

# Interdisciplinary Approach to a Coping Skills App: A Case Study

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### **Abstract**

Rich learning opportunities exist when academic departments reach beyond their discipline. During the COVID-19 pandemic, we organized an interdisciplinary team to create a mobile app to measure and support mental health through better coping skills education in the local community of Erie County, Pennsylvania. Guidance on how to develop a professional level organization at an undergraduate academic institution for app creation is sparse. Best practices in developing this environment are needed. This article describes how we, a team of four educators and three students, created the mobile app. The process mimicked a professional development team with many adjustments. The arrangement of the team and the process taught the students teamwork and gave the educators an opportunity to collect meaningful data on the local population. The methodology included adaptations from industry in a project planning guide, requirements gathering processes, user testing processes, prototyping and iterations. Development encountered several unanticipated challenges with the need for two institutional review board approvals, consultation with an attorney, hosting challenges, and Google Play Store hurdles. We suggest that future academic teams plan for these challenges at the outset. This interdisciplinary experience is a complement to any digitally-oriented classroom and is a nice introduction for students to gain the needed skills to advance to Startup and Tech Accelerator programs already in place at many universities.

## Introduction

Rich learning opportunities exist when academic departments reach beyond their discipline and engage with each other. Interdisciplinary approaches are key to success in independent business entities and they allow a team to “engage with their ideas, maintain productive interaction, and successfully implement these ideas” (Brodack and Sinell 2017, 10). Interdisciplinarity broadens the knowledge base of a project team, taking full advantage of the specialized knowledge of its members while avoiding the peripheral blindness often associated with such specialization. When managed correctly, creative problem-solving outcomes are enhanced (Moirano, Sánchez, and Štěpánek 2020), silos are merged, and focus limitations associated with specialization are removed (Blackwell et al. 2009). Working on a project within an academic environment is no different. Students have specialized knowledge and often a preconceived perception of a problem. Collaboration with those outside their field broadens their interpretation of and approach to a problem while allowing them to use their special skills with external input. Developing a mobile app requires the technical skills of computer scientists, the knowledge of subject matter experts, and the expertise of user experience researchers. Here, we present a case study of a successful app development process as a blueprint for others to follow with a discussion of tools, activities, time budgets, resources, challenges, and potential impact.

During the COVID-19 pandemic, two psychology faculty members (a clinical psychologist and an engineering psychologist) and one computer science faculty member collaborated along with the corporate liaison at the university to address the increased need for coping skills in the local and student community (Fernández et al. 2020; Naeem et al. 2020; Saltzman et al. 2020). We received a grant and hired two undergraduate students and one

graduate student to work with us. This article documents our wins and lessons learned in order to help other academics bootstrap the process.

Research is clear on the significant negative effects resulting from the COVID-19 Pandemic. In addition to significant physical health risks, there are substantial increases in the rate that individuals are experiencing mental health symptomatology such as distress, anxiety, sadness, and isolation (Kar et al. 2020; Pierce et al. 2020). Unfortunately, there has been less focus placed on increasing our ability to address mental health concerns at a systems level even in the face of rising pathology (Kar et al. 2020).

As a result of the pandemic, there is a shift within the mental health field towards providing more services remotely (e.g., meeting with a therapist by webcam). However, that shift does not address the increasing demand for mental health services. Thus, there is a significant need to develop other digital avenues to try and reach individuals in need (Ho 2020). According to Ho (2020), apps developed for smartphones to provide users with psychoeducation, resources, and coping strategies may prove especially useful to help meet increased mental health needs during the pandemic. Previous research demonstrates the viability of using smartphones to integrate mental health services through technology. Digital apps have been created to monitor, record, and, in some cases, modify mental health, such as providing location-based services to alert users to the nearest mental health clinic, providing self-help mantras and guided meditations, and tracking mood ratings based on self-reporting (Luxton et al. 2011).

According to the Centers for Disease Control and Prevention (2021), engaging in appropriate coping strategies during the pandemic is important to maintaining one's mental wellbeing. We developed the Serene app to help our students and the surrounding community cope with the pandemic while gathering information on the mental health of the community.

Specifically, the app was developed to accomplish this goal through non-medical advice that engages users with behavioral activities, psychoeducation, motivational quotes, video exercises for relaxation and breathing, local and national professional resources, and connections to available, external, evidence-based mental health apps.

We set out to determine the best practices in developing a professional level organization for app creation. We anticipated the project would take four months, but it took eight months with an additional four weeks for the Google Play Store release and an additional eight weeks for media coverage.

### **Organization**

Our group was separated into three pairs, each consisting of a faculty member and a student. Faculty members chose students in their discipline based on previous coursework, previous independent study, and their experience of the students in their courses. The faculty/student pairs are referred to as teams. The three teams were as follows:

- a) UX (user experience) team (an engineering psychology professor and an undergraduate human factors psychology student who successfully completed the assignment in Appendix A),
- b) Content team (a clinical psychology professor and a counseling graduate student), and
- c) App development team (a computer science professor and an undergraduate computer science student).

The corporate liaison provided advice and guided compliance to the institutional mission and the funding agency's mission.

#### **User experience (UX) team**

The UX team organized first to create the design for the minimally viable product (MVP) prototype. Eric Ries (2013) discusses the specifics of MVPs and how they can save development time. The UX student used her expertise in human factors and referred to the research-based best practices on Don Norman and Jakob Nielsen's NN group website (Nielsen Norman Group 2020). Don Norman is a faculty member at the University of California San Diego and one of the forefathers of UX. Jakob Nielsen is an engineer and a principal at the NN group.

The UX and content students conducted a competitive analysis to discover what similar apps existed and what these apps provided to users as Jill DaSilva (2020) discusses. They created a spreadsheet of similar apps and their features. This was the basis of requirements gathering as Janet Six (2019) suggests. The team reviewed the spreadsheet and developed the requirements document using a version of the MOSCOW method (must, should, could, won't) as discussed in ProductPlan (2020) and then refined this list. Some desired but untenable features were "connecting to a counselor on campus through a chat feature" and "talking to others using the app." Both of these features would require infrastructure that was unavailable. Then, the UX student organized the architecture of the app discussed by Jen Cardello (2014) and used [LucidChart](#) to create the architecture as shown in Figure 1.

