

**Mobile app development: The effect of smartphones, mobile applications and  
geolocation services on the tourist experience.**

by  
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## Abstract

Currently in Bermuda, there is limited access to information about scuba diving sites and shops. Research shows that smartphones and mobile applications are a popular tool used by tourists during travel to look up information and make decisions. The current study aims to design and develop a mobile application that gives access to information and is appealing to users. The application should utilize functionalities such as geolocation services, social media photo and video sharing and reviews. Design development was conducted which consisted of a competitive analysis, card sorting, personas, site mapping, wireframes, user testing, branding, and focus groups. Participants were between the age of 18-60 and consisted of both divers and non-divers. The final branded app was a summation of edits from the user testing with the objective of appealing to users by engaging them, reducing clicks, simplifying information, and gaining repeat users.

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## Chapter 1: Introduction

Bermuda is a well-known destination for scuba diving and snorkeling. Its waters are home to many shipwrecks and a vast perimeter of coral reef. The economy in Bermuda substantially depends on the tourism industry, which thrives on the island's exotic beauty and tropical climate. While other countries offer tourists mobile solutions for travel which help improve their experience, a technological gap exists in Bermuda. As a result, electronic and mobile options are dated and information users seek is inaccessible. Existing platforms provide limited information on scuba diving and snorkeling opportunities to these tourists.

Millions of people now have smartphones, and therefore have mobile access to an excess amount of information (Palumbo et al. 2013). Mobile applications (apps) have changed the history of consumer technology as they have become the fastest-growing communications channel (Kennedy-Eden & Gretzel, 2012; Newark-French, 2011). According to Cantoni et al. (2016), tracking user's activities and delivering location-based services is an important part of geolocation and location-based services that are essential in mobile technology today. Furthermore, Kennedy-Eden & Gretzel (2012), Newark-French (2011), stated that app marketplaces are the fastest-growing in the history of consumer technology. Users expect instantaneous information, therefore; smartphones are changing the emotional and behavioral responses of tourists. Cantoni et al. (2016), wrote that users now require real time results. Geolocation and location-based services may help satisfy this requirement and are therefore are an integral part of mobile app development. Smartphones also give users the ability to save and share their experiences. Wang et al. (2012), suggested that smartphone technology be combined with geolocation and location based services, to create an integrated platform for the best user experience.

In order for Bermuda to continually gain new and repeat visitors, it is vital for the tourism industry to evolve. In a study by Kennedy-Eden & Gretzel (2012), researchers reported that 55% of tourists purchased apps for their destination either before or during

their travel. This highlights how popular apps are to tourists. Furthermore, tourism related apps are the seventh highest downloaded app category (Kennedy-Eden & Gretzel, 2012). The evolution of smartphones and apps has created an influx of opportunity for the tourism industry. Tourists faced with unfamiliar locations during travel look to smartphones for guidance. Immediate access to information helps tourists to make decisions and eliminate any doubt they may have with their decisions (Wang et al. 2011). Essentially, smartphones have become modern alternatives to the traditional destination guidebook.

Bermuda has been dubbed the shipwreck capital of the Atlantic Ocean, with hundreds of shipwrecks (wrecks) lying on the sea bed around the island. Many of the wrecks were caused by the coral reefs (reefs) that surround and protect the coast of the island (Go to Bermuda, 2017). Coral reefs form some of the most diverse ecosystems on Earth, and therefore provide an abundance of diving and snorkeling opportunities for marine enthusiasts, both local and visiting.

Five licensed dive shops are currently open in Bermuda that offer guided scuba diving or snorkeling tours. The dive shops do not provide their clients with any additional information specific to the dive sites, outside what is shared with them throughout the duration of a paid guided tour. As an alternative to dive shops, much of the existing public information on dive sites comes from printed booklets or handouts created by the Bermuda Tourism Authority or the Bermuda Government. Currently the only mobile solution related to dive site information in Bermuda is the Professional Association of Diving Instructors (PADI) app. However, a critique of the PADI app is that it offers very limited information and a poor user experience.

There is a demand for a platform that offers historical dive and snorkeling site information which includes images and videos, as well as geolocation and social media sharing communities. The platform needs to be mobile and internet accessible to meet practical requirements such as taking on boat tours or using before water activities. The

current study will explore how mobile technology and apps affect user experience, and examine factors that affect the success of an app in terms of repeat users.

## Chapter 2: Literature Review

There are currently over 60 billion mobile apps available online, and in the United States alone, 119.3 million people have a smartphone. It was predicted that in 2015 the sale of smartphones would surpass the sale of personal computers (Palumbo et al. 2013). This highlights a trend in consumer buying and a shift in behavior toward smartphone use.

Furthermore, smartphones have become an important asset in the tourism industry. They create a connection to the online world where users consider staying “online” and “always connected” part of their everyday routine (Westlund, 2008). They also provide users with solutions that reduce practical difficulties when traveling (Laporte et al. 2009). Older designs and systems are unable to meet current tourist requirements because tourists are constantly refining and redefining their needs (Huang and Zhu, 2015). This demonstrates the importance of creating and designing a successful, user tested application that enables tourists to always have access to the application’s content, whether online or offline, perhaps due to international travel or service interruption.

Wang et al. (2012) stated that smartphones offer tourists the opportunity to solve problems more efficiently, share their experiences and store memories. This suggests that a mobile application would be beneficial for tourists and locals of Bermuda’s waters. It would offer users the ability to share their experiences and include pictures and videos. They can review dive sites, discuss marine life and connect with other users. The current review will discuss the following: Mobile Application Demand, Smartphone Development, Application Quality, User Recommendation Systems, Tourism and Mobile Accessibility, The Tourist Journey, The Tourist Experience and Geolocation Functionality.

### **Mobile Application Demand**

According to the official Bermuda Tourism Authority website, Bermuda has more shipwrecks per square mile than anywhere else in the world (Go to Bermuda, 2017). Due to a deceiving 200 square miles of protective reef surrounding the small island, many ships were unable to navigate to the island successfully, resulting in many sunken ships around Bermuda's waters. This inevitably gave Bermuda the nickname "Isle of Devils". Shipwreck occurrences date from the 1600s to 1997 (Go to Bermuda, 2017). Aside from an abundance of shipwrecks to explore, the coral reef surrounding the island also creates many thriving diving and snorkeling opportunities. Bermuda is a location that provides easy access to these sites, some being accessible from short boat trips, and some even accessible from the shoreline or the beach (Go to Bermuda, 2016).

It is widely known that coral reefs are struggling to survive and thrive across the world. In large part, due to Bermuda's strict protective laws, the coral reef is healthy. Nonetheless, it is still a difficult task to maintain the environmental health of the island's waters while educating as many people as possible, both locals and tourists (Go to Bermuda, 2016). This highlights the need of an accessible app providing educational information about the waters and reefs around Bermuda. Engaging tourists and locals to learn may help protect the very waters that tourists are learning about because they will gain more respect through historical and factual information about the underwater ecosystem. They may even become ambassadors on how to treat the ocean.

Bermuda is home to the Bermuda Institute of Ocean Sciences (BIOS), which is a US non-profit scientific research and educational organization. It consists of both full time and visiting researchers and scientists that work on both local and global environmental issues in and around the ocean. BIOS plays a consistent role in Bermuda's environmental development and is currently working on many different coral reef projects (Bermuda Institute of Ocean Sciences, 2017).

## **Smartphone Development**

Smartphones now allow users to be online, anytime and anywhere, including during travel. This enables users to constantly access information in unfamiliar environments, and to maintain communication with people no matter where they are in the world. The smartphone is changing how we use apps through tourist travel (Dickinson et al. 2014). According to Kennedy-Eden & Gretzel, (2012), Newark-French, (2011), mobile applications have now become the fastest-growing media outlets in the history of consumer technology. Apple's App Store has over 2.2 million apps, while there are 3 million on the Android Market, 600,000 on Amazon AppStore, with a forecast of 197 billion mobile app downloads happening in 2017 (Dogtiev 2017). Geolocation and location-based services have now become readily available on smartphones to track user's movements and provide them with location-based services (Cantoni et al. 2016). Users now require in the moment updates and information on demand to satisfy their requests in real time. This suggests that providing users with an app that offers geolocation is essential.

