

“Lagoon Learn” Capstone Project Final Report

Project B8IS133

BSc in Computing (Data Science)

Justin Lazarev

STUDENT NO. 10567499

STUDENT EMAIL: 10567499@dbb.ie

Supervisor: Clive Gargan

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Abstract

Lagoon Learn is a resourceful study app designed to accommodate to learners across extensive age groups. Inspired by the calming aesthetics of sandy beaches and waves, the application offers a user-friendly platform for the creation, storage, and sharing of flashcard-based study materials. It allows users to customise their learning experience with this creation and to manage study sessions with integrated timing features. Furthermore, Lagoon Learn strives to a collaborative learning environment through its community features, enabling users to exchange study materials and insights. The inclusion of a testing ground allows learners to evaluate their knowledge and track progress by practicing with their flashcard stacks and recording test scores.

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Chapter 1: Introduction

This paper offers an overview of a completed project centred around the development of Lagoon Learn, a study aid application designed as a flashcard tool. The primary aim of this project was to produce a user-friendly, aesthetically pleasing application that enhances learning through a unique feature: the ability for users to share flashcards amongst themselves. This functionality seeks to elevate the educational experience by encouraging collaborative learning and knowledge exchange. (Blankensee, 1999)

The project's scope extended to creating an application that is accessible to users with varying levels of technical skills, emphasising simplicity in its design. The development approach used Windows Presentation Foundation (WPF) with C# in Visual Studio, known for its resourceful application-building capabilities. (MacDonald, 2009) Lagoon Learn stands out by containing a public page, and direct sharing, while leveraging a SQL database for the robust data management of public forums. This choice reflects a consideration for usability and ease in dealing with extensive data sets.

The assumptions made at the onset of this project included users' general familiarity with application login processes and an understanding of flashcard usage, aiming to streamline the user experience without necessitating extensive technical knowledge. The subsequent sections will delve deeper into the specific phases of development, the challenges encountered, and the strategic resolutions implemented. It also shows the changes made in the various stages of the creation process and will give a comprehensive analysis of Lagoon Learn's journey from concept to deployment. (Johannesson et al., 2000)

The purpose of providing a background is to equip the reader with the necessary context to understand the project's development pathway, its aims, and the rationale behind its design choices. This foundation sets the stage for a detailed exploration of Lagoon Learn, anticipating the main points of discussion that will be expanded upon in the rest of the report.

Chapter 2: Background

Lagoon Learn is a flashcard program designed to close the gap between conventional teaching methods and the needs of the digital age. The Windows Presentation Foundation (WPF) is a framework designed for building desktop applications on the

Windows platform. This technological decision to use WPF is one that will make use of its architecture makes use of its powerful features and its advantages in flexibility and UI design. The program seeks to provide a collaborative, interactive learning environment that adjusts to the changing demands of its users to surpass the constraints of traditional flashcards.

Enhancing learning efficiency through a digital medium is the central principle for Lagoon Learn's existence. The tool makes the process of creating, revising, and organising study materials more efficient than it would be with traditional paper flashcards. In addition to saving time and money by eliminating the need to manage paper cards, this digital approach offers a test environment which offers more accurate indications of retained study. (Caladine, 2008) The attraction and efficacy of this test environment are increased by its ability to accommodate faster retention methods.

Another essential component of Lagoon Learn that promotes an effective learning environment is the application's sharing functionality. Users can interact in real-time, access content provided by the community, and share their decks with others. By utilising collective intelligence, this community-driven knowledge base enables users to gain from a variety of viewpoints and levels of experience. (Castek et al, 2013). A feature like this is especially helpful in educational settings where teachers can provide pupils with carefully selected materials.

The target audience for Lagoon Learn is purposefully wide, including students in secondary and postsecondary education, teachers looking for additional resources, and anyone who are dedicated to lifelong learning. This inclusiveness reflects a knowledge of the many situations in which useful learning resources can be used as well as their universal need to be developed. Lagoon Learn will aim to be a flexible tool to aid users whether for professional development, personal enrichment, or academic preparation. (Burdescu, 2015)

From an educational perspective, Lagoon Learn is based on heavily researched ideas like active recall and spaced repetition. (Xue et al. 2011). By designing elements such as a timer and a quiz page, users can more easily regulate their study, and apply spaced repetition improves which memory retention over time. Conversely, active recall strengthens connections between memories by posing a challenge to users to

recover material without cues. When combined, these tactics provide a strong basis for the application, which is designed to support learning that is long-lasting.