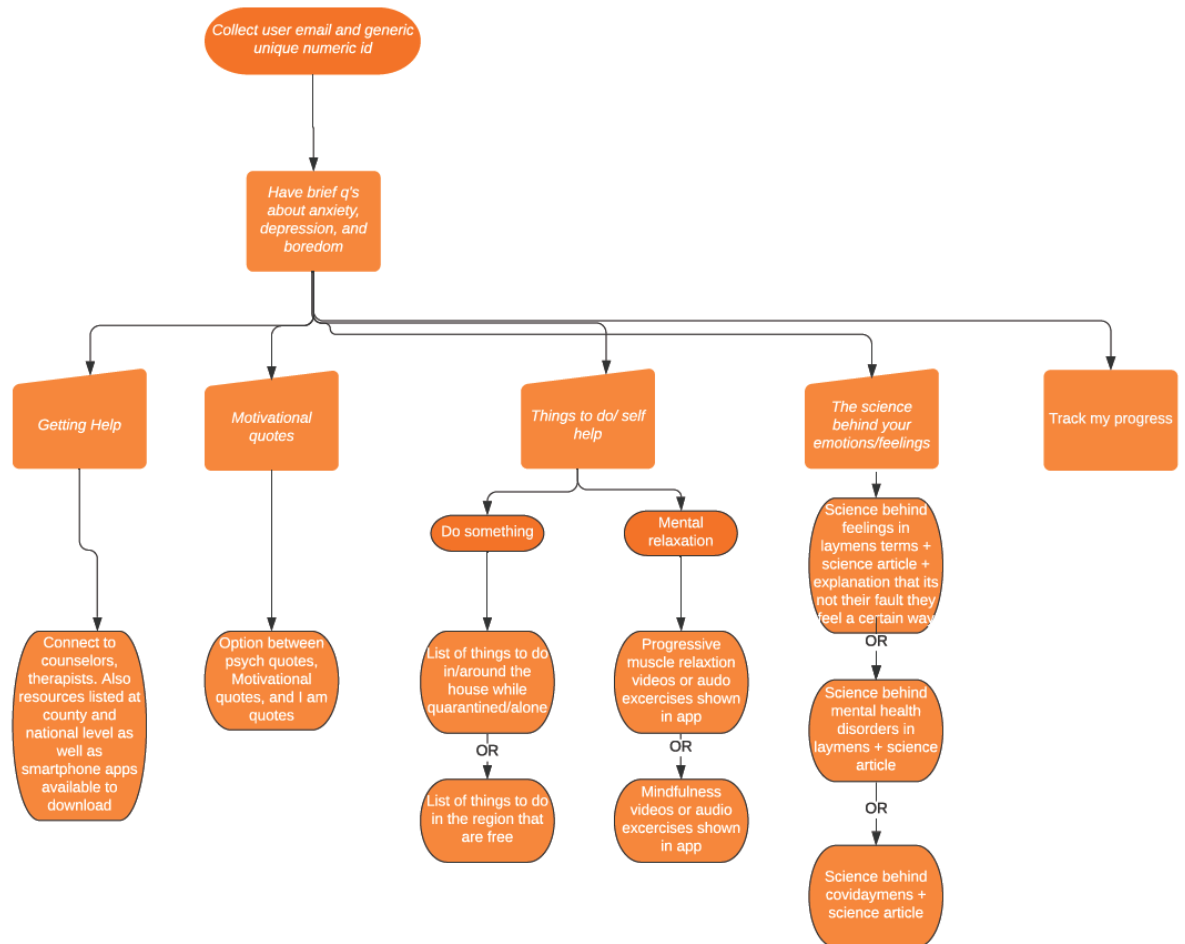


Figure 1. The information architecture.

After approval, the UX student generated pencil sketches of the screens and then developed the individual screens using the open-source material design pattern library (<http://material.io/>).

Next, the student used the Invision App (<https://www.invisionapp.com/>) with a free educational license (<https://www.invisionapp.com/education>) to work out the navigation between the screens.

At each stage of this process, her work was approved by the group. The prototype took two weeks longer than anticipated. The Serene app design is stored online at Invision (<https://projects.invisionapp.com/share/8DXSLUJCRAK#/screens>).

### App development team

The development team participated in the discussions of the overall design, the design of the architecture, and the design of the UX. Following creation of the UX design by the UX team, the app development student created a prototype of Serene that followed the UX design and turned the prototype into a fully functioning app product using his expertise in computer science, following weekly discussions with the entire team. The development process consisted of the development of the back end, a Java server that handled the processing and storage of data, and the front-end, the app itself, built using HTML5 and JavaScript with Cordova (<https://cordova.apache.org/>), providing multi-platform support.

### **Content team**

The content team helped the UX team to research similar apps. A spreadsheet was created to compare similar apps and their functionality. Following discussion with the whole team, the content student developed comprehensive resource lists to provide users with information regarding:

- Mental health providers in Erie County, Pennsylvania. The list consisted of local agencies and organizations, their contact information, and the target population.
- Nationwide mental health resources. The list consisted of national mental health hotlines and organizations for various populations.
- Other mental health smart-phone applications. In collaboration with the UX team, a list was created with all the mental health applications that the team was able to find. The content team assessed the applications and chose a small number of evidence-based applications to suggest in the Serene app as additional applications.



- Behavioral activities that users could consider doing. Based on psychological principles of behavioral activation (Kanter et al. 2010) to help increase well-being by remaining physically active, the content student used her expertise in counseling psychology to compile a list of various activities users could do across a variety of settings and circumstances (see Appendix B). Given some of the restrictions experienced due to the COVID-19 Pandemic, these resources provide users with ideas for activities they can engage in regardless of pandemic-related circumstances (e.g., socially distant outdoor activities or things to do at home if faced with a stay-at-home order).
- Motivational quotes. Upon discussion with the whole team, it was decided that three categories of quotes (i.e., psychology quotes, I am... quotes, and motivational quotes) were needed. The content team sought to include at least 365 quotes in each of the three categories thereby ensuring a steady stream of new content (i.e., one new quote from each category for every day of the year) to help promote regular use of the app and gather information on how users were feeling. The final list consisted of approximately 380 quotes for each category.

The content student also used her expertise in counseling to research and write articles that provided users with evidence-based information regarding mental health and COVID-19, all accessible from within the Serene app. The mental health information discussed emotional reactions and stigmatization in mental health. The COVID-19 article was a comprehensive summary of the characteristics of the coronavirus, along with ways individuals can protect themselves. All sources used were either governmental (e.g., CDC and WHO) or other high-quality online resources (see Appendix C; e.g., information from the Bill and Melinda Gates

Foundation). These articles and resources assist users in finding valid and reliable information about mental health and the COVID-19 pandemic.

Providing users with this type of information, also referred to as psychoeducation, is a very important component of multiple therapeutic models in mental health services. That is to say, we need to provide information related to the individual mental health concerns of mental health consumers in order to raise awareness and offer a sense of reality and control. Since the Serene app was created as a tool to assist its users with mental health struggles in isolation during the COVID-19 pandemic, our articles are meant to provide users with information about basic mental health concepts like stigma and emotions, as well as information about the coronavirus. Further, many un reputable online resources spread misinformation and inaccuracies that may confuse or even disturb individuals. Therefore, providing reliable resources and psychoeducation to users of the Serene app may also help to decrease potential distress that individuals may face if they were to search for and receive this same information from other, potentially unreliable or misinformative sources.