Mobile devices, unlike personal computers, are usually only used by one user, which enables them to become personalized (Kenteris et al. 2007). Bellman et al. (2011) wrote that mobile phones have now become extensions of their owners. The mobile phone is the bridge between the personalized experience and other social media users; moving from the physical experience to the virtual story-telling of that experience. App development that is designed and branded well results in higher levels of user engagement, which can then provide some of the best interaction and advertising for a company's target audience (Bellman et al. 2011). Smartphones have also become key tools in news and media coverage, as users are constantly using their phones to capture images, conversations and videos (Cantoni et al. 2016). This suggests that smartphones certainly are an integrated part of daily life, and are used for communication, information gathering and recording—either with photographs, video or social media. Therefore, apps

need to create new opportunities for conversation and feedback in order to communicate effectively to their users and provide them with an integrated platform.

Human-computer interaction (HCI) plays an important role when it comes to context and content. Context and content cannot be divided as they lift and support one another (Mehra 2012; Dourish 2004). According to Lamsfus et al. (2015), context is important because it provides a deeper and sufficient understanding to the mobile tourism environment which helps establish new developments and opportunities for active tourists and their needs.

Although mobile apps are wide in scope and content, most of them fit into three categories: native, web-based and hybrid. Native apps are directly on the user's phone and run off the operating system, web-based apps are used through a web browser on the smartphone, and hybrid apps are web apps that are natively located on the phone as an app (Joorabchi et al. 2015, Masi et al. 2012). As Ferreira and Silva (2012) stated, it is important to aim to reach every mobile device, whether the app is native or a mobile web page, because there is no 'one size fits all' for apps. Different apps meet different business requirements. The authors suggested that due to native apps being slow to connect online, similar to web pages, they are therefore not superior to web pages. Thus, users should be provided with a hybrid app that includes a native and a web-based app. The aim in creating both is to provide users with an app that uses internal storage or cache of the browser to help eliminate network issues and to optimize load times.

Even though much of the technology is currently available for mobile apps, functionality, usability, and design must be implemented and incorporated to meet the standards of current user's experiences within applications across other categories (Kentris et al. 2007). The fundamental components of the smartphone are voice calling, stock applications, and the ability to access the internet. These base components are the norm across the board (Dickinson et al. 2014). Many components in a mobile phone play major roles in the process of creating a seamlessly performing app for tourist service providers. These factors include limited battery, memory, storage capacity, optimal

display size, font size, keyboard options (touch screen, key pad, etc.), and network cost and availability (Kentris et al. 2007).

In summary, smartphones have developed at such a rapid rate that users are able to be online anytime and anywhere. This development for mobile applications has made history in consumer technology with the fastest-growing media marketplaces, and has therefore provided high levels of competition for design, interaction and content in order to create a successful app. Creating a seamless app that meets the users' needs will ensure the enduring success of a new mobile application. To maintain success the Go Dive app will provide anytime, anywhere usage with a high level of integrated design.

### **Application Quality and Repeat Visitors**

Due to such a high number of apps being made available, it has become increasingly important to maintain a high quality app to ensure repeat use. Khalid et al. (2015), found that in order to produce higher quality apps, developers first needed to find out what issues or challenges determine the quality of apps for users. During the study, it was found that functional errors, feature requests and app crashes were responsible for over 50% of the poor reviews. These criticisms can help app development in new feature creation, and also help tackle existing problems in the app. The study also found that privacy, ethical issues, and hidden app costs proved to have the highest negative impact on app ratings. This ultimately shows the importance of gaining users' trust and meeting expectations in the app.

When it comes to reviews, users tend to write reviews when they are either extremely satisfied or extremely dissatisfied with a product. It was found that users gave more in-depth feedback and a broader range of words when giving poor reviews on apps, determining that poor reviews are more useful in highlighting app issues (Khalid et al. 2015).

The tourism industry now has many different mobile tour guides available, mainly due to increasing bandwidth and hardware capabilities. These mobile guides all have



different functionalities, aesthetics and target audiences (Schwinger et al. 2009, Hopken et al. 2010). This means that although an app may functionally work perfectly, if it is not tailored to the target audience's expectations and requirements specifically, you may be at risk of having a one-time user of the app. Instead, the aim should be to maintain the relationship and gain repeat visitors (Palumbo 2013).

In summary, the biggest influences on bad reviews were functional errors, feature requests, app crashes, privacy and ethical issues, and hidden app costs. These reviews can turn away potential users of a new app, highlighting the importance of creating a fully functional, designed and focused Go Dive app that is specific to its target audience.

### **User Recommendation Systems**

Husain et al. (2012) listed three types of recommender systems; collaborative filtering, content-based filtering and knowledge-based recommendations. The benefit of recommender systems is to provide the user with the most personalized information. The recommender system creates recommendations and projections based on the user's data and previous decision making.

A collaborative filtering recommendation system collects comparable users' preferences to create a recommendation for the user at hand. Similar to this system, memory or user-based collaborative filtering uses data from other users. It can work out what the target user's preferences are by filtering data from surrounding users (in similar contexts) and then making recommendations; for example, tours, museums and other recreational activities (Husain et al. 2012). Secondly, content-based recommendations, which are based on the user's preferences, will thus differ from those recommendations provided to other users. The content is served based on browser history and mobile interaction data. Based on that information, the content is then fed to the user. This system is able to cater to the unique interests of the user (Husain et al. 2012). Finally, there are knowledge-based recommendations. This system compares the features of the item and the user's preferences to provide the most accurate output. Navigational

functions also help to gain user preferences, but in this case, are not stored for use in the future (Husain et al. 2012).

Due to Bermuda's low population count, the app may not have enough of a user pool to provide a successful collaborative filtering system. Therefore, content-based or knowledge-based filtering will work best for the Go Dive app. The content-based filtering would work well as it will pull from the user's history to provide the best options in the area, whereas knowledge-based recommendations would be more precise for the user by taking their history and pairing it with the features of the app. This would offer the user a better tailored set of information.

In summary, further research is needed to determine whether the content-based or knowledge based filtering system would be best for a geolocation tourist guide like the Go Dive app.

### **Tourism and Mobile Accessibility**

The tourism industry has rapidly transformed due to both smartphones and app accessibility. Dickinson et al. (2014) suggested that apps are so prevalent that tourism would fail if it didn't stay up to date with local information or new content. Kennedy-Eden & Gretzel (2012), reported that 55% of travelers purchased apps up to three days before they traveled or once they had arrived at their destination. The authors also reported that tourism applications are now the seventh most downloaded app category.

Functionalities such as contextual awareness are becoming a reliable and required asset to smartphones, proving to the travel industry that app development will only continue to flourish (Adobe Systems Incorporated, 2010). Information technology (IT), and the internet in particular, has completely changed people's behavior during travel (Lamsfus et al. 2015). Smartphones have become such a necessity in people's lives that it is now affecting their behavioral and emotional states as they are addressing informational needs during travel as necessary (Wang et al. 2012). People are frequently

searching new information to help confirm their choices and to help remove any uncertainty (Wang et al. 2011).

Cheverst et al. (2000), suggested that the tourism industry has ultimately gained a partner in smartphones. The ability for users to connect with remote information networks, geolocation data and social media information has dictated a new way of travel. It is important to recognize that tourists deal with a significant number of images and information therefore, app performance is crucial in order to meet users' high expectations (Ferreira and Silva, 2012).

In summary, the success of the tourism industry depends largely upon staying up to date with smartphones and applications. Over half of all tourists are purchasing apps prior to their trips as tools for their travels (Kennedy-Eden & Gretzel 2012). This demand necessitates high app performance to provide users with a positive experience.

