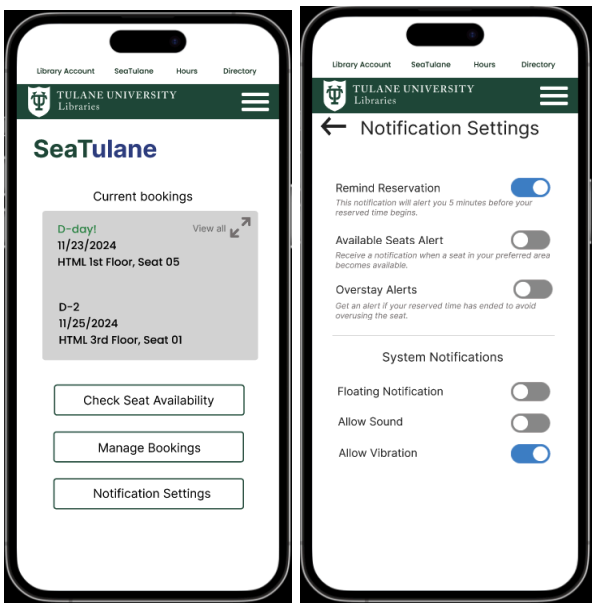

Figure 14a-b. The Notification Settings page, accessible from the Home screen, allows users to configure various alerts. Notifications are categorized into three main types: "Remind Reservation," "Available Seats Alerts," and "Overstay Alerts," with explanatory descriptions provided below each option for clarity. Additionally, settings for sound and vibration notifications are grouped under the "System Notification" category, making it easier for users to customize their preferences efficiently.

Alternative text: Two app screens illustrating the flow to access the Notification Settings page. The first screen shows the main page with a "Notification Settings" button, and the second screen displays the Notification Settings page, where users can configure alerts such as "Remind Reservation," "Available Seats Alerts," and "Overstay Alerts," along with sound and vibration options under "System Notification."

Conclusion:

SeaTulane was created with the goal of allowing Tulane students to track and reserve available seats in Howard Tilton Memorial Library. Through a combination of student interviews and surveys, we (the SeaTulane team) were able to hone in on pain points in the Tulane community to ensure our app would ease

these studying frustrations. We then developed our low-fidelity prototype, analyzed any issues with its flow, and used Figma to develop our high-fidelity prototype. We subjected this prototype to both heuristic and user evaluations to further refine the user experience. We hope this prototype showcases the potential SeaTulane has to positively impact a student's study experience during their time at Tulane.

REFERENCES

1. Jakob Nielsen. 1994, Updated 2024. 10 Usability Heuristics for User Interface Design. NN/g. Retrieved December 2, 2024 from https://www.nngroup.com/articles/ten-usability-heuristics/

APPENDIX

Appendix A - Interview Questions

1. In the past week, how often have you visited the library?
2. Walk me through your usual process of finding a seat in the library.
3. In the past week, which floors of the library have you studied on or visited?
4. Tell me why you like certain library study spots better than others.
5. Tell me about a time you struggled to find a seat in the library.
6. Tell me about other study spots you use outside of the library.
7. Walk me through your thought process of how you decide to study in the library.
8. Describe a time you had a group study session in the library.
9. In the past week, how often have you studied with others in the library?
10. What in your opinion would be a feasible way to deal with these students having trouble looking for space?
11. Have you had an experience using QR codes around campus?
    a. How was it?

Appendix B - User Research Survey

https://docs.google.com/forms/d/e/1FAIpQLSfPr9zPfTFJZ-5fC3_8_7JhFu3DqzOcvykGH_CysG7x7MJtqQ/viewform?usp=sf_link

Appendix C - User Testing Pre-Test Survey

https://docs.google.com/forms/d/e/1FAIpQLSdeMbmlcxK4BWZy8HbAuEuhxZYlHVUHw3juZoFsKITQPQaNlA/viewform

Appendix D - User Testing Post-Test Survey

https://docs.google.com/forms/d/e/1FAIpQLSc5-IhvV046BRkRh3B0i3XOlwxcrvnPW48Y1VxPhL9UJfsbmw/viewform