Finally, the content student's expertise in counseling helped her to create mindfulness, meditation, and progressive muscle relaxation exercises that users could freely access within the Serene app. For this purpose, appropriate audio recording equipment (Studio Condenser USB Microphone with Adjustable Scissor Arm Stand) was purchased. Moreover, the content student searched online resources to find and adapt scripts and soundtracks for use within the app. The content student recorded the audio for each of the exercises, mixed the audio with background music and visuals, and uploaded each exercise to the team's YouTube channel, for use within the app. The majority of the content student's hours were spent in the creation of these exercises because significant time was needed for the student to locate appropriate scripts and soundtracks

and to get familiar with the recording equipment and software. By the end, a five-minute recording would take approximately two hours to complete from start to finish.

### **Student Work and Time**

As this was the first time that we had developed an application together, we had many questions about how much time the students should spend and what they should be doing during those hours. Based on our experiences, 50 percent of person-hours were devoted to the app development student, followed by 36 percent to the content student, and 14 percent to the UX student. To help future academic development teams determine a budget, we have included the actual student time/activities as concrete guidance.

#### **UX team**

Students were screened in an “Introduction to Human Factors” class on a prototype development assignment (see Appendix A). One of the challenges we had was budgeting for student hours. While these times may not work for every project, here is the time breakdown for the UX student.

<b>UX student time</b>	<b>Activity</b>
8 hours	Competitive app research
2 hours	Helping with content
2.5 hours	Information architecture
16.25 hours	Meetings—requirements development, review sessions, organizing the project
30 hours	Prototyping
8 hours	User testing and reporting
2 hours	Miscellaneous

Table 1. The time that it took the UX student excluding final user testing.

### **App development team**

Students were screened in a computer science class where coding assignments were a major component. Students' assignments were reviewed based on their performance, which included the correctness, efficiency, and organization of their written programming code. One student was invited to join the team based on his performance and his availability in the schedule of the development.

<b>App development student time</b>	<b>Activity</b>
12 hours	Back-end development, including the storage of data on a server and server setup*
205 hours	Front-end app development, including the app interface and the connection to the back end
6 hours	Miscellaneous
18 hours	Meetings

Table 2. The time that it took the app development student excluding submission of the final version to Google Play. \*Server setup requires the support of the IT department at the institution, which may take days or weeks depending on the institution. This is not counted in the development table.

### **Content team**

Given the mental health nature of the content to be created for this application, it was important to find a student with expertise in both the research and practice of clinical psychology. Therefore, the student for the content team was hand selected from a clinical psychology graduate program on campus. Prior to working on this project, the student worked as a research assistant for the content team lead. Through this work the student demonstrated several key qualifications for this position, including: a passion for mental health advocacy, a

mastery of the material, and the ability to work efficiently and effectively both as part of the team and on an individual level.

<b>Content student time</b>	<b>Activity</b>
16 hours	Creating a database of county-wide mental health resources (e.g., providers) as well as select nationwide resources (e.g., the National Suicide Prevention Lifeline)
3.5 hours	Researching other mental health smartphone applications to list within this app to provide users with additional wellness resources
9 hours	Creating a list of behavioral activities users could access to help find things to do across a range of current circumstances (e.g., things to do at home, if faced with a stay-at-home order due to the pandemic; socially distant outdoor activities)
34 hours	Collating several lists of positive and inspirational quotes
91.5 hours	Producing video content for the app (e.g., mindfulness exercise videos)
16 hours	Attending team meetings
3 hours	Miscellaneous

Table 3. The time that it took the content student.

### **Project Development and Implementation**

Initial development began in late April 2020 with team organization for the summer and an application for grant funding. Project planning was done using a mix of free templates. For planning purposes, the UX work and content work happened in the first three months. App programming began concurrently in the second month once the initial prototype screens had been determined. User testing began in the third month along with iterations to solve the issues that were discovered. Figure 2 outlines the order in which the development occurred as well as the stages of ideation, solidification, and implementation within each phase. Review was

ongoing in each phase. Development finished in the sixth month with submission to Google Play Store in the seventh month. The app was approved and deployed in the eighth month.

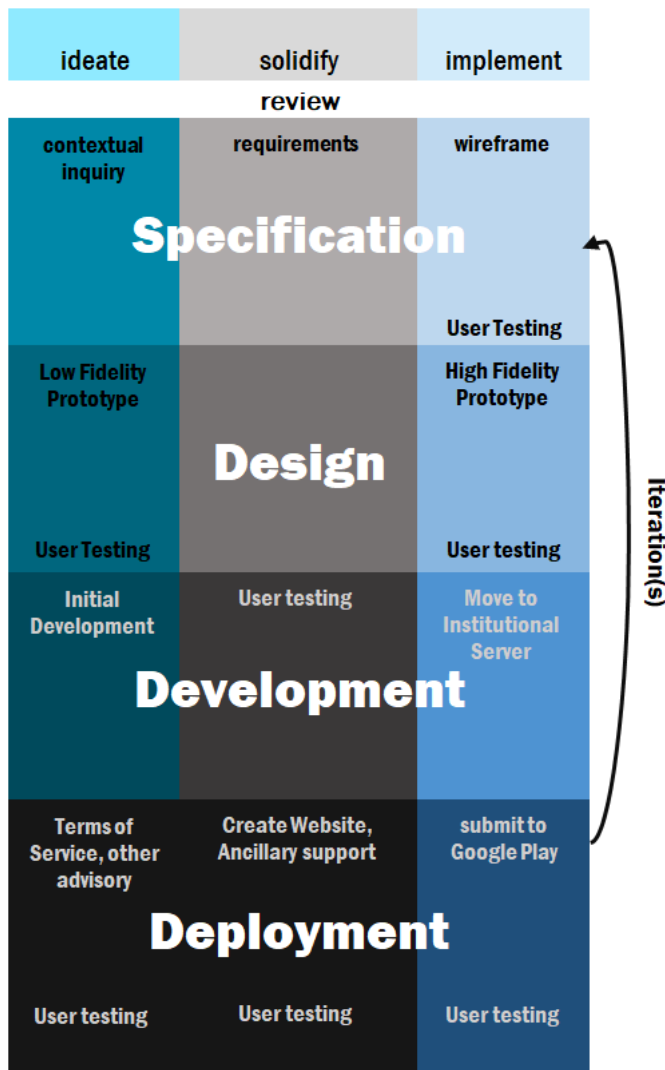


Figure 2. The development cycle.

### Resulting Impacts

In order to keep the team focused and establish a collaboration, a project plan was our first action. Within the project plan was the rationale, the project scope, team composition, team responsibilities, team deliverables, milestone activities, communication management plan, the contact information for each team member, the budget, how the meetings would be conducted,

and a quality baseline commitment. All members reviewed and revised the project plan until it was agreeable. The document was critical to the interdisciplinary focus and prevented role drift where one person tries to take over all the roles in the development process.

The Serene app included three opportunities for learning. The first opportunity was to learn more about how a multidisciplinary team could be structured to deliver specific applied skills in an academic setting. The second was the learning environment of developing the app itself. The third occurs in deploying the app to the larger community and learning more about the community's mental health.

