UI Design Study: Collaborative Pomodoro Study Tool

Mattia Chiarle, Francesca Fusco, Sri Keshav Katragadda, Colin MacRae

In today's fast-paced world, students often find themselves struggling to maintain focus and optimize their study sessions. Our study aimed to find out the challenges they faced, with special attention paid to the role played by isolation. Our focus statement can be synthesized as "*Investigate how to improve study productivity and efficiency by an integration of Pomodoro technique and collaborative learning*". Being university students our target user group, we interviewed 7 university students, ages ranging from 21 to 23, two females and five males. The participants were recruited mainly using Instagram stories and were interviewed on Zoom, Google Meet, or FaceTime after signing an informed consent. We report here the most important questions asked:

- *Have you ever used a productivity app?*
- *Do you struggle with maintaining focus while studying?*
- *Tell me about your experience with group studying. What, in your experience, are the benefits and downsides of group work? What do you think could be done to improve it?*
- *Have you ever heard of the Pomodoro technique or tried it out?*
  NO: What study strategies do you use?
  YES: What was your experience with the Pomodoro technique?
- *How do you motivate or reward yourself for studying or work?*
- *What are some examples of results from study that you're most proud of? What attitudes or behaviors contributed to your success?*
- *Think about the last time you struggled with being productive. What didn't work? What was missing?*

Asking multiple similar questions regarding the same topic has proven itself an effective technique for subjects that wouldn't articulate long answers on their own.

Transcripts of the interviews were analyzed using *empathy maps* to identify user needs and insights. The "Saturate and Group" technique was also used to recognize common patterns. An interesting insight that was drawn during the analysis process was the contradiction regarding studying in groups. Even if almost all the participants stated that they don't like group study sessions (the reasons go from "incompatible time management with respect to their colleagues" to "feeling behind with respect to others"), the majority told us that they are the most productive when there is someone next to them doing something (also completely unrelated to studying, like cooking). Coherently, almost half of the participants stated they easily lose concentration and motivation when they find themselves studying alone. Another important insight was the fact that around one-third of the subjects seem to benefit from someone else repeating the subject they are studying, either from study pals or YouTube videos. Finally, six subjects out of seven didn't appreciate design probes which were heavily based on competitiveness and leaderboards; the most frequent reasons were the anxiety these comparisons would cause and the fact that productivity should not be measured with time dedicated to a task.

Regarding the Pomodoro technique, all of the participants stated that they don't like the concept of a break after a fixed time period. All of them prefer to use a "personalized" Pomodoro in which they take a small break after each little task. The most frequent habit among our subjects was creating a list of *to-do*s (on post-its, notes, etc…), and they all seemed to enjoy the feeling of crossing the corresponding line after the completion of the task. Flashcards also

seemed to be considered an effective method for revising, and having a goal (both long-term and short-term) seemed to play an important role in staying motivated.

Regarding user needs, it seemed important for a tool to have very little overhead for configuration (*no one wants to waste time in optimizing time*, we could say); being able to appreciate the potential long-term contribution of a subject in one's professional life also seemed to encourage motivation and productivity. Other important user needs that we identified were *presence, time-saving features,* and *customization.*

Various applications have been developed to harness established productivity techniques, notably the Pomodoro method. This technique, widely recognized for its effectiveness, is a cornerstone in many study-enhancing applications. However, a primary challenge these applications face is retaining user engagement. Our investigations, supplemented by user interviews, reveal a common pattern: users often download these apps out of curiosity or a desire to improve their study habits but soon abandon them. This trend can be attributed to the significant mental and routine shift required to develop productive habits, which a simple timer often fails to sustain.

Among these applications, some have made strides in addressing user retention. For instance, Forest, a leading Pomodoro app on the Google Play Store, employs gamification to transform study time into a more enjoyable and engaging experience. Users have expressed initial attraction to such features, like the app's unique plant-growing aspect. However, this novelty often fades, leading to disengagement, which highlights a fundamental issue in Pomodoro apps: they successfully attract users but seem to struggle to maintain long-term engagement.