### **The Tourist Journey**

Tourist consumption can be broken down into three stages according to Gretzel et al. (2006); pre-consumption, consumption and post-consumption. The pre-consumption stage involves researching, decision making, booking, and payments. The consumption stage is for execution, networking, navigation, on-the-go decisions and payments. Social media, recording, and memories are then part of the post-consumption stage.

According to Laporte et al. (2009), tourists want specific information efficiently. Due to limited attention spans, information must be context-related in order to retain interest.

Wang et al. (2012) stated that by mediating behavioral and psychological parts of the tourist experience, apps help facilitate their information search, processing and sharing. This gives travelers the opportunity to learn about new experiences, and get to know a destination better before or during their travel experience. The use of smartphones for travel can easily change travelers' activities in real time (Kramer et al. 2007). The mobile environment allows the users to explore more information and make

decisions in different types of situations. This enables tourists to more effectively solve problems, share their experiences and store memories, either during or after their trip (Wang et al. 2012; Lamsfus et al. 2015).

The tourist process is best defined as an “activity-based” method (Wang et al., 2012). This is because during the tourist experience, they go through phases which are a series of activities, including information searching, activity planning, reservations, visiting, dining, and recollecting. These are part of the tourism, social and environmental activities that are all factors of the overall experience of tourists (Andereck et al. 2006). According to Wang et al. (2012), visitor and industry perceptions of tourism are molded by mobile technology.

Jennings and Weiler (2006), stated that traveling is a meaningful experience constructed by the absorption, understanding and feelings stemming from the places and things visited, especially the local culture. Many groups of people are invested in this experience including, tour operators, governments, communities and indigenous people. All may contribute to the experiences that a tourist has on their journey (Wang et al. 2012).

According to Anegg et al. (2002), first generation tour guides were confined by the suppliers and the information they were providing. This meant that the guides were focused on communicating what information they knew rather than what tourists wanted and needed to know. The developments in the app world have created opportunities for mobile and tour guide apps like CrumpeT (Poslad et al. 2001), Intrigue (Ardissono et al. 2003), GUIDE (Cheverst et al. 2000), and COMPASS (Schwinger et al. 2009), that are designed to visualize surroundings and present tourists with recommendations as they have interactive and personalization capabilities.

In summary, the three stages of consumption are important when considering how the user will work through an application. How the user absorbs and processes the information will help determine whether they will be a repeat user. Due to mobile

tourism development, the experience and information need to be based on the tourist needs and not dictated by the supplier's information.

### **The Tourist Experience**

Dickinson et al. (2014) suggests it is important to provide connectivity between users for ad hoc choices while they are on-the-go and networking. Hopken et al. (2010), found that if international users discovered an app they were satisfied with, they were willing to pay roaming charges to use the app while traveling. This is an important factor to be considered when developing an app for tourists traveling outside their country of origin, particularly to Bermuda where roaming charges are known to be high.

Museums and other tourist attractions need to continue to find new ways to engage tourists that work through their mobile device, effectively becoming a virtual museum. A museum is a place to learn, see and experience in a single activity (Palumbo et al. 2013). Thus, the Go Dive app can be considered a museum guide as it will showcase Bermuda's waters and shipwrecks. Similar to a walk through a museum, the visual and physical experience is gained through the dive and the information is provided by the app.

In a study by Wang et al. (2012), about a quarter of users felt that smartphone apps were able to provide "good value" for their trip. This is because they felt more efficient at researching and planning, which contributed to a better overall experience. Other users also stated that the use of smartphone apps added "delight to their trips" and gave them a "rich experience", as destination guides help urge tourists to visit different places on their trips. It can also provide tourists with local knowledge, for example, the best local food, the best cup of coffee, locations of public bathrooms, and closest public transport. Some tourists may want to have as local an experience as possible when visiting a location such as Bermuda. Providing this opportunity to tourists may be key to creating return visitors.

In a study by Kenteris et al. (2007), on the mobile tourism research prototype, the authors created an app that provided content and user preferences for convenient tourist applications. Once initially downloaded there was no network coverage required. This is because the app was able to complete requests in “standalone” mode and only once the user was back online would the app update. This provides evidence that apps can be created that may not require a constant network connection to run adequately. The authors also provided the prototype with a “push model” where users would be notified of updates to services or new material once it is pushed live by the app’s administrator. The push model helps to reduce data transfer costs as the user is not made to continuously search for new information. Users automatically receive the related information, which therefore reduces the user’s effort and the need for searches for new data. This is a key point for international travelers as it may help with minimizing high roaming costs (Franklin & Zdonik, 1998, Hopken et al. 2010).

The evolution in mobile phones and their capabilities, including larger screen creation and internet access, has progressed immensely. The incorporation of powerful location awareness functions has also developed enormously (Want, 2009). Users’ access to information and the ubiquity of mobile apps also creates new problems. Due to time constraints, users expect highly personalized information, connected to their personal profile, preferences and current location or situation. Not only does the tourist's present situation play a part for the user but also the environment in which the app is being used. Noise, lighting conditions, activity, current season and crowds can all play a part in the design and development of tourist apps (Hopken et al. 2010).

In summary, although providing tourists with an app they are willing to pay roaming charges for is confirmation of a good app, it may not be a feasible request. Providing tourists with an app that can be used both online and offline will give the app an opportunity to be used more successfully, and ultimately more often. For offline usage, some functions like automatic geolocation may not be possible in real time, but online usage will help inform the user's offline uses in the app. Creating the best

environment possible for the user is crucial in gaining repeat users. Therefore, the Go Dive app will have the capability to allow users to download maps of specific areas to use offline and allow users to use the app content offline.

### **Geolocation Functionality**

As smartphones are so readily available to the average tourist, they now help by providing them with information and suggestions that are personalized to their current destination and preferences (Wang et al., 2012). Wang et al. (2012) also found that if tourists enjoyed a location they visited, they would research other destinations within the same area. Geolocation and a positive experience for tourists may also help with securing more repeat visitors to the locations they visited (Palumbo et al. 2013).

Enabling tourists to geotag their photos onto a location map immediately after they take them to share the photo through their social media networks provides travelers with the capability of sharing and uploading to their social media network (Wang et al., 2012). This concept will create a fluid connection between the Go Dive app and the other popular social media sites such as Facebook and Instagram. This will help users as they can easily post through one application instead of multiple ones, and they can use geolocation across the platforms. Providing geolocation and location-based services in an app will help to make the app distinctive compared to the thousands of apps already created for the Apple, Android and Windows platforms.

In summary, smartphone users now expect geolocation capability in most apps. Geolocation function makes the experience easier for the user when researching information, as they do not have to do manual searches. Instead, they are able to allow the app to essentially do a lot of the work for them. Therefore, it was decided the Go Dive app would feature geolocation services to allow users to improve their choices based on location based decision making

### Chapter 3: Competitive Analysis

A competitive analysis was conducted on four different applications in order to help provide better understanding on what is currently available in the marketplace. The Professional Association of Diving Instructors (PADI) app was chosen because it has the closest similarities to the current study as it provides users with dive shop and dive site information. The other three apps were chosen based on their relation to travel and planning and having 14 or more reviews on their App Store profile; these apps were: Viator, Maps.Me and Triposo. It is important to note that none of these apps are exclusive to the Bermuda region. Instead they are commercial apps that originate in the United States and have included other locations. With a lack of competition exclusive to Bermuda, the current study has included apps from the nearest region with a thriving competitive market which operate more globally, relative to the tourism industry.