The first learning opportunity gave us a greater appreciation of how each discipline perceived the work and structured priorities. For example, the content group had a great interest in gathering mental health data. At first, the UX and app development teams failed to realize how important biological sex is to mental health data collection and analysis. The content team explained a long-standing issue in the mental health field pertaining to a need to research and better understand biological sex differences in relation to psychopathology as Cynthia Hartung and Thomas Widiger (1998) and Cynthia Hartung and Elizabeth Lefler (2019) discuss. As a result, it is important to ensure that data such as biological sex is collected and analyzed in mental health research to help elucidate whether any potential findings vary by sex. Even through this simple occurrence, the students learned the value of the various perspectives provided by an interdisciplinary team. The team included five options to report sex: prefer not to say, male, female, intersex, and other.

The second opportunity happened both during and after development as we learned to coordinate our expertise. The members of UX, app development, and content teams used their expertise to move the project forward. Faculty mentors coached students on teamwork skills and

developed the students' expertise in separate meetings. The weekly team meetings were opportunities for joint design decisions, review of the work, and progress maintenance by following the four *we*'s: (a) this is what *we* were thinking in our role, (b) this is what *we* did to move the project forward, (c) this is what *we* think should be done next, (d) what do *we* think? The forming, storming, norming, and performing stages are well documented (Tuckman 1965), however, in this project a deeper sense of inquiry was necessary to convey respect for each role's effort. This respect freed individuals from preliminary criticism that would hamper their motivation yet allowed the team to critique the project at critical milestones. For example, the UX team struggled to devise the weekly, monthly, and yearly graphs. During weekly reviews, the team settled on an earlier solution. The UX team enjoyed the freedom to exercise their expertise and intellectually explore the options before the final design decision was made by the team.

The third learning opportunity is ongoing and comes from anonymous user data being collected to identify and address potential mental health inadequacies prevalent in the regional community. Typically, mental health needs outpace the resources available. By creating this app, we not only provided valuable resources to the community during a time of immense need, but we also gained valuable insight into the ongoing needs of our community. For instance, these data allow us to analyze the anonymous, self-reported, mental health data, across time throughout and after the pandemic. It also allows us to examine and better understand what types of local resource content are most applicable to our community members. Ultimately, these data will allow the team to better understand the specific needs of our area, as reported by the community, and can serve to tailor engagement towards addressing specific community needs.



While we often put students in teams in class, they rarely participate in teams across disciplines. This project was a beneficial example of how to construct an interdisciplinary team. Each student responded positively in their comments (see Appendix D): “The biggest challenge was taking what suggestions the development team had and giving them life”; “Nonetheless, working with a large group of experienced professors and students allowed for a painless development process;” and “The main sense that remains with me after the completion of Serene is that of working and communicating with people from various fields who all used their own language, interests, and expertise for the same project.”

### **Challenges**

We encountered several challenges through our development process. They range from technical—data warehousing, quality assurance, design, to legal—terms of service, to managerial—content. The following sections describe each of them.

#### **Data warehousing**

One of the first challenges was where to host the programming code as the project developed. Two back-end server hosting solutions were considered. The first was a cloud-based solution, Amazon Web Services (AWS). However, this solution was abandoned due to its ongoing costs associated with storage (AWS Simple Storage Service), computing (AWS Elastic Compute Cloud), and communication (AWS Data Transfer). We chose the second solution, hosting with an internal institutional server using Windows Server. This solution required:

- Help from IT support from the university in setting up server
- University computing and storage resources
- Compliance with university, including accessibility
- Access to the Google Play Store from a university-owned account

## **Content**

A considerable amount of time was spent in finding mindfulness scripts, soundtracks, and images with no copyrights. Also, the composition of the audio files was quite challenging, and particularly the pairing of the soundtrack with the narrative. The first few recordings took many hours to complete. Finally, the list with the quotes was unexpectedly time consuming, as the content team had to proof-read the quotes and ascertain the authors for all the quotes that appeared “unknown” during the search.

Many of the resources were kept in a spreadsheet file. The team decided to use html tags so the app could easily access the spreadsheet resources and use those resources, as is, within the app. The content team easily learned the tags and adapted.

## **Institutional Review Board**

We found that we needed two reviews for human subjects research. One was for user testing during development. The other was for using the data that the app gathered. As this second review of data had information that was not identifiable to a person, it was determined that this was not human subjects’ data.

## **Attorney services**

There were many questions about how to best navigate terms of service and data use. We worked closely with the legal department at our institution through the corporate liaison officer to implement a terms of service appropriate to the general nature of the app and for the information on the data and how it would be used. Since the Serene app has a mental health focus, it was essential to ensure that it was not used as a substitute for medical care and that the development team and the university could not be held liable for any such misuse. Therefore, the corporate liaison consulted with the university’s offices of risk management and general counsel.

These offices helped to craft simple, understandable terms of service and data usage language.

As the app was produced by the students, we chose to provide that information on the accompanying website rather in the app itself.

### Design of charts

Other challenges included problems related to a specific content area. In UX/UI- there was quite a bit of work on how the charts would look. Initially, we considered a complex line and bar chart such as in Figure 3.

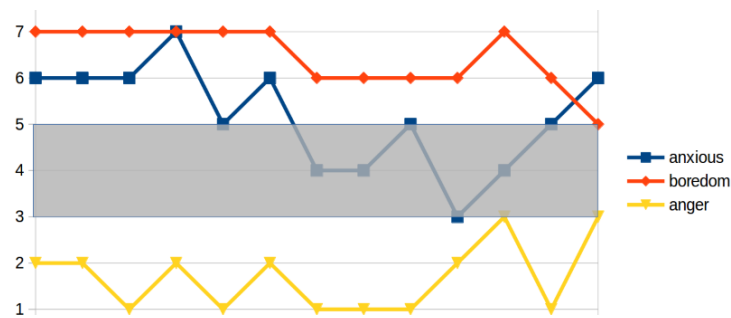


Figure 3. Initial prototype for tracking emotions.

However, this chart was too complex for the small real estate on a mobile phone screen and did not capture the weekly, monthly, and yearly changes. Then, we tried three different charts as shown in Figures 4 to 6.

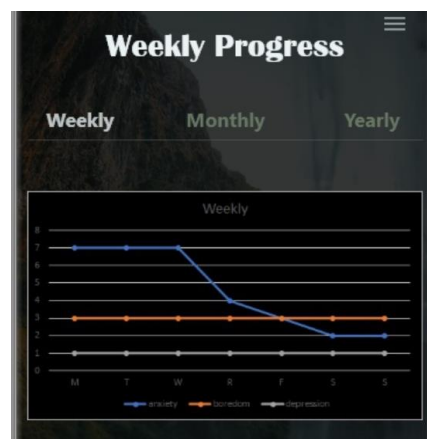


Figure 4. Prototype of weekly progress.



Figure 5. Prototype of monthly progress.