Our interviews also uncovered a variety of unmet needs in the study process. Users expressed diverse preferences, from the desire for communal study environments to the use of flashcards and to-do lists. A recurring theme was the importance of goal-setting in maintaining motivation. However, an application that allows them to perform all of these habits in the same place seems to be missing. Additionally, none of the popular existing apps seems to address the common user need for motivation. Current Pomodoro apps focus primarily on short-term task management, often misaddressing broader, long-term needs. Some apps like "Pomoroom" and "My StudyRoom" have attempted to bridge this gap. Still, their approaches—such as group timers or plan-centric features—haven't fully resonated with users whose need for company does not translate into actively studying with other people. Finally, the perceived effort in using the tools available in these existing solutions, like creating flashcards, was often seen as counterproductive as they required a long configuration time.

Our project aims to fill the gaps discussed by emphasizing personalized, long-term planning and minimal user input for task setup. This approach aligns with key Human-Computer Interaction (HCI) principles such as efficacy, discoverability, usability, and simplicity. By focusing on these principles, we intend to create an interface that demands minimal interaction, allowing users to access what they need and start studying efficiently and quickly. We believe that by offering a streamlined, feature-limited platform, we can reduce the likelihood of user overwhelm and abandonment, ultimately enhancing the study experience.

How the Research and Client Interviews Impact Our Design

The insights from our interviews laid the foundation for our design. Key findings include:

1. Need for Presence: Although most students don't prefer group study sessions, they feel more productive when there's someone present. This led us to design a feature that allows users to study virtually with someone else.

2. Customizable Pomodoro Technique: In our interviews users expressed a dislike for the fixed break periods in the traditional Pomodoro technique. Our app incorporates a 'flexible Pomodoro', where users can customize their break after each task.

3. To-do List & Goal Setting: Almost all participants wanted task lists and goal setting. This guided us to integrate an interactive to-do list where tasks can be crossed off, and a goal-setting feature where users can set daily, weekly, or monthly academic goals.

4. Simplicity: We recognized the need for a user-friendly design. The app is designed to be intuitive, with minimal setup time required.

To address our user needs, we decided our interface should have an interface with the following screens:

1. Homepage: Displays the user's goals, and a button to start a study session.

2. Study Session Page: Features a timer (customizable Pomodoro) and the partner's video if a call was started

3. Goal Setting: Users can set and track their academic or study goals. A visual representation, with checkboxes, shows how close they are to achieving their goals.

4. Interactive Goals List: Allows for tasks to be added, crossed off, or rearranged to the goals list.

5. Settings: Allows customization of the app's features, from the design theme to the Pomodoro timer's intervals.

In order to better understand the user needs mentioned earlier and how they could be addressed, we used a UXD tool known as a persona. Personas are profiles of fictional characters which contain imaginary information describing what a potential target user's life might be like. These descriptions can help design teams like ourselves better understand the typical target user's lifestyles and avoid personal biases when coming up with product features. For this stage of our design process, we developed two different personas; Xena and John.

Xena is a 28-year-old graduate student studying mechanical engineering. She is hard-working and disciplined, but she gets tired of studying alone. She would study with friends at the library, but sometimes their schedules don't line up and her apartment is a long way from campus so it takes some time to get back. She is tech-savvy and is familiar with time-management tools like the Pomodoro technique. Unlike John, she doesn't struggle without the ability to study in groups; however she wants to improve herself further. Yahweh on the other hand has noted difficulty with his study habits.

John is a 19 year-old studying for an IT certification while working full-time in food service. He thinks he could benefit further from studying in a group setting so that he could be "peer-pressured" into productivity. He also has never used any time-management techniques like the Pomodoro technique. He isn't as technologically literate as Xena, but he has plenty of

experience using telecommunication services like Zoom after going to school remotely during the COVID-19 pandemic. The differences between John and Xena help better understand a broader spectrum of people who want to study; some are better practiced than others and are learning a wider variety of topics; furthermore, not everyone who wants to study already exists in a university setting.

The personas can be found on the Miro board at this link.

Brainstorming Design Alternatives

Our design decisions were deeply influenced by the user feedback. Through this user-centric approach, we aimed to ensure that our designs not only addressed specific user needs but also enhanced usability and user experience. Design alternatives can be found on the Miro board.

Methods Used to Develop Design Alternatives

Brainstorming: Initially, each of the four group members worked independently to conceive various design ideas, ensuring diverse ideas and creativity.