#### **PADI**

The PADI app provides users with the opportunity to explore dive shops and sites associated with the PADI brand, while also offering users country specific travel information (Figure 1). The app provides a lot of content that users may be looking for when looking to travel and visit a PADI certified dive location. Through the app, certified divers can log their dive information and update or build on their certification level. On the App store the PADI app has a 1.5 out of 5 stars rating over 70 reviews. The majority of positive reviews stated that the use of ecards worked well. Negative reviews stated the app's usability was not adequate. Users found the app "full of bugs," "impossible for navigation," and struggled with "functionality issues". Users also stated that they could not log their dives well within the app. These issues resulted in some users saying they would not be returning to the app.



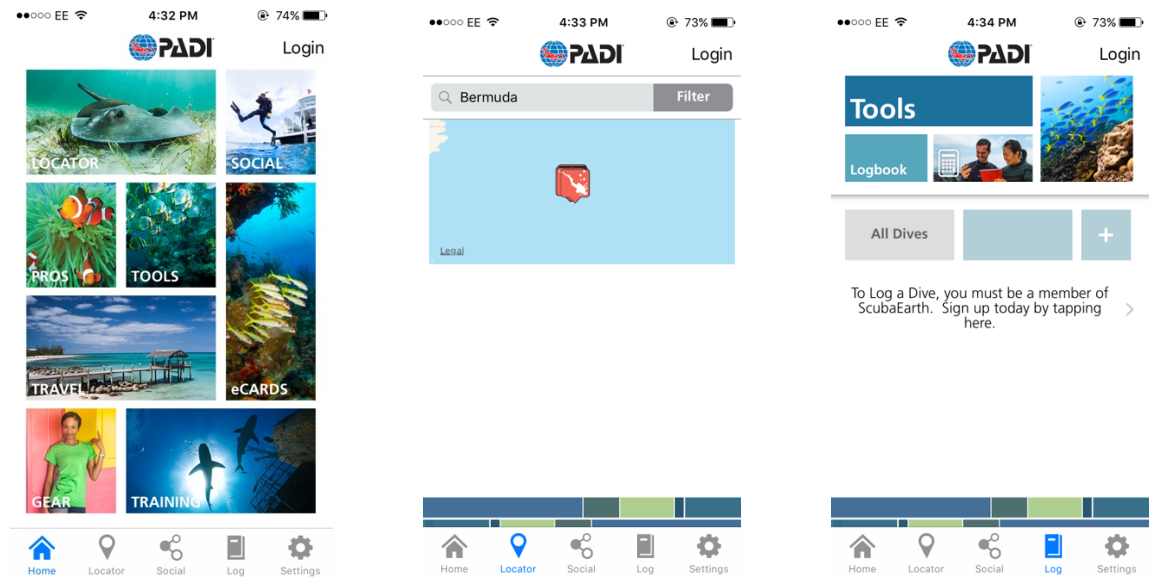


Figure 1. PADI in-app screenshots.

## Viator

Viator is a Tripadvisor company travel app boasting as one of National Geographic's "Favorite On-The-Road Apps" (Figure 2). It provides users with information on thousands of locations around the world and travelers reviews and photos for each destination. The Viator app has a 4.5 star rating on the App Store with 314 reviews. Users were happy with the app for common destinations, basic functionality and the appeal of the app was that it was visually well designed and inviting. Negative reviews showed that users were unhappy with the reliability of the app when opening it and the app froze frequently. Users also commented that for less popular destinations there was not enough detail and many ticket offerings for tours were incorrect. That being said, many users were pleased with the Viator app.

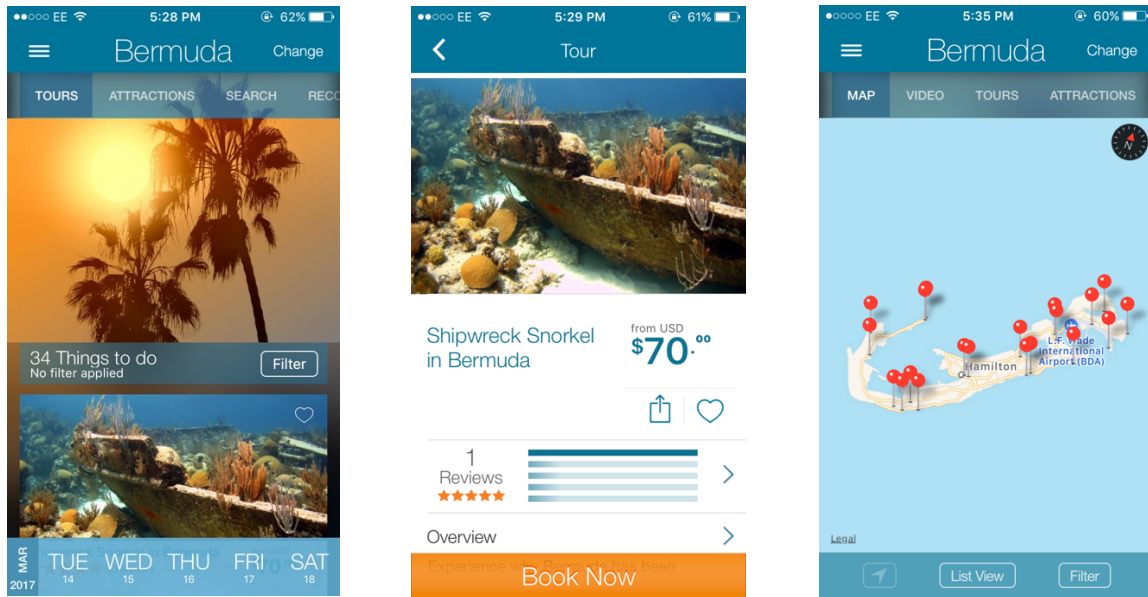


Figure 2. Viator in-app screenshots.

### Maps.Me

The Maps.me app is an app that offers offline maps to users (Figure 3). It provides users with detailed navigation or business location without the need to be online. The Maps.Me app has a 4.5 star rating on the App Store with 585 reviews. Users found the app easy to use and very accessible due to the offline nature of the maps and content. Many of the negative reviews stated users became frustrated with advertisements as they took up a lot of the screen on numerous occasions.

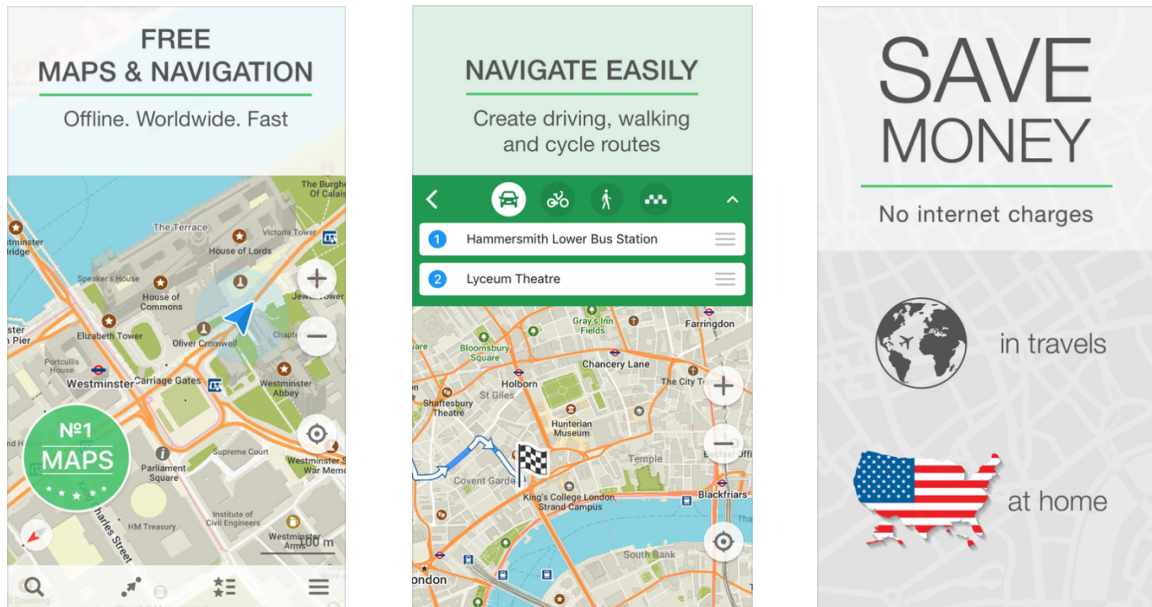


Figure 3. Maps.Me in-app screenshots.