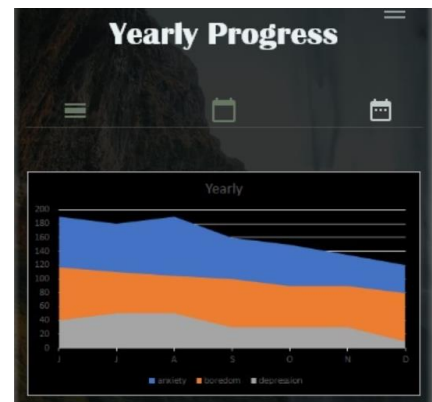


Figure 6. Prototype of yearly progress.

## User testing

In order to discover how well the design was understood, we conducted user testing with five undergraduate students from the psychology course testing pool which was approved by the IRB. The UX student used standard user testing methodologies as recommended on NN group's user testing videos (Nielsen Norman Group 2020). In the user testing, participants were asked to do three tasks: Find a mindfulness video, find an activity to do on the phone/computer, and find a local resource for depression. Then, the researcher took note of any problems the participant had and how long it took each participant to do each task along with satisfaction ratings as described by Erik Frøkjær, Morten Hertzum, and Kasper Hornbæk (2000). Participants in user testing

found that some of the labels were unclear and there was confusion about where to find specific tasks within the app. There were also questions about the use of a password and if users would be able to use the app on their Android phone and on the web. Users said that they would like a password, but this would invalidate some of the anonymity of the data and could cause some late-stage development changes. Thus, we decided to leave the password issue to the future releases and comments were gathered.

### **Quality assurance team**

Once the code is working, there needs to be a dedicated team that tests the app, looks for the weaknesses and finds out if there are bugs that might break the app. We did not have such a team and instead functioned as our own quality-assurance team along with friends who volunteered their time. This method took longer and a professional-level assurance team should be included in the budget.

### **Conclusions and Future Directions**

Despite the challenges encountered during the development of the app, the combination of talents into one interdisciplinary team allowed the creation of a completed product that far exceeded what one discipline could accomplish alone. One purpose of the project was to give the students the experience of working in a structured and distributed environment with a team that was segregated by roles but followed an agile software development approach, where development happened in an iterative way. Professors spent additional hours mentoring the students on teamwork and communication as well as learning about the other roles. Working together while maintaining a constant line of communication was key to its success. Having regular stages of reviews during the development cycle helped guide the process in the right direction. Using the right collaboration tools, such as Microsoft Teams, Google Docs, and

GitHub, made team work much easier. The Serene app is available through Google Play and can be accessed on the [Serene website](#).

Knowing that the project would result in an app launched to a large community of potential users provided ample motivation to meet the learning and performance needs for successful completion of the project. Learning requirements were high and extended well beyond knowledge gained in coursework. Also, it did not go unnoticed by the students that the audience for this project was external to the university, and it motivated them to take extra care and expend extra effort in their work. Working within an interdisciplinary team that extends beyond students to include university faculty and staff helped the students to broaden their perspective of app development work to include the work of the other teams, focus their thinking on alignment of the project with the mission of the university, understand potential legal responsibilities, and value meeting the expectations of external stakeholders. For example, the funding agency has a strong local focus, so the students had to be sure to target a sufficient portion of the app's functionality toward a regional audience.

Our university is highly focused on being an Open Lab (Birx, Ford and Payne 2013), an interdisciplinary living laboratory where learning and discovery are applied to solve problems defined in partnership with external stakeholders. The Open Lab concept evolved from the idea of research clusters working on pressing local problems. The Open Lab is a win for students, faculty, and the external organizations: students gain career-building, real-world experience; faculty enjoy the ability to keep their skills relevant and transfer their networks to students; and external partners benefit from the energy and ingenuity of student talent. More information can be found at the Open Lab website through the university homepage (<https://behrend.psu.edu>). This project aligns with that focus, as it creates an outward-facing product that receives and

engages with feedback from the external community, adding motivation and accountability to the students' work. It is notable that all students acknowledged the value that this experience provided to them and their career development. Students involved in this team left individual comments regarding their experience (see Appendix D).

We plan on continuing an extension of this project. For future work, psychology content can be updated and expanded with additional mental health or COVID-19 focused information, resources, or the creation and addition of new wellness exercises that users can freely access from within the Serene app. We have deployed the app and are monitoring user feedback. Additional user testing will be conducted based on user feedback. We also plan to deploy the app to iOS. When recruiting undergraduate students, it is a good idea to have overlapping years. There should be some second-year students, some third-year students, and some senior students. This approach ensures smooth transitions for projects having a multi-year life expectancy.

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## Appendix A: UX Screening Assignment

*Instructions. For this project, I want you to imagine that you have been hired to create a prototype for a mythical application. The goal of the application is to reach out to people who are feeling anxious and provide them with mental health resources and exercises to help. Boredom is part of anxiety, so it also addresses boredom. The red route in this app is that people should be able to report their level of anxiety and then get a breathing exercise and then get the phone numbers of mental health professionals. Please use one of these programs: Adobe XD (inside Adobe Creative Suite), or Figma, or Invision to create a prototype for this app. Your prototype must be designed for an Android phone and have at least one screen for each box in the information architecture outline which is here in Figure 7.*

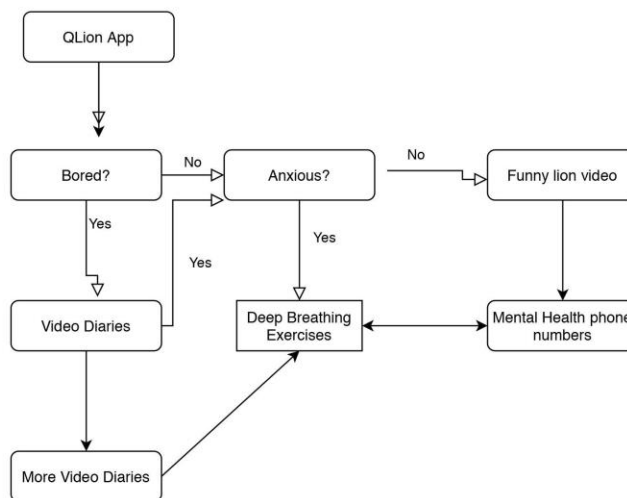


Figure 7. The architecture that the assignment used.