Group Consolidation: After our individual brainstorming, we all decided to meet to present our designs to each other. This collaborative session allowed us to discuss the strengths and limitations of each concept.

Drawing Our Thoughts: To make our ideas clear, we quickly drew them and tried the designs on Invision. This helped us see how our ideas could look in reality and to check if the designs are actually easy to use.

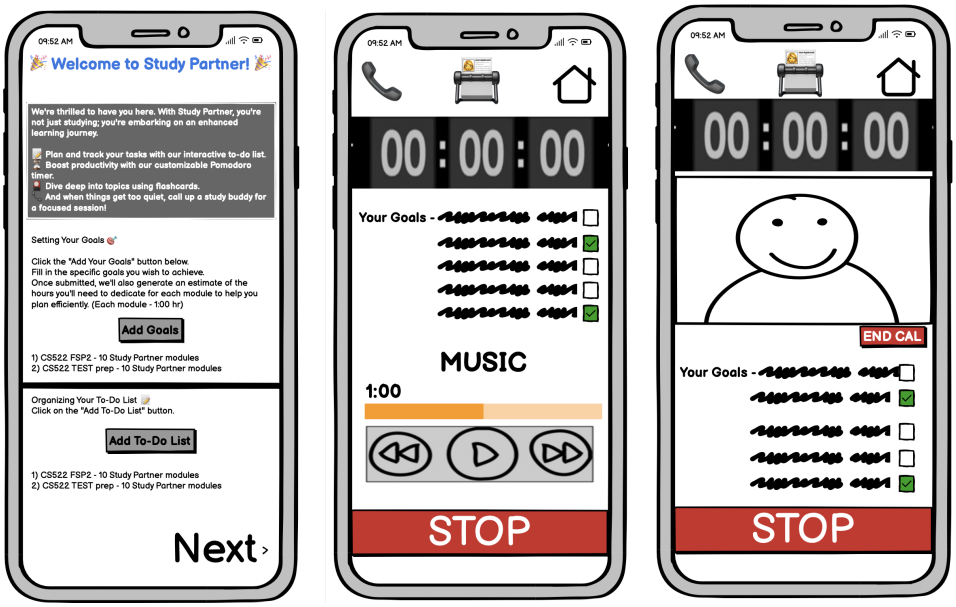
Combining the Best Parts: Through mutual feedback, we identified elements from each member's design that were approved with the group. We then combined these features, effectively showing our individual strengths into a user friendly design.

Justification of Design Alternatives

Our design decisions were heavily influenced by our representative users, Xena and John, and the broader target user base. Throughout the design process, we continually asked, "Would this interface resonate with Xena or John? How about our target users? Would this functionality be beneficial for them?"

Revisiting primary user preferences like customizable settings and enhanced planning capabilities, we made sure that each design element not only catered to Xena and John but also addressed the broader needs of our target users.

Rejected Design #1

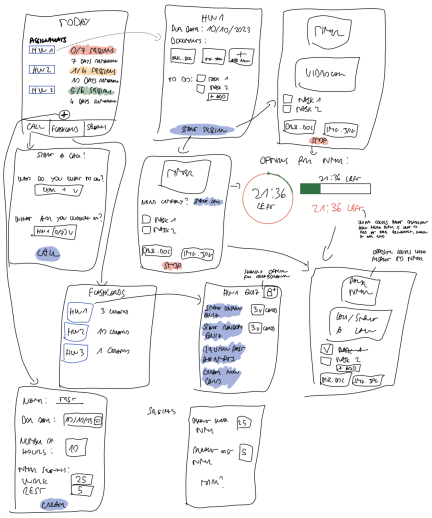


Although this design had many features like studying together on a video call, playing music etc. we felt users might find it confusing, especially if they wanted something straightforward. Plus, moving between features could be tricky.

Some other reasons why we rejected this design:

1) The welcome screen is quite text-heavy which could overwhelm users.
2) It's unclear how users might adjust the call volume, mute themselves, or use other common video call features.
3) We felt like this design doesn't appear to have a clear navigation menu or way to jump between different sections of the app.
4) Finally we also didn't like the cluttered feeling on the timer page. We felt like that was too much, especially when that's the main screen that the user will use.