### Triposo

Triposo is a travel guide app that provides users with information gathered from different websites and analyzes search information to provide better search results for the user (Figure 4). In-app purchases are available for a variety of different travel guides and audio guides. The app provides both online and offline usage. The Triposo app has a 3.5 star rating on the App Store with 16 reviews. Users found both the offline usage and the in-app purchases beneficial as it enabled them to buy more detailed guides on specific locations. Users also found however, the app crashed a lot during usage and therefore, was frustrating to use.

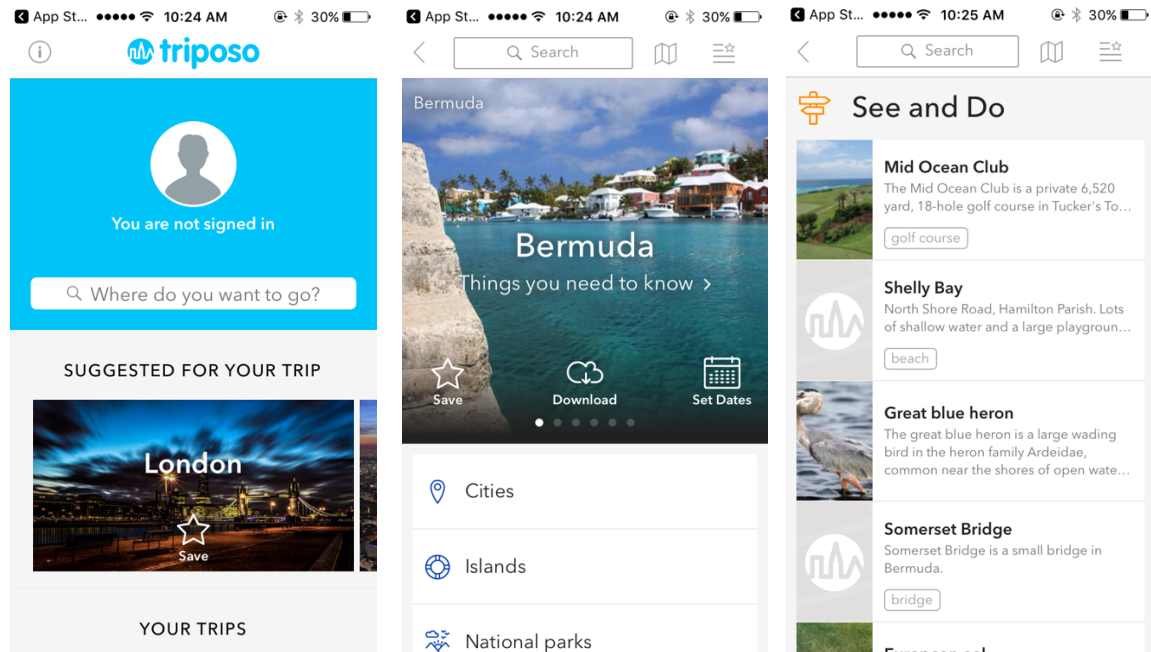


Figure 4. Triposo in-app screenshots.

Table 1. Competitive Analysis comparison

	PADI	Viator	Maps.me	Triposo
App Store rating	1.5	4.5	4.5	3.5
Number of reviews	70	314	585	16
In-app purchases	yes	yes	yes	yes
Offline usage	Basic – unable to access any maps, travel information or search content.	no	yes	no

To summarize, PADI is considered to be the app that would be used for the information needed on diving around the world, particularly in Bermuda as all dive shops

are PADI certified. PADI reviews talk about the bad user experience, therefore, possibly decreasing return users. Viator, Maps.me and Triposo are online travel based guides and do not directly relate to the Go Dive app, however, they provide insight into visual elements and user experience that work well for the user. Viator utilizes imagery in their design and Maps.me provides downloadable maps to use offline. Both of which are capabilities users are seeking in all apps. These concepts helped inform vital decision in the Go Dive app development.

## Chapter 4: Methods

### **Research Design**

User research was run in concurrence with the design process in order to better inform design choices moving forward. Design development consisted of; Competitive Analysis, Card Sorting, Personas, Site Mapping, Wireframes, User Testing, Branding, Focus Groups, Participants and Instruments.

### **Competitive Analysis**

Competitive analysis was important to the research process in order to provide information and visuals of apps already available to users. Research for apps with similar content to the Go Dive app was conducted through the App Store for Apple, Mac and iOS devices, Google Play Store for Android devices, and Google keyword search. Keyword searching included the following terms; scuba dive app, scuba diving app, tourist dive app, snorkeling app, and museum guide app. The apps that met the inclusion criteria were further analyzed for function, content, layout, accessibility and design aesthetic.

### **Card Sorting**

Card sorting provided the opportunity to see where users place app content into categories. During this exercise, the app's content was broken down into short titles of content (cards) listed as well as providing categories for the participant (Figure 1). A hybrid card sort was used through OptimalSort which is an online card sorting software on the Optimal Workshop website ("OptimalSort," 2017). There were 32 participants with 25 completing the questionnaire and exercise; seven participants abandoned the exercise. Ultimately, the card sorting exercise resulted in five main navigation headings, determined predominantly by the standardized grid methodology. Hybrid card sorting

involves providing users with category options to choose from, but also allowing them to create their own category if they feel their category better suits the content.