*Each screen must show the choices that would bring you to the next screen (yes/no). The screens must use the Material design pattern library which is here: <https://material.io/>.*

*Once you are finished with all the screens and they are linked so that they work as an app would, please turn in the URL. I don't want the screens or the file, just the URL for the prototype.*

## **Appendix B: Activities Provided to Users Within the Serene App**

<b>Activity Category Type</b>	<b>Activity</b>
Indoors	Cook/Bake a new recipe
Indoors	Take a nap (or two)
Indoors	Do a jigsaw puzzle
Indoors	Organize your room
Indoors	Take a (long) bath/shower
Indoors	Clean your room/house
Indoors	Try out DIY crafts
Indoors	Organize your cabinets
Indoors	Throw away expired items
Indoors	Redecorate your room/house
Indoors	Repaint your room/house
Indoors	Reorganize your closet (check out Marie Kondo)
Indoors	Fix broken items
Indoors	Plan your outfits (even your “Zoom” ones)
Indoors	Clean your electronic devices
Indoors	Do your laundry
Indoors	Clean your fridge
Indoors	Create an emergency kit
Indoors	Cook/Bake for your friends or co-workers
Indoors	Rearrange your furniture
Indoors	Make a pillow fort
Indoors	Make a cardboard house
Indoors	Take care of your plants
Indoors	Sing around the house
Indoors	Cook a Michelin worthy meal
Indoors	Meal prep for the week/month (it will change your life)
Indoors	Change your bedsheets
Indoors	Organize your workspace
Indoors	Shave
Indoors	Cook an international cuisine
Indoors	Make home-made “fast food” (pizza, tacos, etc.)
Indoors	Grow an indoor kitchen garden
Indoors	Make your own peanut butter and jam
Outdoors	Start a vegetable garden
Outdoors	Clean out your car (Beware!)

Outdoors	Plant flowers
Outdoors	Find a place to volunteer
Outdoors	Go to church
Outdoors	Sell stuff you don't need
Outdoors	Go on a solo date
Outdoors	Go for a walk/run
Outdoors	Go for a bike ride
Outdoors	Plan and go on a scavenger hunt
Outdoors	Make a cardboard house
Outdoors	Birdwatch
Outdoors	Go for a drive
Outdoors	Have a bonfire (and roast marshmallows, of course)
Outdoors	Sunbathe (don't forget your sunscreen)
Outdoors	Take care of your plants
Outdoors	Fly a kite
Outdoors	Go camping (and roast marshmallows, again)
Outdoors	Walk on the beach/riverfront
Outdoors	Go roller-skating
Outdoors	Go hiking
Outdoors	Go out for dinner/lunch to a new restaurant
Outdoors	Go fishing
Outdoors	Gaze at the stars (appease the romantic in you)
Outdoors	Go on a picnic
Outdoors	Go to a coffee shop (no, not the drive-thru)
Outdoors	Have a barbecue
Outdoors	Spend time in nature
Outdoors	Go to home opens
Outdoors	Walk around the city
Outdoors	Mow your lawn
Outdoors	Build a bird house/feeder
Outdoors	Go to a scenic spot and enjoy the view
Outdoors	Learn tricks with a jumping rope
Outdoors	Turn your yard into an outdoor cinema
Outdoors	Take your dog to the park
Outdoors	Check out geocaching (yes, it is still a thing)
Outdoors	Let out some energy by screaming or running around like crazy (not recommended if you live near people)
Outdoors	Build a hammock
Outdoors	Watch the sunset/sunrise
Outdoors	Build a sandcastle
Entertainment	Watch YouTube videos
Entertainment	Binge-watch a new TV show
Entertainment	Play a video game

Entertainment	Read a book/magazine
Entertainment	Blast some music
Entertainment	Discover new music
Entertainment	Visit museums virtually
Entertainment	Watch a documentary
Entertainment	Read your favorite blogs/find new ones
Entertainment	Listen to your favorite podcast/find new ones
Entertainment	Play online games with your friends/family
Entertainment	Make a new playlist
Entertainment	Make a playlist for every mood
Entertainment	Download fun apps
Entertainment	Listen to an audiobook
Entertainment	Watch a Disney movie
Entertainment	Learn a magic/card trick
Entertainment	Dig out old board games
Entertainment	Listen to the radio
Entertainment	Re-watch your all-time favorite movies
Entertainment	Have a movie marathon
Entertainment	Read a comic book (DC or Marvel?)
Socializing	Text/call someone you haven't talked for a long time
Socializing	Play online games with your friends/family
Socializing	Take on a new challenge with your friends/family
Socializing	Ask your parents and grandparents about their childhood
Socializing	Find a place to volunteer
Socializing	Go to church
Socializing	Throw a themed Zoom party
Socializing	Call your grandparents
Socializing	Plan your next vacation/get-away (visualize that the Earth and people are fine again)
Socializing	Contact a distant relative
Socializing	Talk with your family
Socializing	Plan/Go on a road trip
Socializing	Go old school and get a pen pal
Socializing	Have a class reunion (Zoom makes it easier)
Socializing	Don't take your loved ones for granted and remind them that you love them
Socializing	Plan a Zoom trivia night
Socializing	Teach a skill to someone
Socializing	Plan a surprise for someone
Socializing	Get to know your neighbors
Socializing	Spread some positive energy and give someone a genuine compliment
Pen & Paper	Draw/Paint/Doodle
Pen & Paper	Do a painting tutorial

Pen & Paper	Create a bucket list
Pen & Paper	Write thank-you cards
Pen & Paper	Start a journal
Pen & Paper	Create a healthy meal plan (and follow it)
Pen & Paper	Schedule your week/month/year
Pen & Paper	Solve brainteasers/crosswords
Pen & Paper	Make a list of your favorite quotes (Serene can help you out with this)
Pen & Paper	Make a travel bucket list
Pen & Paper	Write a letter to your future self
Pen & Paper	Start a gratitude journal
Pen & Paper	Color an adult coloring book
Pen & Paper	Make a list with all the things that make you happy
Pen & Paper	Create a list with all the things you don't know and want to Google
Pen & Paper	Write a poem/essay/story/song
Pen & Paper	Design your dream house (maybe log in your Sims account?)
Pen & Paper	Plan your next vacation/get-away (visualize that the Earth and people are fine again)
Pen & Paper	Make a pros-cons list to help you make a decision
Pen & Paper	Plan/Go on a road trip (Google themed road trips; you won't regret it)
Pen & Paper	Learn calligraphy
Pen & Paper	Follow a writing prompt
Pen & Paper	Document all the self-isolation days by photography or writing for the future generations to see
Personal Growth	Read a book/magazine
Personal Growth	Visit museums virtually
Personal Growth	Watch a documentary
Personal Growth	Organize your finance
Personal Growth	Start a journal
Personal Growth	Create a healthy meal plan (and follow it)
Personal Growth	Make a list of your goals with 3 logical and feasible steps to achieve them
Personal Growth	Learn a new language (well, get started at least)
Personal Growth	Update your resume
Personal Growth	Watch TED-Talks
Personal Growth	Start a gratitude journal
Personal Growth	Learn how to play an instrument
Personal Growth	Listen to an audiobook
Personal Growth	Apply for a new job
Personal Growth	Plan your future education
Personal Growth	Look for online/free certificates
Personal Growth	Make a list with all the things that make you happy
Personal Growth	Expand your vocabulary (appease your intellectual self)