Rejected Design #2



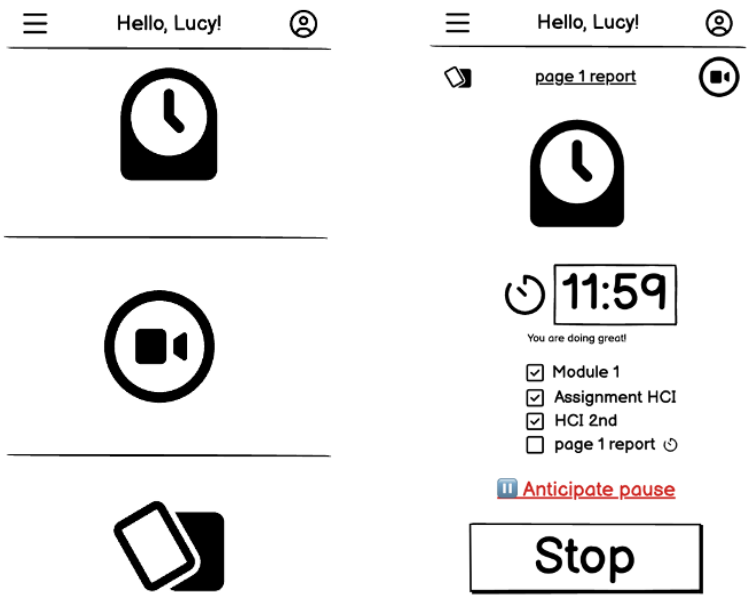
While the flashcard section stood out for its innovative quiz feature, enabling users to test their memory, other parts of the interface were less impressive. Several other ideas made us reject this design.
Some other reasons why we rejected this design:
1. The overall interface was fragmented, making navigation confusing. A more streamlined approach was necessary for intuitive user experience.
2. Some parts from the checklist like "HW1" appearing multiple times, could lead to confusion and repetition.
3. The information wasn't clear, especially with regards to prioritizing assignments and tasks.

On the other hand, the flashcard design was especially compelling. Its interactive nature not only aids in better memory but also adds an engaging element, making study sessions more productive. We felt it was essential to integrate this feature into our primary design to cater to the diverse learning styles of our target users.

Low-Fidelity Prototype

We already analyzed the most relevant user needs that emerged in the interviews. In the design of our prototypes, we tried to focus on them as much as possible, thinking about solutions that could help users satisfy them.

The most important guideline of our designs has been simplicity. While the other needs were not homogeneous, the need for rapidity and immediacy was shared among all the users. To comply with this aspect, we designed an essential homepage that contains only the buttons to start the most frequent activities (Pomodoro timer, call, flashcards). Furthermore, we included within the timer interface shortcuts to rapidly access the other features, avoiding complex interaction paths that would have made users lose a lot of time.



For the strategization need, we created a task functionality within the timer. In this way, users can track their goals for the session or the day. This helps them have a clearer view of their productivity and remaining workload.

For presence instead, we made calls a core functionality of both the homepage and the timer. Users are always just one tap away from creating a call with their friends.
Lastly, for customizability, we thought about a menu in which users can set their default parameters, such as the default working time and rest time. We haven't implemented it yet in the low-fidelity prototype, since our main goal was to analyze if the structure of our application was intuitive enough and if it included all the needed features. However, we already inserted a placeholder for the menu in the top-left corner.

The low-fidelity prototype that we created is not perfect, of course. User interviews were extremely useful in highlighting flaws in our reasoning and ideas and helped us understand its problems and how we could successfully address them. However, it is worth reporting that, as we'll analyze later, all the improvements are related to the structure of the application and not to the choices made to address user needs.

User Testing of Low-Fidelity Prototypes

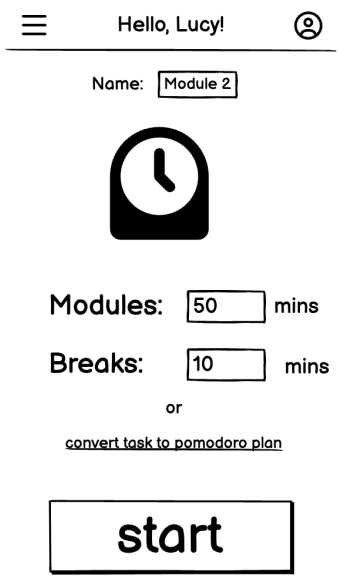
We invited two participants, who were initially interviewed during the needfinding phase, to test our low-fidelity prototype. Both participants are 21-year-old university students; one is female and the other is male. While one of them had previously used pomodoro applications, the other had no experience with any productivity software. They will be identified by a code represented by a S followed by a progressive number.