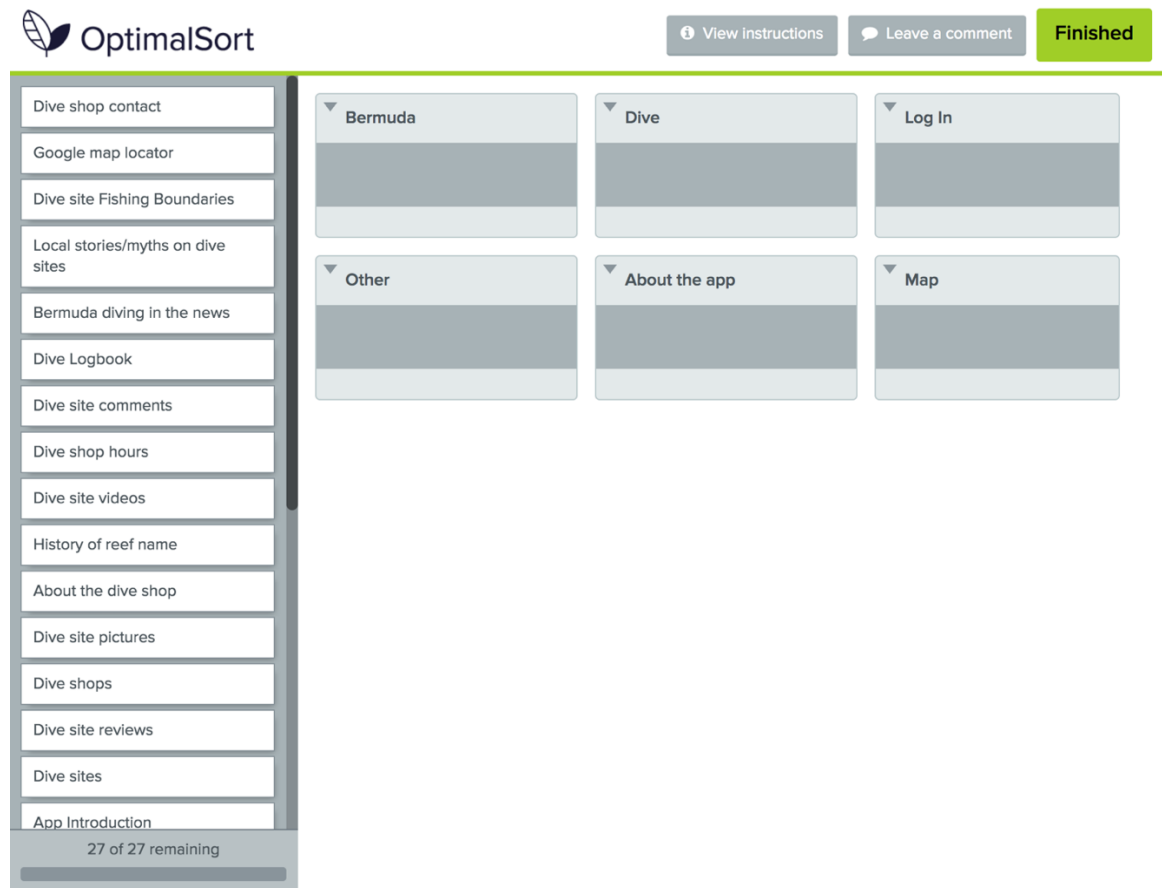


Figure 5. OptimalSort card sorting exercise screenshot.

Through OptimalSort, results were provided by multiple analysis options. A general cards and categories results list was generated to show what cards and how many were put into each respective category. A standardization grid was also used to analyze the data (Figure 6). A standardization grid shows all the cards down the left side of the grid, with the provided categories along the top of the grid. The grid shows the number of participants who chose each category.

## Standardization Grid ?

	About the app	Bermuda	Dive	Log In	Map	Other
About Bermuda		20		2	2	
About the dive shop	1		13			4
App Introduction	19		1	4		
Bermuda diving in the news	1	20	1			2
Bermuda Lionfish program		15	2			7
Dive Logbook			18	2		3
Dive shop contact			14			4
Dive shop hours		1	13			4
Dive shop location	1	1	4		11	1
Dive shop reviews		1	10	1		7
Dive shop services			14			4
Dive shops			11		5	4
Dive site comments			18		2	1
Dive site Fishing Boundaries		7	5		9	1
Dive site history		1	17		2	1
Dive site location		1	5		16	
Dive site pictures		1	16	1	2	
Dive site reviews		1	16	1	1	2
Dive site videos			17		4	
Dive sites		1	13		7	
Google map locator		1			22	1
History of reef name		9	5		2	5
How does the app work?	23			1		
Local stories/myths on dive sites		14	6		1	1
Regularly visited sites by each div...			11	1	3	5
Sign Up/Log In Information	1			22	1	
Social media connection	4			8		10

Figure 6. OptimalSort standardization grid analysis screenshot.

## Personas

Personas were important in the research process as they helped determine how a specific participant would use the app, based on their personality. Three personas were created to gauge an understanding of specific participants using the app. These personas



were created by using the following characteristics; age, gender, occupation, tourist or local to Bermuda, short personal description, motivations, primary goals and a short summary quote. These personas were also accompanied by a user journey, which was how each persona would fulfill a task in the app. The personas help indicate patterns of behavior and to gauge how a “type” may use an app.

These profiles can then be used to help navigate the product experience, highlighting how each persona may interact with the product. Three personas were created during the study; Brittany, an avid diver in her spare time, Gavin, a tourist to Bermuda looking to try something new, and Spencer, a local dive and tour operator. Technical proficiency was rated as low, medium and high. Low proficiency is someone who has a smartphone and is able to use the basic calling applications. Medium proficiency is someone who is comfortable using their smartphone, downloads and uses apps but sometimes needs help from others to understand a new apps functionality. A high level of proficiency is a user that has personalized their smartphone specifically for their individual needs that make their everyday uses easier and more efficient. For example, a user that adjusts settings and downloads third-party apps rather than using the stock apps that come with their smartphones. High level users are also comfortable researching new and improved apps to download and use on a continuous basis to make their lives more efficient, for example, the newest photo editing or budget app.

**Brittany.** Brittany was a busy mom with two young children, Chloe, five, and Jacob, two. Not only did she have a busy schedule at home as a mom she also managed the North Rock Tank at the Aquarium (see Table 2).

Table 2. Brittany’s Go Dive Persona

<p><i>“I love diving and I like to try and go as much as possible outside of work hours during the summer season.”</i></p>	<p><b>Name:</b> Brittany  <b>Occupation:</b> North Rock Tank Manager  <b>Age:</b> 34  <b>Location:</b> Bermuda  <b>Tech Proficiency:</b> Medium</p>
<p><i>“As I am so busy at the Aquarium I need one place where I can go to get as much</i></p>	<p><b>Circumstance:</b> Very busy working long hours at the Aquarium but tries to find time to dive a two-tank dive at least every two weeks.</p>

<i>information about diving opportunities and experiences on the island.”</i>	
<i>“I need a resource that will provide me with up to date information.”</i>	<b>Goals:</b> Find out what dive sites each dive shop is using the most so I can try and book a few dives to dive sites I am interested in.
<b>Prototype:</b> <ul style="list-style-type: none"> <li>Reflects ease of use; minimal clicks to find dive sites</li> <li>App encourages trial use; Brittany won’t need to sign in/up before she browses the app</li> <li>App features all the dive sites available from each of the dive shops as well as shore diving locations</li> </ul>	<p>It is important for Brittany to stay up to date with her diving and certifications. She’s very interested in doing more dive tours to sites she’s never visited but she doesn’t have enough time to research it all. She really needs a resource that will provide her with all of the diving options on the island.</p> <p>By using the GoDive app, she can see at a glance what the most commonly visited dive sites are around the island and if she decides she wants to go with a dive shop she can quickly and easily request a booking through the app.</p>

**Gavin.** Gavin had booked a five day trip to Bermuda for he and his wife in the upcoming month. He was very excited to explore the waters of the island as he had heard great things from many friends who had already vacationed in Bermuda (see Table 3).

Table 3. Gavin’s Go Dive Persona

<i>“As a tourist to Bermuda in a few weeks, I am looking for some great diving opportunities.”</i>	<b>Name:</b> Gavin <b>Occupation:</b> Accountant <b>Age:</b> 48 <b>Location:</b> New Hampshire, USA <b>Tech Proficiency:</b> Medium
	<b>Circumstance:</b> Works full time as an accountant which doesn’t leave much spare time especially in tax season. Is always looking for new places to travel and dive as that is one of his major passions.
<i>“I am a bit of an adrenaline junkie and love to try new experiences when my wife and I go on vacation.”</i>	<b>Goals:</b> To plan ahead of his trip to Bermuda in a month and see what dive and water activities are available on the island for Gavin and his wife.
<b>Prototype:</b> <ul style="list-style-type: none"> <li>1 Step Sign Up Process - 1 sign up to become a member where he can log his dives</li> </ul>	<p>Gavin has booked himself and his wife on a five day trip to Bermuda in a month.</p> <p>Although both Gavin and his wife (a nurse) don’t have much time outside of work they always try to find time to take short vacations as much as possible.</p>

<ul style="list-style-type: none"> <li>• Easy research to view the different dive sites around Bermuda</li> <li>• Easy to find the different dive shops and what sites they frequently visit and being able to view what dive shops will be closest to his hotel</li> <li>• Easy booking requests through the app so a third party or external site does not need to be used</li> </ul>	<p>When they do get a chance to go on vacation they like to do adventurous activities and be outdoors as much as possible. Both Gavin and his wife are master divers and therefore, are looking to do a few dives while they are in Bermuda. They are interested in doing multiple different sites including reefs and wrecks but are unsure what dive shop or tour would be best to go on.</p>
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**Spencer.** Spencer was the dive manager at Fantasea Dive & Watersports, where daily Scuba Dive and Snorkeling tours occurred. During the peak season he was extremely busy with tourists traveling to Bermuda by cruise ship (see Table 4).