Lagoon Learn was developed in stages, with close attention to detail at each turn. The first stages of development concentrate on using XAML in Visual Studio to create an aesthetically beautiful and user-friendly interface. The next steps include building SQL databases to manage user information and content and putting functional logic into practice for user interactions. The application's architecture is thoughtfully designed to keep backend operations and the user interface apart, guaranteeing ease of understanding and maintainability. By streamlining the debugging and review process and facilitating future additions, this hierarchical design approach enables continual development based on application functionality testing. (James et al. 2015) (*Figure 1*)

Chapter 3: Literature Review

The integration of technology and educational practices has significantly improved people's learning capacities, making it more interactive, accessible, and efficient. This literature review explores the academic opinions surrounding the design of educational applications, with a particular focus on flashcard applications. It discusses various scopes including the principles of educational application design, the efficiency of utilising flashcards, effective study techniques such as the Pomodoro Technique (Gobbo et al. 2008), the advantages of sharing study materials, the importance of test environments in study applications, the role of gamification, and the benefits of using Windows Presentation Foundation (WPF) for developing applications.

Designing educational applications requires a thorough understanding of academic principles and user interface design to create an effective learning environment. The prioritisation for a clear flow of the usable elements and mechanisms, as emphasised by Zhang et al. (2012), plays a key role in enhancing ease of use and thus motivation among learners. Additionally, aligning application design with the principles as highlighted by Jones et al. (2007), is essential for reducing unneeded features and making everything as direct as possible, which are critical for the process of creating effective learning tools.

The use of flashcards, celebrated for their effectiveness in promoting active recall, represents a method that is vastly used by people to retain items to long-term memory. The simplicity and versatility of flashcards, according to Wissman et al. (2018), make

them an ideal tool for spaced repetition, a technique that Kang et al. (2016) have proven to improve memorising. Flashcard apps should use these benefits to their advantage by aiming to provide customisable and accessible platforms for learners to engage with material across a wide range of subjects, thereby facilitating a more interactive and personalised learning experience.

The consideration of study techniques such as the Pomodoro Technique within flashcard application usage can significantly change how the app is developed. Que et al. (2023) describes Pomodoro as a time management method that involves breaking work into intervals spaced out by short breaks, this technique aids in maintaining focus and preventing straying from the studied topic, making study sessions more productive and efficient. This approach to learning not only improves time management but also makes learners less likely to burnout.

The ability to share learning materials through study applications introduces a collaborative aspect to learning. Marjanovic (1999) notes that collaborative learning environments not only garner a deeper understanding of material but also can allow for healthy competition among learners. Allowing users to share flashcards and study sets, it facilitates applications to have a communal learning experience, allowing learners to benefit from diverse views and pooled knowledge. This feature of flashcard apps enriches the learning experience, making it more dynamic and interactive.

The inclusion of a test environment within flashcard applications is essential for preparing learners for real-life assessments. Hacker et al. (2000) demonstrates the testing effect, wherein taking tests enhances long-term memory retention more effectively than additional study time. Such environments simulate exam conditions, offering immediate feedback and helping learners identify areas requiring further review. This feature not only raises students' confidence levels but also equips them with the necessary skills to excel in actual examinations, thus putting into practice the materials learned with flashcards as the educational medium. (Vajak et al. 2018)

Gamification in apps introduces an element of play that can significantly boost engagement. One such way is integrating game-like elements such as points, quirky graphics, and rewards into the educational process gamification taps into the natural human desire for competition and achievement. (Sailer et al., 2019). This approach has been shown to increase motivation in groups of students, (Santhanam et al, 2016),

making the learning process more enjoyable and effective. The addition of gamification elements in flashcard apps can transform routine study sessions into a more rewarding and relaxing experience, elevating the overall learning outcomes.

Windows Presentation Foundation (WPF) based applications will play a crucial role in the effectiveness and user experience of the proposed app. WPF offers a robust framework for building visually appealing user interfaces, which can enhance the usability and accessibility of the development process. (Tiku et al. 2015) Its ability to support advanced elements and segregation of coding methods enables an easier creation of educational content tools. By developing a clearer app, it facilitates users to understand complex concepts more fully. Moreover, WPF's flexibility of presentation and appearances makes it easier for developers to update and maintain a modern design, ensuring that these tools can evolve in response to changing educational needs and feedback from users.