We outlined three tasks for the participants to undertake:

1. Set up a pomodoro timer, followed by adding a call.
2. Initiate a flashcard quiz for HW1.
3. Update completed goals.

The user testing took place on mobile devices. Participants accessed the prototype through a provided Figma link and the session lasted approximately 30 minutes. Throughout the testing, participants were encouraged to "think aloud", sharing their thought processes, reasoning, and observations. If they encountered challenges in completing a task, we refrained from offering direct guidance, allowing them time to navigate the interface and discover a solution on their own.

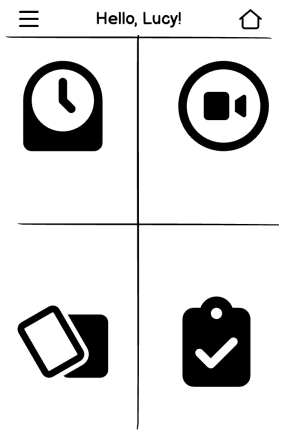
S1 expressed appreciation for the option to postpone the break after a pomodoro cycle ends. She felt this would be especially beneficial for situations where she couldn't complete a task within the given cycle, suggesting that this feature aligns well with user need for customization. The first difficulty encountered by the user was that of choosing the right place to click on in order to start a pomodoro session: she mistakenly clicked on "convert task to a pomodoro plan" instead of the "Start" button (image below); this highlighted the potential ambiguity of our labels, prompting us to consider clearer wording. Additionally, she noted the absence of a feature to add new goals on screen, which we recognize as an oversight.



After finishing the initial two tasks, the subject encountered challenges while trying to update the completed goals. After some minutes, she managed to complete the task, but she claimed that it was not very practical to only be able to access the tasks after starting and ending a pomodoro module.

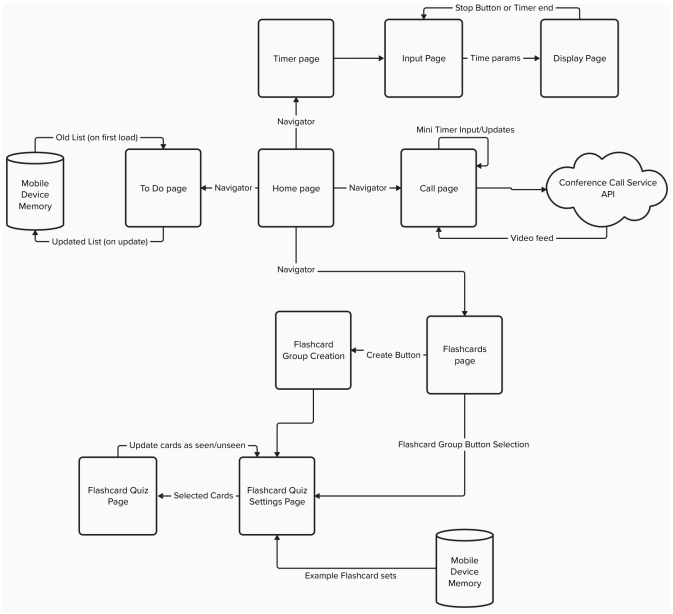
In addition to subject S1, subject S2 experienced difficulty returning to the homepage, perceiving the user icon as misleading. He echoed S1's sentiment regarding the impracticality of accessing goals solely during a pomodoro break. Furthermore, S2 expanded on the task management feedback, emphasizing not only the missing "add task" feature but also the need for a function to edit existing tasks.

In the following image, we provide an alternative low-level prototype that addresses the main user challenges, enhancing navigability of our application along with the discoverability of its functions.



Implementation

To implement the application, we decided to use React Native. Most of us already knew the React framework, which was a great support while developing the most complex interactions (such as the one between the timer and pause screen). Our interaction logic is well-explained by the following diagram.



The best way to describe the implementation is to go through all the weekly sprints. This strategy will allow the reader to get insights into the progressive evolution of our application, giving a better understanding of our choices and the final result.