Personal Growth	Do the one thing you have been putting off (you know what we are talking about)
Personal Growth	Make a plan to pay out your debt
Personal Growth	Learn how to build up a good credit
Personal Growth	Find a place to volunteer
Personal Growth	Practice your religion
Personal Growth	Learn about spirituality
Personal Growth	Research ways to make your living situation more sustainable and “green”
Personal Growth	Research about other cultures
Personal Growth	Update your LinkedIn
Personal Growth	Create a vision board
Personal Growth	Start a money saving challenge
Personal Growth	Take a fun online course
Personal Growth	Google things that interest you
Personal Growth	Finish unfinished projects
Personal Growth	Research fitness/wellness videos/blogs
Personal Growth	Learn more about finance and budgeting
Personal Growth	Make a pros-cons list to help you make a decision
Personal Growth	Create a savings plan
Personal Growth	Learn a new skill
Personal Growth	Learn a graphic design program
Personal Growth	Learn first aid
Personal Growth	Explore career options
Personal Growth	Buy a newspaper to read with your morning coffee instead of checking your phone
Personal Growth	Teach a skill to someone
Personal Growth	Spread some positive energy and give someone a genuine compliment
Personal Growth	Practice self-affirmation (you deserve it)
Physical Activities	Dance (like no one is watching)
Physical Activities	Play with your pet or teach it a new trick
Physical Activities	Exercise
Physical Activities	Practice a new physical activity
Physical Activities	Do yoga
Physical Activities	Stretch (daily if possible)
Physical Activities	Go for a walk/run
Physical Activities	Go for a bike ride
Physical Activities	Do aerobics (remember Zumba?)
Physical Activities	Try out martial arts/self-defense
Physical Activities	Go swimming
Physical Activities	Go roller-skating
Physical Activities	Go hiking
Physical Activities	Play your favorite sports



Physical Activities	Walk around the city
Physical Activities	Learn tricks with a jumping rope
Computer/Phone	Play a video game
Computer/Phone	Visit museums virtually
Computer/Phone	Back-up your computer
Computer/Phone	Play online games with your friends/family
Computer/Phone	Make a new playlist
Computer/Phone	Make a playlist for every mood
Computer/Phone	Watch TED-Talks
Computer/Phone	Declutter your emails
Computer/Phone	Download fun apps
Computer/Phone	Create a TikTok video
Computer/Phone	Delete old contacts from your phone
Computer/Phone	“Get lost” with Google Sky and Google Maps
Computer/Phone	Search for birthday gifts for your loved ones
Computer/Phone	Unsubscribe your email from newsletters
Computer/Phone	Sell stuff you don’t need
Computer/Phone	Organize your documents
Computer/Phone	Google things that interest you
Computer/Phone	Research fitness/wellness videos/blogs
Computer/Phone	Leave a positive review on Amazon (because we all need some positive in our lives)
Computer/Phone	Make a wish-list on Amazon
Computer/Phone	Make a to-watch list on IMDB
Computer/Phone	Make a to-read list on Goodreads
Computer/Phone	Update your social media bio(s)
Computer/Phone	Learn a graphic design program
Computer/Phone	Start a blog
Other	Organize your pictures
Other	Start a new challenge
Other	Practice relaxation techniques
Other	Meditate
Other	Look into your family tree
Other	Put together a family history book
Other	Go through old pictures
Other	Stay hydrated and drink more water
Other	Practice breathing techniques
Other	Do a picture challenge-take pictures with certain themes
Other	Care for your pet
Other	Do a pet photoshoot
Other	Sew something
Other	Patch up an old blanket
Other	Make a short movie

Other	Try out a new makeup look
Other	Try out a new hairstyle
Other	Keep track of your alcohol/caffeine intake
Other	Start a collection (coins, shells, stamps, etc.)
Other	Try embroidery/cross stitching/crocheting/knitting
Other	Go to a beauty salon (applies to all genders)
Other	Babysit for a friend/neighbor (kids are fun)
Other	Daydream like everything is possible
Other	Spend a day with children
Other	Play dress-up
Other	Light up candles and relax
Other	Do some research for the best deal on the things you want to buy
Other	Do a favor for someone
Other	Donate blood
Other	Turn off your electronic devices for an hour
Other	Blow bubbles
Other	Try out origami
Other	Do something nostalgic (listen to old songs, watch old pictures, etc.)

### Appendix C: Sources Used for the Mental Health and COVID-19 Content Articles

BBC. “Coronavirus global update” bb.co.uk  
<https://www.bbc.co.uk/programmes/w13xtv39>

Bill and Melinda Gates Foundation. “COVID-19” gatesfoundation.org  
<https://www.gatesfoundation.org/TheOptimist/coronavirus>

Centers for Disease Control and Prevention (CDC). “Coronavirus (COVID-19)” cdc.gov  
<https://www.cdc.gov/coronavirus/2019-nCoV/index.html>

COVID-19 facts. “COVID-19 facts” covid-19facts.com  
<https://www.covid-19facts.com/>

Department of Homeland Security. “Master question list for COVID-19 (caused by SARS-CoV-2)” dhs.gov  
[https://www.dhs.gov/publication/st-master-question-list-covid-19?fbclid=IwAR0R7XbMPaANzMYahmW311zv2Iekk-eVIn97xIk8VPUvD\\_hgZAIKS9qPASU](https://www.dhs.gov/publication/st-master-question-list-covid-19?fbclid=IwAR0R7XbMPaANzMYahmW311zv2Iekk-eVIn97xIk8VPUvD_hgZAIKS9qPASU)

Inside Higher Ed. “Live updates: Latest news on coronavirus and higher education”  
insidehighered.com  
<https://www.insidehighered.com/news/2020/05/29/live-updates-latest-news-coronavirus-and-higher-education>

Law librarians of Congress. “Coronavirus resource guide” loc.gov  
<https://blogs.loc.gov/law/2020/03/coronavirus-resource-guide/>

National Center for Biotechnology Information (NCBI). “LitCOVID” ncbi.nlm.nih.gov  
<https://www.ncbi.nlm.nih.gov/research/coronavirus/>

National Institute of Health (NIH, official website). “Coronavirus (COVID-19)” nih.gov  
<https://www.nih.gov/coronavirus>

National Institute of Health (NIH). “Open-Access Data and Computational Resources”  
 nih.gov  
<https://datascience.nih.gov/covid-19-open-access-resources>

Occupational Safety and Health Administration (OSHA). “COVID-19” osha.gov  
<https://www.osha.gov/SLTC/covid-19/>

Pennsylvania Department of health. “Coronavirus (COVID-19)” health.pa.gov  
<https://www.health.pa.gov/Pages/default.aspx>

Rapid reviews. “Rapid reviews: COVID-19” rapidreviewscovid19.mitpress.mit.edu  
<https://rapidreviewscovid19.mitpress.mit.edu/>

Surgo Foundation. “Bringing greater precision to the COVID-19 response”  
 precisionforcovid.org  
<https://precisionforcovid.org/>

The U.S. Census Bureau. “COVID-19 Demographic and economic resources”  
 covid19.census.gov  
<https://covid19.census.gov/>