Concluding this section, the literature supports the numerous positives of flashcard applications for educational settings. Effective application design, inspired in educational psychology and different learning theories, is crucial for maximising the potential of flashcards. (Hamer et al. 2018). Study techniques like the Pomodoro Technique, the social aspect of learning through sharing, the incorporation of test environments, the engagement offered by gamification, and the developmental advantages provided by platforms like WPF, all contribute to making flashcard applications a powerful tool in the landscape of modern education. Through the consideration of these topics, Lagoon Learn can better service its users and offer a dynamic and effective approach to learning.

Chapter 4: Login and Registration

In the initial stages of creating Lagoon Learn, the primary focus was on designing the first interface a user encounters, setting the tone for their entire experience. The decision to adopt a "beach" theme influenced the entire visual aesthetic of the application, leading to the selection of a colour palette that mirrors the natural transition from the shore to the water of a beachfront. Complementing this theme, a pixel art logo was chosen to introduce an element of gamification to the application, further engaging users by leveraging nostalgic and playful design elements.

The font choice throughout Lagoon Learn plays a critical role in reinforcing the application's gamified and informal style. MV Boli was selected for its casual and approachable appearance, enhancing the user's immersive experience within the beach-themed learning environment. Upon launching Lagoon Learn, users are presented with the login page, which serves as the gateway to the application. This page offers users the option to either log in with existing credentials or register as a new user, guiding newcomers to a registration page.

The registration process was designed to be intuitive and simple, requiring users to complete several fields essential for creating an account. (Haoyu et al., 2012). This information is then securely stored in a database through a data function that invokes two distinct stored procedures. These procedures are responsible for segregating user registration data, such as usernames and passwords, from personal information like names, email addresses, and phone numbers. This separation not only enhances security by limiting access to sensitive information but also facilitates easier management and retrieval of user data, with usernames serving as the primary identifier for user-generated content like flashcards. To further secure user data, passwords are encrypted using a Hash Pass function, ensuring that even if the database were to be compromised, critical information would remain protected. (Deka, 2016)

After successfully registering, users are redirected to the login page, where their credentials are verified through a secure process that involves comparing the inputted password against the encrypted data stored in the database. This process ensures that users' privacy is maintained, with passwords being decrypted only for the purpose of authentication and then immediately re-encrypted. Once the login is successful, the new page is opened. The user now has access to the app in its full capacity.

Chapter 5: Index page and timer

Lagoon Learn's main core is the WPF-built homepage, named as the index page in the project file. Users are taken to this main screen after logging in, where they see a session timer—a feature that is essential to facilitating productive study habits like using the Pomodoro technique or other time management techniques. (Beishuizen, 1999) With this design option, users can enter the desired number of minutes and set aside certain times for their study sessions. while users move through the app's

different areas, the timer continues to function while it counts down, allowing them to manage their time effectively.

In the development process, a significant hurdle was encountered in creating a timer that could function seamlessly between the backend and frontend in the WPF environment. The lack of a native frontend timer required a creative approach, leading to the utilisation of the Dispatch Timer function. This function had to be connected to a frontend label for the display element. However, this solution was met with challenges, such as discrepancies in pausing the timer between the frontend and backend, issues in halting the timer effectively, and inaccuracies when resetting the timer's minutes.

To refine the user interface, the initial design, which featured basic buttons for managing the timer, was revisited. (*Figure 2*) These buttons were upgraded to simple icons, which were designed with the applications colour scheme. These also enhanced the user experience with an easier and accessible interface. Furthermore, the homepage is equipped with a taskbar at the bottom, serving as a navigational compass to the core features of the application. This taskbar contains five buttons; creating new flashcards, studying flashcards, testing knowledge with flashcards, exploring public flashcards, and sharing flashcards with users and/or to publicise them. (*Figure 3*)

Originally, the plan was to incorporate a study calendar to assist users in planning their study sessions. However, with the fast-paced nature of flashcards, it was decided that a timer would be a more fitting tool for users. The change from a study calendar to a timer was aimed at accommodating the quick and efficient study sessions that flashcard learning entails, thereby enhancing the overall user experience. (Light et al., 2018)

Moreover, the homepage features essential navigational tools, including a logout option within the menu, allowing users to sign out without exiting the application entirely. Alongside this, an exit button is provided, giving users the choice to close the application fully. The navigational elements were also added to the menu and are usable throughout Lagoon Learn.

Chapter 6: Creating Flashcards

Users are redirected to the creation page in order access application's flash card stack writing process. (*Figure 4*). With the help of this interface, users can quickly arrange their study resources into stacks that are categorised, resulting in a learnable sets of flash cards. Users are prompted to give their flash card stack a title when they open this page, and below, there is the easy-to-use creation user interface. This title acts as the collection's overall theme or category, which also facilitates the retrieval of relevant data.