<u>Week 1 – Timer</u>

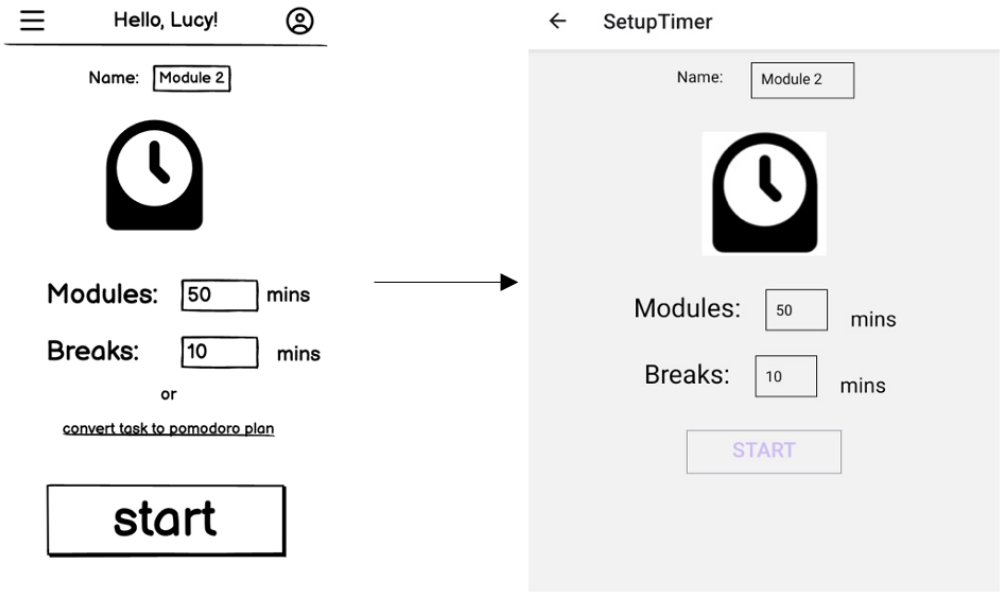
Since the core of our application is the Pomodoro technique, it felt natural to start from that. We wanted a simple and essential, though complete, implementation that could allow users to focus on their tasks and not their interaction with the interface.
The user story that guided our implementation is the following:

> "*As a user, I want to start a Pomodoro timer to focus on my studies for a set period.*"

1. The user opens the app and lands on the main dashboard.
2. The user clicks on the "Timer" option.
3. The user selects the desired time interval.
4. The user clicks the "Start" button.
5. The timer starts counting down from the selected interval.
6. A notification or alarm sounds when the timer reaches zero.

To implement it, we had to address many different challenges. First, we created the project skeleton, including the homepage, all the available routes, and all the empty components that

could have been useful. Then, we moved to the setup page for the timer, as well as the interaction between the timer screen and the pause screen.
The interviews conducted on the low-fidelity prototype were valuable. Even before starting to develop the interface, we were able to identify some weaknesses in our design and perform some modifications to address them. For example, our low-fidelity prototype presented an option named “Convert task to Pomodoro plan.” The idea was to propose to users a more advanced and complete Pomodoro management tool instead of the well-known timer. However, this button was not noticed by any of the users, and they didn’t express the need to have such an option in our low-fidelity testing. After the interview analysis, we decided to remove it to improve the simplicity of the interface.



Week 2 – Call, todos and modules

In the second week we focused on what has probably been the most challenging and complex part to implement, the call feature. In fact, at this point, we realized that to implement what we wanted we needed a server. Without having accounts, it is impossible to implement a timer that synchronously starts for all the users in the call at the same time.
However, unfortunately, we didn’t have enough time to implement all the features we wanted to include and the server. Thinking in perspective, we decided to drop the server and mock all the features that needed it to work. The conclusion of our whole work is user testing, which is especially useful to investigate the usability of our application concerning other available treatments. So, it is far more valuable to have all the features (although some are not fully working) instead of a subset of them. This is, of course, a limitation of our study.