Table 4. Spencer's Go Dive Persona

<p><i>"As the manager of the Scuba Diving for Fantasea Dive &amp; Watersports it is important to maintain both local and tourist interest in diving opportunities that we offer on both a daily and seasonal basis."</i></p>	<p><b>Name:</b> Spencer  <b>Occupation:</b> Dive Manager at Fantasea Dive &amp; Watersports  <b>Age:</b> 28  <b>Location:</b> Bermuda  <b>Tech Proficiency:</b> Medium to High</p>
	<p><b>Circumstance:</b> During peak season Spencer works 12 hour days with usually only one day off a week. Cruise ship passengers make up the majority of his clientele but he is trying to build his local and airline tourist clientele.</p>
<p><i>"I want to gain a wider clientele from across the island and maintain Fantasea as one of the top dive operators on the island."</i></p>	<p><b>Goals:</b> To get more tourists from outside the dockyard cruise ship terminals and locals to experience dive tours with Fantasea Dive &amp; Watersports tours.</p>
<p><b>Prototype:</b></p> <ul style="list-style-type: none"> <li>• 2 Step Sign Up Process</li> </ul>	<p>As a full time employee at Fantasea Dive &amp; Watersports the peak season is from April to October where days are at least 10 hours long and days off are rare. In the off-peak season Spencer maintains the</p>

<ul style="list-style-type: none"> <li>• I sign up to become a member where he can create a profile and log his dives</li> <li>• I sign up Fantasea Dive &amp; Watersports as a business and begin building the profile</li> <li>• Keep up to date with any new information other dive shops are posting</li> <li>• Keep active on the shops profile to maintain customer service, review reviews that are being written to make sure any issues are rectified and to update daily dives for users to see their activities</li> </ul>	<p>equipment, boats and business with the possibility of some seasonal tours.</p> <p>As the manager of the Scuba Dive section Spencer needs to maintain Fantasea's high ranking as a business and provide great customer service.</p> <p>He has also recently started thinking about other opportunities to help the business grow and bring in more clientele. He has travelled and dived all over the world and aims to bring some of the things he has experienced elsewhere back to Bermuda to support the experience on the island.</p> <p>Bermuda is known for having some of the most dive sites per square mile. Therefore, divers can experience a lot of different dives without having to travel for hours to get to them.</p>
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## Sitemap

After concluding the card sorting exercise and analysis, a sitemap was created. Sitemaps provide the opportunity to visually see the layout and connections of all the pages within the app. Sitemaps are also known as tree diagrams, where each page is connected by a path to show what virtual pages are connected to one another. It also provides an opportunity to see the entire app and all its pages laid out in one single visual.

## Wireframes

In order to begin design and content research, wireframes needed to be created. A wireframe for each page was created following the sitemaps layout. Wireframes consist of basic shapes and labels for visual element placement for users to get a sense of the apps components and content. The design was in black and white and created in Sketch (Figure 7) then connected through the Invision app (Figure 8) to provide participants with an interactive online product when paper prototyping the wireframes.

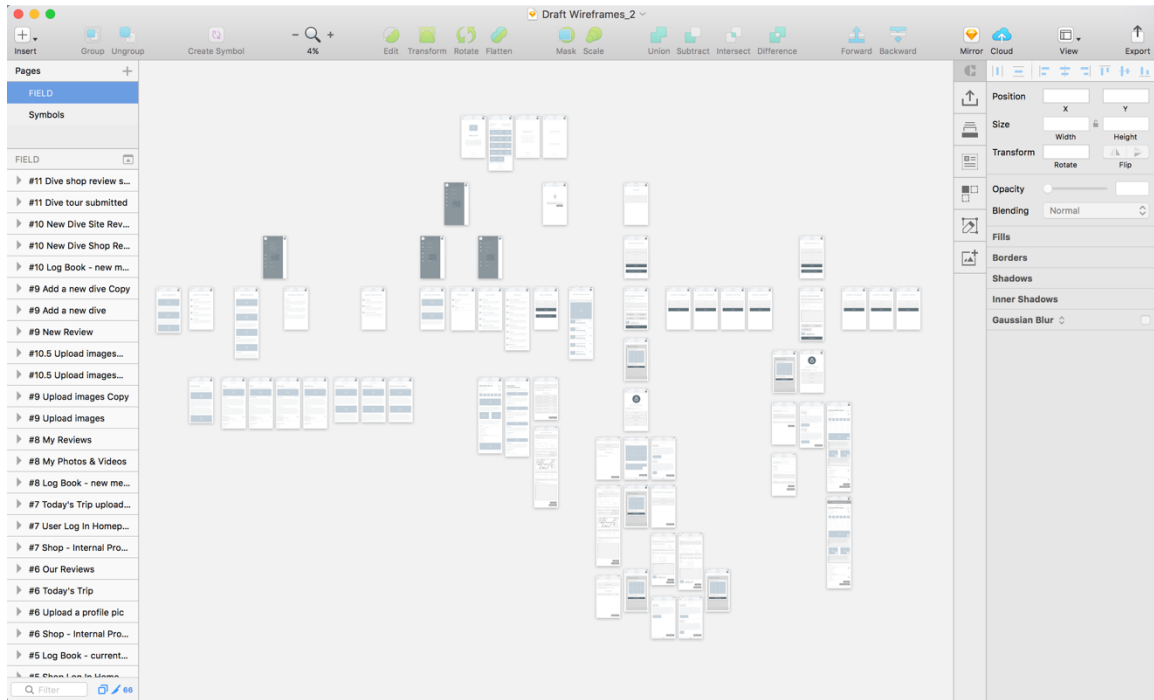


Figure 7. The Sketch program used to create all app wireframes.

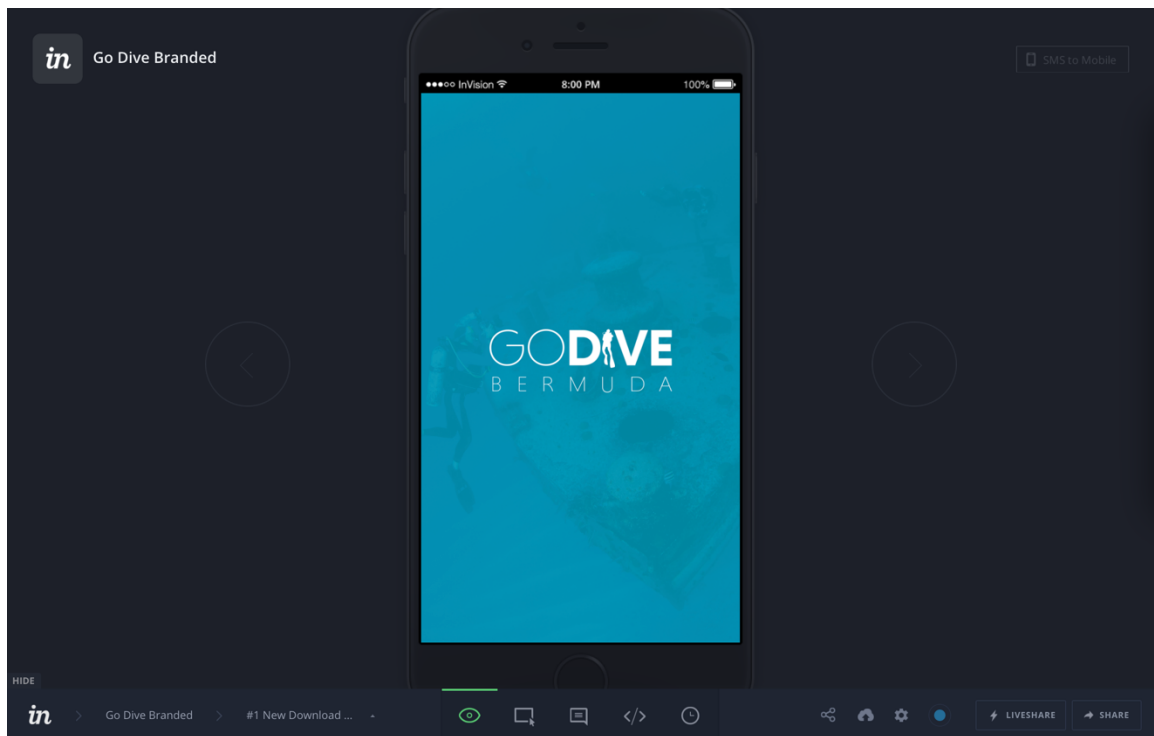


Figure 8. The InVision online app used for all user testing.