It is intended to be straightforward and intuitive to add individual flash cards to the stack. After being added, each flash card shows up next to the input fields in a list box. Users can view and evaluate the contents of their stack briefly before saving thanks to this preview feature. Users can edit flash cards straight from this list, demonstrating the system's flexibility. With features like altering, and removing, they have complete control over the contents of their stack. (Kung, 2012)

The "Save Flash Card" button must be clicked for the flash card to be committed to the database. Users will always have the chance to check and edit their entries before they are saved thanks to this intentional activity. The database structure is scalable and efficient, with a single table holding all the flash cards. Under four distinct headers, this table is arranged: question, answer, stack name, and current user identity. A session-specific mechanism is used to manage the current user's identity, making sure that the context of the user's content is preserved and shown during each app session.

There are a lot of benefits to keeping all flash cards in one database, regardless of user. It makes the back-end code structure simpler, which facilitates more efficient data handling. Because each flash card is associated with a stack and a user, it can be uniquely identified, making data retrieval and manipulation simpler. Additionally, this architecture facilitates users to make their accumulated knowledge available to others by publishing their stacks on a public page. In addition to improving the app's collaboration capabilities, this feature helps create a shared learning environment where users can find and learn from each other's collections. (Pan et al., 2022)

Chapter 7: Studying and Tests

When Lagoon Learn's design was first being developed, the study page (*Figure 5*) was intended to be the final page to facilitate study resources and quizzes. But as the project progressed, it became necessary to create a different page specifically for flashcard tests (*Figure 6*). The Test page includes multiple functions that were contained within the study page itself since their purposes were similar. Firstly, the flashcard list box would populate with stacks that were created by the currently logged in user.

One of the bigger challenges of this page was to create a method to show the flashcards when they were selected while keeping the question-and-answer part of the cards joined. These two cards were paired together using a tuple filled list. Making use of lists made it simpler to move through flashcards because lists naturally provide an index for each item. As a result, users can cycle between the indexes by clicking the moving arrow for the flashcards, choosing whether to loop around or only increase or decrease depending on the total number of flashcards and the current index. The page also has a "delete stack" option that let users remove stacks that they decided were not worth studying or saving.

After due research and consideration, it was determined that although the study page is helpful, users need to have access to a test environment for self-evaluation to genuinely improve learning. (Andrade et al., 2009) The test page it allowed reduced distractions and restricted access to the answers. Apart from the events brought about by the right or wrong buttons, the coding for these two pages was similar. The stacks are loaded in the List Box and loaded for viewing the same. Repetition is essential for remembering, thus any flashcards a user failed to get right on should be repeated. (Uchihara et al. 2019). Each wrong flashcard was added as another tuple to a new list, which was then shown once the initial list had finished displaying. With this method, users can keep track of how many correct answers they received overall during the test; the number increased with each right answer to make counting easier. The results are then displayed in a message box along with an option to restart the test.

To improve user experience and offer insightful feedback on their learning, it was decided to add a secondary page that assists the test page that allows users to

carefully monitor their progress and examine their test history across all their attempts. (Figure 7)

When a test is over, the program carefully logs the user's score, the flashcard stack that was used, and the test date to a different table called "Scores". Users are then provided with a complete and up-to-date record of their testing history, thanks to the statistics page that populates the List View element with the appropriate data.

With the help of this statistical summary, users may effectively evaluate their own learning, discover learning trends, establish goals for the future, and adjust their study habits. The statistics page provides a customised overview of the user's learning path, making studying more interesting and productive—whether the user is trying to learn a new subject or is getting ready for an impending test. (Tao et al., 2014)

Chapter 8: Sharing and Public Pages

Users are encouraged to collaborate and share knowledge in an environment that has been established on the Share and Public pages. Specifically, the Sharing page is the platform that facilitates users' sharing of stacks of flashcards with members of the community at large or with individuals. This function greatly enhances everyone's educational experience while also facilitating the smooth distribution of information. (Sampson et al., 2009) (Figure 8).

The capacity of a sharing page to bring together individuals with opinions and degrees of knowledge is one of its main advantages. This diversity creates a stimulating learning atmosphere where people can learn new viewpoints, expand on their comprehension of challenging concepts, and produce creative solutions to issues. Users foster a more inclusive learning community by contributing to a collective body of knowledge that is open to everybody through exchanging ideas and resources.