Our most important user stories are:

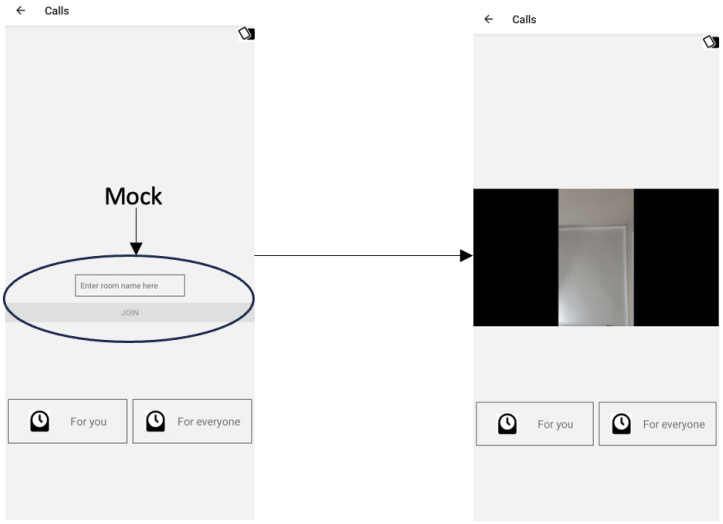
“As a user, I want to initiate a study call to invite friends to join me in a collaborative study session.”

1. The user navigates to the "Call" section of the app.
2. The user clicks the "Start a New Call" button.
3. As friends join, their names and videos appear in the active call list.

“As a user, I want to track my goals during Pomodoro sessions thanks to todos.”

1. The user starts a Pomodoro timer
2. Break starts
3. The user clicks on “track my ToDos” button
4. The user looks at todos (completed and not completed)
5. When the user completes a task, s/he marks the todo as completed

Moving to the call, our initial idea was to take advantage of Jitsi SDK for React Native. It is a free service that offers us all the features we need (especially the creation of different room calls). However, we couldn’t integrate it into our application due to some version conflicts. After numerous searches, we found Signalwire. This service has a React Native SDK, too, and it works correctly. However, also here we had to accept some compromises. Signalwire is meant to work along with a server, which stores the API keys and can create and handle multiple rooms. As previously discussed, the lack of a backend didn’t allow us to do it. However, the API keys are required only to create a room and not to join it. This allowed us to use a pre-created room and insert its token inside the application so that the user automatically connects to it when s/he opens the call interface. This solution is unfeasible in a real-world environment, but it works for user testing, so we decided to use it. Another downgrade is that this SDK does not allow us to insert the room name to join (in fact, the users will always join the pre-created room). However, we decided to leave this pattern in our application even if it’s useless since it is the interaction we intended. The room name inserted by the user in the call screen won’t be used in any way, but in our view, it simulates the interaction, so the user feels as if s/he is joining a specific room instead of the default one.
For todos and modules, we implemented them by exploiting the local storage of the phone.



Week 3 – Flashcards, minor cosmetic adjustments

Last week’s goal was to implement the missing feature, the flashcards, and to make all the cosmetic changes needed to make our application look as similar as possible to the low-fidelity prototype. The most relevant user story of this week is the following one.

“As a user, I want to create flashcards to use them for quick revision and testing my knowledge on specific topics.”

1. The user navigates to the "Flashcards" section of the app.
2. The user selects one of the subjects for which there are quizzes created
3. The user decides to start a random quiz

For the reasons previously mentioned, it hasn’t been possible to implement all the sharing features we thought about for the flashcards. This was probably the biggest drawback of our application since, during the interviews, we figured out that this would be appreciated by users (although it wasn’t part of the critical features).

Overall, we implemented all the critical features and most of the non-critical ones. We always tried to be as close as possible to the low-fidelity prototype. When that wasn’t possible, we tried to find workarounds that privileged the user testing phase or, in other words, solutions that hid all the missing components from the users.

Evaluation Study:

In order to determine whether our application was actually effective, we conducted a user evaluation study. We gathered five participants to engage in our study. This study consisted of giving users three tasks. These tasks were Task 1: Create a call then start pomodoro timer; Task 2: Create a group named HW1, create two flashcards for HW1, start a flashcard quiz for HW1, and Task 3: Update to-dos during a pause break. We asked users to complete these tasks using two treatments; firstly, by using our application (Treatment 1) and then using another collection of tools (Treatment 2). For treatment 2, we allowed users to complete the tasks using whatever collection of applications or tools they desired, the only limitation being that they weren’t allowed to use a Pomodoro application for the pomodoro timer task. For example, some users chose to use Obsidian for the Flashcards task, Google Meet for the Call task, and Keep Notes for the To-Do list task

In conducting our study, we chose to do a within subjects design. We chose to conduct a within-subjects design for our study because we mainly aim to collect from users a comparison between the usability of the two treatments. This is essential for the System Usability Scale questionnaires we used during our evaluation study; it is fundamental that users go through both treatments to allow us to understand if our proposed solution simplifies user interaction or not. Secondly, we were limited in time and resources. Within subjects design allows us to gather ample data without needing to find more participants.