The U.S. Food and Drug Administration (FDA). “Coronavirus disease 2019 (COVID19)”  
 fda.gov  
<https://www.fda.gov/emergency-preparedness-and-response/counterterrorism-and-emerging-threats/coronavirus-disease-2019-covid-19>

The U.S. Department of Health and Human Services (HHS). “Coronavirus (COVID-19)”  
 coronavirus.gov  
<https://www.coronavirus.gov/>

Very Well Mind. “Emotions and types of emotional responses” verywellmind.com  
<https://www.verywellmind.com/what-are-emotions-2795178#citation-1>

World Health Organization (WHO). “Coronavirus disease (COVID-19) pandemic”  
 who.int  
<https://www.who.int/emergencies/diseases/novel-coronavirus-2019>

## **Appendix D: Student Feedback**

### **UX student**

When we created the app, the challenge was how to make the app feel calm and soothing while the potential users were in the app. Research on what apps were already available and what features they offered helped me to shape what I wanted the app to look like—leading to the blues and nature theme throughout the app. The biggest challenge was taking what suggestions the development team had and giving them life. There were several changes along the way as we got into the development of content. I think that is one of the interesting points of being a UX researcher, is the continued changes that must happen along the way as we progress with the application. The journey from starting the app to finishing my part with the development of the app has been a really great experience and it has given me skills that I can build upon and take into my career with me. An exciting part of this app development for me is that this will not only be available to university students but the whole community as well, which is a point that helped me to create a mental health app that is visually soothing and helpful for those users.

### **App development student**

While developing the application, I learned many new skills and faced just as many challenges. Throughout college, I have never worked on a project of this scale. This forced me to apply my, somewhat entry level, skills as a web/application developer and build upon them immensely. This included countless hours of experimentation and research in concepts that were new to me. If I had to choose two skills that I am grateful for learning through the development process, it would be working with Amazon Web Services and Windows Server. It is one thing to develop an application on your computer at home, but it is a completely new experience when

the application is running on a server for everyone to enjoy. Amazon Web Services makes the process of hosting an application simple but working with a Windows Server proved to be a much greater challenge. This required working within the limitations of the server's security and, on many occasions, discussing with the IT department to make changes to the server that I did not have clearance to access. Nonetheless, working with a large group of experienced professors and students allowed for a painless development process. Overall, I have gained valuable experience and knowledge that will be beneficial to my future and I enjoyed it along the way.

### **Content student**

The first unexpected challenge was the creation of the "Quote" list. I had to track down the authors of the quotes that appeared as "by unknown" during the search and also check the background of each author to assure that a certain identity was real and the person had a capacity that allowed them to say the specific quote.

The next and biggest challenge was the creation of mindfulness exercises. First, I had to familiarize myself with the digital audio editing software (Audacity). Second, during the recording, I had to assure that the words were being pronounced correctly. As an international student with English being my second language, I had to re-record the same sentence multiple times or even record word by word until I had a final output where my accent was as indistinct as possible. Finally, pairing a recording with a soundtrack had its own difficulties, as the soundtracks were typically shorter than the recordings and I had to assure that the transition from one track to another was smooth and did not interfere with the recording.

The final challenge was the composition of the two brief articles about mental health. This task required a significant amount of merely thinking, trying to narrow down to specifics all the knowledge I had as a clinical psychology student. I had a large amount of information

available, but my task was to provide a very specific and, at the same time, comprehensive summary of it all. I also tried to avoid writing based on my own biases and opinions. Finally, I had to use everyday language to explain scientific terms and concepts that would make sense to people unfamiliar with the field.

What I had not realized until I started working on the tasks was that when I was providing the users with every piece of information I had to be completely valid, reliable, and accurate at all levels. I had to be as meticulous as I could. The main sense that remains with me after the completion of Serene is that of working and communicating with people from various fields who all used their own language, interests, and expertise for the same project. In a very short period of time, I was able to gain an experience valuable for my academic and professional future.

### **Acknowledgments**

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### **About the Authors**

**Antigoni Kotsiou** was the primary content developer on the project. She graduated from Penn State Behrend with an MA in Applied Clinical Psychology. She works as a therapist providing treatment to children, adolescents, and young adults with trauma history and/or other mental health and behavioral concerns. Her research interests include therapeutic processes, techniques, and models, and psychopathology. She is interested in qualitative research and the subjective experiences of those involved in psychotherapy and mental health services. Her responsibility in the Serene project was to create the content based on various psychotherapy theories and models, such as cognitive therapy and mindfulness.

**Erica Juriasingani** was the primary UX/UI developer on the project. She is a human factors psychology student at Penn State Behrend and is currently completing her last semester. She is

working as a UX Researcher with Innovation Commons at Behrend and plans to continue pursuing UX work after her graduation.

**Marc Maromonte** was the primary software developer on the project. He is an engineering student at Penn State University and is currently completing his Bachelor of Science in computer science. He is currently working as an Application Developer with Innovation Commons at Penn State Behrend. He plans to continue pursuing software development after his graduation.

**Jacob Marsh** is the Industry Relations Coordinator at Penn State Behrend. Jacob has a bachelor's degree in biochemistry from Grove City College, a history in virology research at Penn State Hershey, and a master's degree in project management from Penn State World Campus. He was instrumental in founding, and currently oversees, the Innovation Commons at Penn State Behrend, a product design and rapid prototyping center staffed by undergraduate students, as part of the Invent Penn State initiative. Jacob also helps develop, fund, and manage various other programs involving entrepreneurship, economic development, and industrial partnerships with Penn State Behrend.

**Christopher R. Shelton** is an Assistant Professor of Clinical Psychology and the director of the Virtual/Augmented Reality Lab at Penn State Behrend. He has significant clinical experience providing diagnosis, assessment, and treatment for mental health concerns across a wide spectrum of the population. His current research focuses on: (a) examination of ADHD and Sluggish Cognitive Tempo; (b) development of digital mental health assessments and interventions to increase treatment availability; and (c) the use of immersive technologies, such as augmented and virtual reality, across a range of domains. Dr. Shelton earned his Ph.D. in Clinical Psychology from the University of Wyoming.

**Richard Zhao** is an Assistant Professor in the Department of Computer Science at the University of Calgary. He led the app development team on the Serene project. His current research group focuses on serious games for training and education where he utilizes artificial intelligence, virtual reality, and eye-tracking technologies for this purpose. He received his M.S. and Ph.D. in Computing Science from the University of Alberta. Dr. Zhao was a faculty member at Penn State Behrend.

**Lisa Jo Elliott** is an Assistant Teaching Professor at Penn State Behrend where she directs the Laboratory for Usability and Interactive Systems – LUIS lab. This lab and Innovation Commons lead a multi-million-dollar grant for a UX-first product design lab. This initiative is one of the first UX-centric product design labs in the United States. It trains UX, UI, interaction design, and experience design students to be future product designers and developers in the engineering, DIGIT, and psychology programs at Penn State Behrend. Dr. Elliott has a Ph.D. from New Mexico State University, Las Cruces, NM, USA.



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