Furthermore, the ability to target individual users by entering their usernames on the Share page gives the learning process a more customised touch. By making sure that the proper resources are available to the right individuals this kind of targeted sharing can improve the efficacy of learning. The capacity to share content with certain users not only facilitates personalised learning but also the growth of targeted study groups or communities of practice. Users can further enhance their learning experience by participating in collaborative projects, peer-to-peer tutoring, and in-depth

conversations within these groups. As students navigate their educational experiences together, this focused approach not only builds community ties but also fosters motivation and accountability in the students. (*Figure 9*).

The procedure was made scalable and efficient by the backend system that enables these functions, which manages the sharing and distribution of content using a SQL public table. The method copies all public cards to a PublicCard SQL table. The decision to present shared content using list views rather than list boxes improves the user experience even further by providing a more arranged and aesthetically pleasing representation of the data as each attribute is bound to a specific column.

Chapter 9: Results and Evaluation.

The finalisation of the Lagoon Learn application marks a significant advancement in the development process. This section provides an overview of the outcomes following the creation of the project to the listed specifications. It focuses on the refinement of the results from the testing phases and an evaluation that identifies areas for potential enhancements without reiterating the project's achievements or deviations from initial plans.

The project's final phase involved a comprehensive testing strategy that meticulously evaluated the application's functionality, usability, and performance across various scenarios. (Sivpathi et al., 2014). Notably, the original concept of utilising .json files for flashcard transfer, as discussed in the interim report, was adapted into a more streamlined in-app feature that relies on the username. This change significantly enhanced user experience by simplifying the process of flashcard sharing and management within the application's ecosystem, thereby eliminating the need for external file routing and handling.

The introduction of new features such as the test page, stats page, and public page further increased the application usefulness. The test page offers users a more structured environment for assessing their knowledge, complementing the more flexible and leisurely study page. This addition enables users to engage in both self-directed learning and more formalised testing to gauge their progress. The stats page provides valuable insights into users' study habits and progress, encouraging continued engagement and improvement. (Lin et al., 2018). Meanwhile, the public page services the users as a collective, allowing a broader audience to access and

benefit from the shared resources within the app. These later additions collectively contribute to a more interactive learning experience, highlighting the project's aim for users to continuously improve learning and increase engagement.

In review of the interim report, the strategic decisions made during the development process, such as planning to integrate the .json file export system directly within the app and linked it to the application's public page, have proven instrumental in raising Lagoon Learn's use case. The removal of these features not only facilitated easier development but also pre-emptively tackled any potential usability challenges, displaying a practical approach to Lagoon Learn's design and development.

However, the improvement can be made, particularly in further aesthetic and functional enhancements. The feedback regarding the visual design emphasises the importance of unique, custom graphics in creating a more engaging and distinctive user interface. Future iterations of Lagoon Learn could greatly benefit from personalised design elements that reflect the application's identity and personality.

Moreover, the addendum of the test, stats, and public pages was to ease a clearer path toward expanding the application's features. Future developments could explore more advanced analytical tools, personalised learning goals, and increased collaboration with other educational resources, advancing the objective to create a complete and user-centric learning platform. (Lee et al., 2015)

Chapter 10: Conclusions and Future Work

This section concludes this report the achievements of the Lagoon Learn project, offering insights into the process from start to finish and the significant learning opportunities it has offered. It aims to compare the project's accomplishments with respect to the original objectives and plans, the changes from the interim report, and the lessons learned during the process. Moreover, it intends to establish a structure for subsequent developments, providing direction and motivation for those who wish to advance the project further. (Saatz et al., 2013)

The Lagoon Learn project began with the goal of enhancing classic educational methods through a digital flashcard application designed to support collaborative and individual learning. The project has achieved this objective, delivering a thoroughly tested application that not only met but exceeded the initial expectations in certain

aspects set forth in the project plan. These extra features include the test page for controlled learning assessments, the stats page for tracking progress, and the public page to broaden user access. These additions helped bring the app together.

Some ideas presented in the interim report underwent significant modification, particularly among them being the removal of the .json file transfer system within the application itself. The intention behind this calculated change in direction was to simplify the user interface and improve the integration and smoothness of sharing flashcards. Another modified feature was the replacement of the study calendar with a session timer.

The creation of Lagoon Learn has been an incredibly educational experience, full of obstacles that called for creative thinking and extensive research of niche functions within WPF. The process of overcoming these obstacles has been crucial in developing technical knowledge, problem-solving talents, and project management skills. Reflecting on the process, this project has significantly contributed to my growth as a learner and as an aspiring IT professional, providing an excellent foundation in the practical application of theoretical knowledge.