We collected five different metrics during our usability studies: Time to complete task in seconds (TTC), number of errors during task (ERR), number of transitions between different mediums/applications (TRANS), total transition time in seconds (TTRANS), and System Usability Scale (SUS) results, where 0 indicates low usability and 100 represents high usability.

To actually determine that our treatment was effective, we made two hypotheses: a null hypothesis and an alternative hypothesis. Our null hypothesis was that users would experience an equal amount of time and errors and will return similar SUS scores across all tasks. Our alternative hypothesis was that users would complete all tasks in less time and more errors using Treatment 1, and that they would also return higher SUS scores for Treatment 1. We believe that users engaged in Treatment 1 will complete tasks in less time despite experiencing greater error frequency because the tools will be consolidated into one location and will

therefore require less time to transition between; users will only experience greater errors because of their unfamiliarity with Treatment 1's novel UI, although we expect learning to quickly occur.

For each user study, we first introduced the user to the purpose of the procedure and our application's goal. We then explained each of the three tasks they would engage in. For each task, we started a timer and the user began the task. As they worked using the tools prescribed by the given treatment, we recorded errors, transitions, etc. Once users had completed all tasks using both treatments, we asked them to complete two SUS questionnaires for each treatment. We then analyzed our gathered metrics and used them to qualify our hypotheses.

We attempted to reject our null hypothesis by way of a paired samples t-test. This test was used because of the between-subjects study design, causing our samples to be dependent. If the result of a paired-samples t-test was less than 0.05, the test was deemed to be statistically significant, suggesting that our treatment did indeed perform differently than the alternative. The p-scores from our results are as follows:

	TTC (Time to Complete)	ERR (# Errors)	TRANS (# Transitions)	TTRANS (Time to Transition)
Task 1 (Pomodoro timer)	0.66	0.81	Identical data	Identical data
Task 2 (Create and Utilize Flashcards)	0.38	0.34	Identical data	0.04
Task 3 (To-Do List)	0.01	0.2	0.47	0.59

T1 Avg SUS	T2 Avg SUS	p
82	68	0.27

Our results have several ramifications. Firstly, there was a similar # of errors across tasks, suggesting that users don't make more mistakes with Pomodoro App than a combination of task-specific apps. Secondly, the statistically significant p score for TTRANS in Task 2 suggests that users benefit from the consolidation of features in our Pomodoro App. We also noticed that users make To-Do lists faster using our treatment than when using their own applications. Finally, we noted that users don't make pomodoro timers faster when using our app. Although our evaluation had less statistically significant results than we hoped, we believe this is partly due to the low number of participants (N=5) and the decision to allow users to use whatever application they chose for the alternative treatment. Limiting options would have decreased variance in our measurements. We also believe we would have seen a greater difference in measurements in Treatment 1 and 2 if the Call implementation was actually able to be implemented; as it currently stands, the Call feature isn't fully implemented, so we cannot test the call implementation to its fullest extent. Otherwise, we presume it would increase Treatment 1's benefits over Treatment 2.

Conclusion:

We believe our study was successful in discovering the challenges faced by students who wish to study in isolation but struggle with motivation and task-management. After conducting our evaluation study, it appears that there is benefit in consolidating features into a single application, and that our application can increase productivity by reducing screen transitions and time to complete tasks. However improved study procedures and higher participant counts need to be implemented before our application's usefulness can be verified. Nonetheless, we were able to elicit four user needs (Presence, Customizability, Goal Setting, and Simplicity) and our prototype addresses all user needs to the best of our ability given the time constraints. We hope our research will assist future developers in their efforts to build applications which can engender hybrid study environments which leverage time-management techniques like Pomodoro.