The project highlighted the importance of flexibility and adaptability in the face of unexpected issues, reinforcing the value of continuous self-improvement. It has also highlighted the crucial role of application testing in shaping a product to ensure that it truly is functional and will not cause any future problems.

While Lagoon Learn is a great accomplishment in its current state, it also provides a foundation for future evolution. It is encouraged that future users and developers expand on this foundation by investigating ways to add more sophisticated features like AI-driven personalised learning experiences, improved data analytics for more thorough progress tracking, and wider integration with other educational platforms and tools. (Platzer et al., 2011)

The use of proper coding segregation and the different iterations of documentation regarding the project have been organised to make it simple to understand and modify, so that future contributors can efficiently continue where this phase has ended. Future improvements will be guided by the lessons learned from user feedback and the difficulties faced during development, with the goal of making Lagoon Learn an even more useful product within different educational tools.

In conclusion, the Lagoon Learn project was a great venture into digital education technology and the reason for continued research and development in application development. The knowledge and skills acquired from this project have helped personal development, technical skills and have established a strong basis for future professional development.

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Appendices

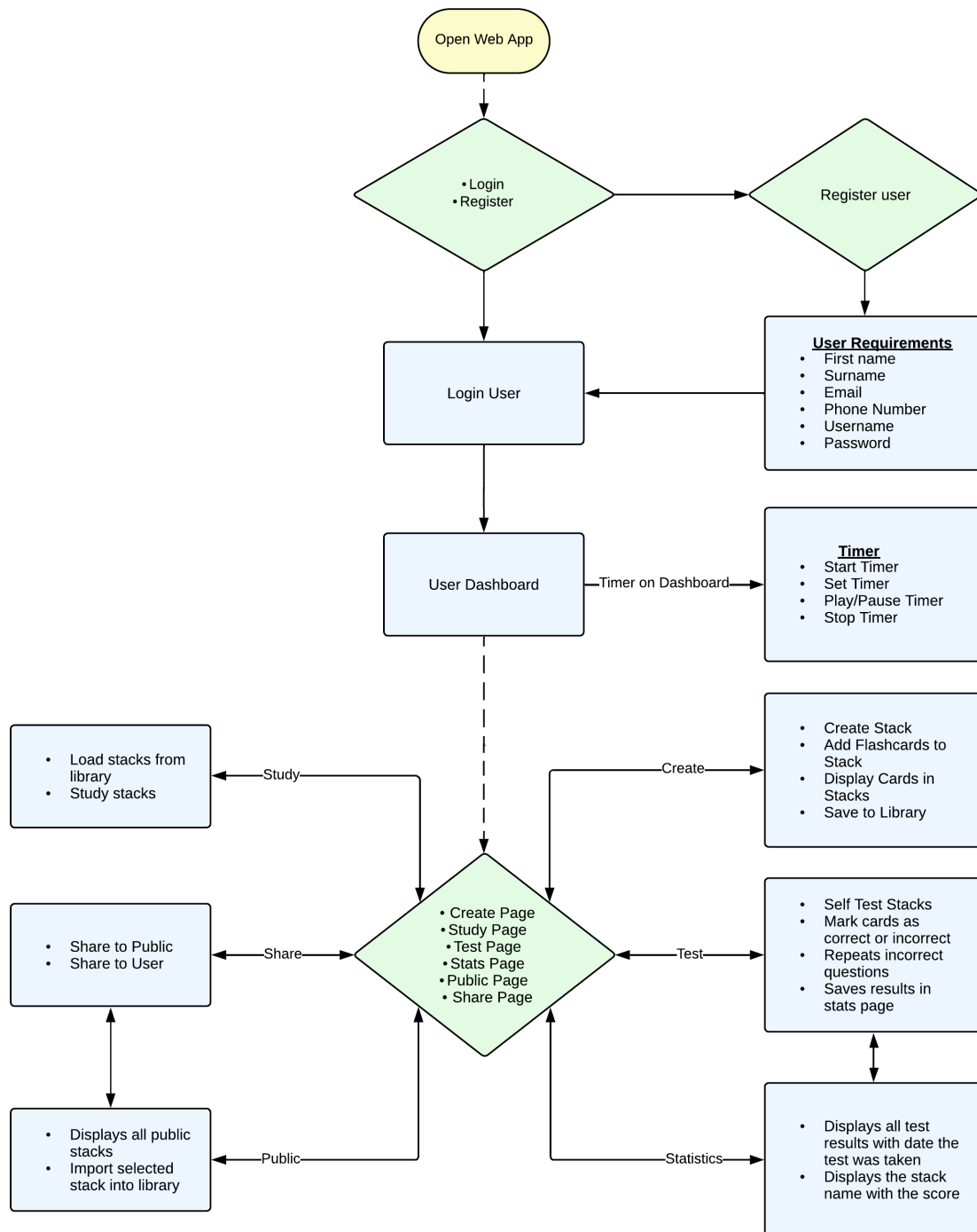


Figure 1 - User Flowchart



Figure 2 - Index page pre-optimisation.

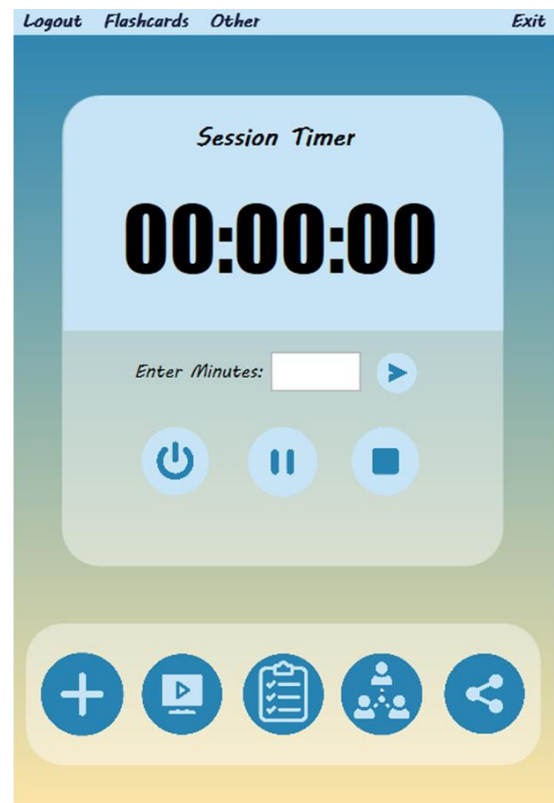


Figure 3 - Index page post-optimisation.



Figure 4 - Create Flashcard Page

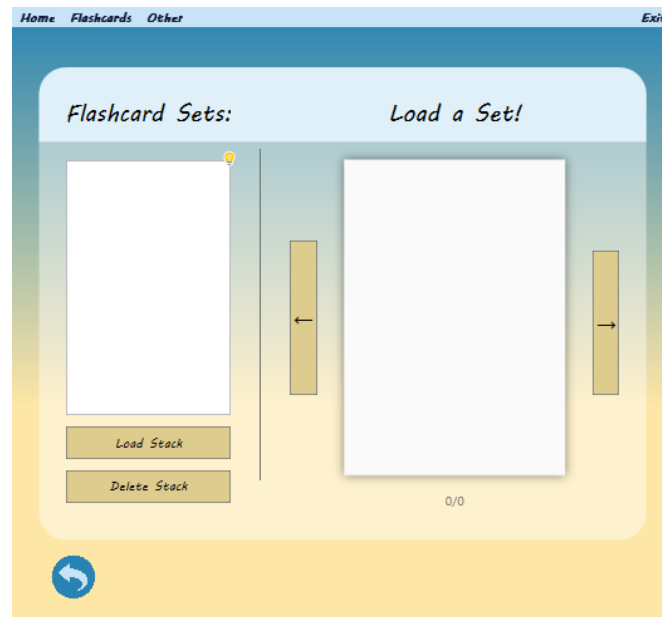


Figure 5 - Study Flashcard Page

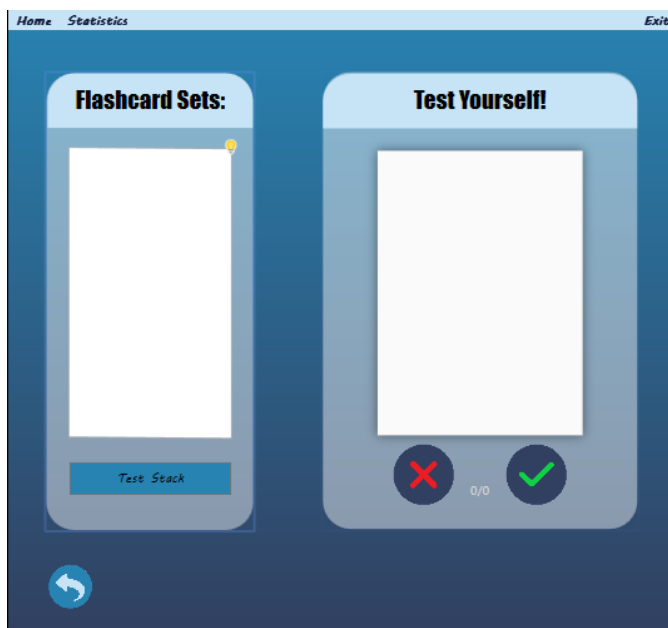


Figure 6 - Test Flashcard Page

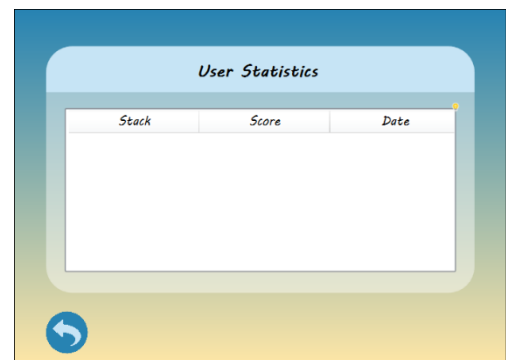


Figure 7 - User Flashcard Statistics

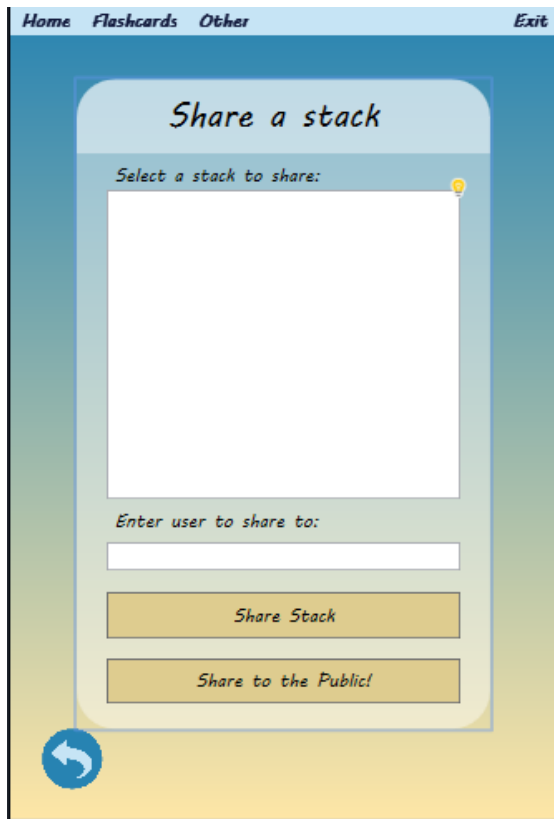


Figure 8 - Sharing Flashcards

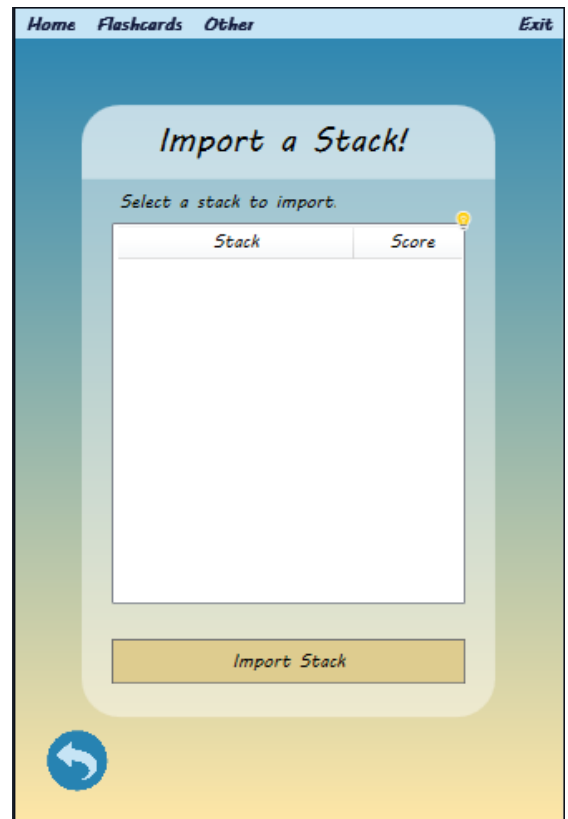


Figure 9 - Importing Public Flashcards