## **User Testing**

User testing involved recording 12 individual participants working through five different tasks on the paper prototyped wireframe designed app. Participants were given the five different tasks in writing. They were asked to read the task they were about to perform out loud. They were then asked to complete the task with no direction from the facilitator. Participants were reminded to think out loud with each step they had taken. Similar to paper prototyping, any difficulties or confusion needed to be voiced during the task, which provided feedback for the design. Once the first task was complete, participants moved onto the second task and repeated the process up to the fifth task. Once all the tasks were completed the participant was offered the opportunity to provide any comments or feedback they may have had on the app, then recording and the user test was concluded.

## **Branding**

The majority of the design was dictated by research and participant feedback. After the user tests, a logo and full branding material were created and incorporated into the developed wireframes. After each research stage, feedback was consolidated and evaluated for design aesthetics and function capabilities and designs were developed accordingly before the next research steps.

## **Focus groups**

A focus group was conducted in the final stages of the app development and design. The short review focus group helped in finalizing the functionality and design concept by using participants that would frequently use the app. The focus group included eight participants and began by the moderator introducing herself and explaining the aims of the thesis project and describing the details of the app. Participants then looked at the Invision app prototype where the participants collectively worked through three scenarios. Each scenario made users work through the app in a different

way. Due to unforeseen network issues with Invision functionality on mobile phones, users were required to use a laptop to work through the app together as a group. This helped determine if the information architecture and layout of the app worked for the user. Once the participants had completed all the scenarios, there was a verbal group discussion where participants had the chance to talk about any further thoughts and product development. Any participant thoughts that were brought up during the focus group were taken into consideration during the next and final design and development of the app.

### **Participants**

All participants were required to be between the ages of 18 and 60, both male and female, and have at least a semi active lifestyle. Participants were originally required to have gone scuba diving at least twice to participate. During user testing and development of the app it became evident that non-divers and tourists would be interested in the app to find dive experiences and water activities. Therefore, the two-dive requirement for the participants was eliminated.

### **Instruments**

Research was recorded using QuickTime Pro and Camtasia. Both programs enable webcam recording and screen casting. Adobe Illustrator and Photoshop were used to create the logo, branding, and visuals for the app, before placing them into the Invision program. Invision prototyping program was used to develop the app into a wireframe paper prototype and a fully designed prototype for testing the app.

Communication with the participants was carried out via email, Skype, phone calls, Facebook Messenger, and WhatsApp Messenger.

## Chapter 5: Results

### Study Findings

#### Card Sorting

Card sorting provided a foundation to start from for the creation of the wireframe layout and navigation. Users had options to put the content cards into categorized groups - About the app, Bermuda, Dive, Log In, Map and Other - while they were also given the opportunity to create their own categories if needed. The standardization grid easily determines what cards and how many were placed into each category. For example, 21 users placed the 'About Bermuda' card into the 'Bermuda' category, 2 into the 'Log In' category, and 2 into the 'Map' category. Therefore, the categories for the wireframes were determined according to the standardization grid results as shown in Figure 9.

	About the app	Bermuda	Dive	Log In	Map	Other
About Bermuda		21		2	2	
About the dive shop	1		13			4
App Introduction	20		1	4		
Bermuda diving in the news	1	21	1			2
Bermuda Lionfish program		16	2			7
Dive Logbook			18	2		3
Dive shop contact			14			4
Dive shop hours		1	13			4
Dive shop location	1	1	4		11	1
Dive shop reviews		1	10	1		7
Dive shop services			14			4
Dive shops			11		5	4
Dive site comments			18		2	1
Dive site Fishing Boundaries		7	5		10	1
Dive site history		1	17		2	1
Dive site location		1	5		17	
Dive site pictures		1	16	1	2	
Dive site reviews		1	16	1	1	2
Dive site videos			17		4	
Dive sites		1	13		7	
Google map locator		1			23	1
History of reef name		10	5		2	5
How does the app work?	24			1		
Local stories/myths on dive sites		14	6		1	1
Regularly visited sites by each div...			11	1	3	5
Sign Up/Log In Information	1			23	1	
Social media connection	4			9		10

Figure 9. Results from the standardization grid.





## Study Findings

**Initial set-up/load screens.** In all tests users were presented with an initial download and welcome screen that introduced them to the app. The aim of the introduction screens was to give users a guide for how to use the app. These pages contained a directory of how to navigate the app; menu, profile and search bar (Figure 11). It also provided users with the information they may find within the app. Critique from initial user testing indicated that the pages were too detailed and complicated, resulting in a number of users skipping to the main app and ignoring the introductory information altogether. Users who did not read the initial download page, yet clicked onto the secondary introductory page, found themselves confused as it was a wayfinding page rather than detailed copy to understand what the page was showing. Therefore, the information on the previous download page had been lost to the user, whereas users that skipped the introduction completely, chose to figure out their own navigation and wayfinding. These users generally explored the app more instinctively to find their way around and get a feel for how the app worked before proceeding with the tasks of the test.

Users skipping the introduction suggested that the content and pages needed to be shortened in order for users to be encouraged to read the content. Introductory pages were simplified and content was shortened after user test seven and again after user test twelve (Figure 12). This provided a more inviting set of pages for users to work through rather than skip and get right into the app.



Figure 11. Original download introductory screen.

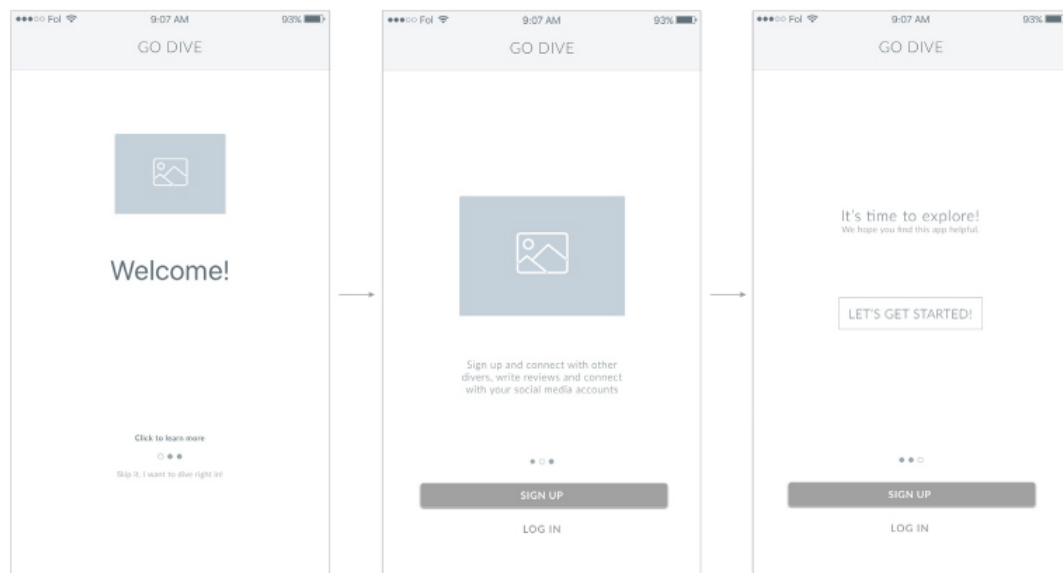
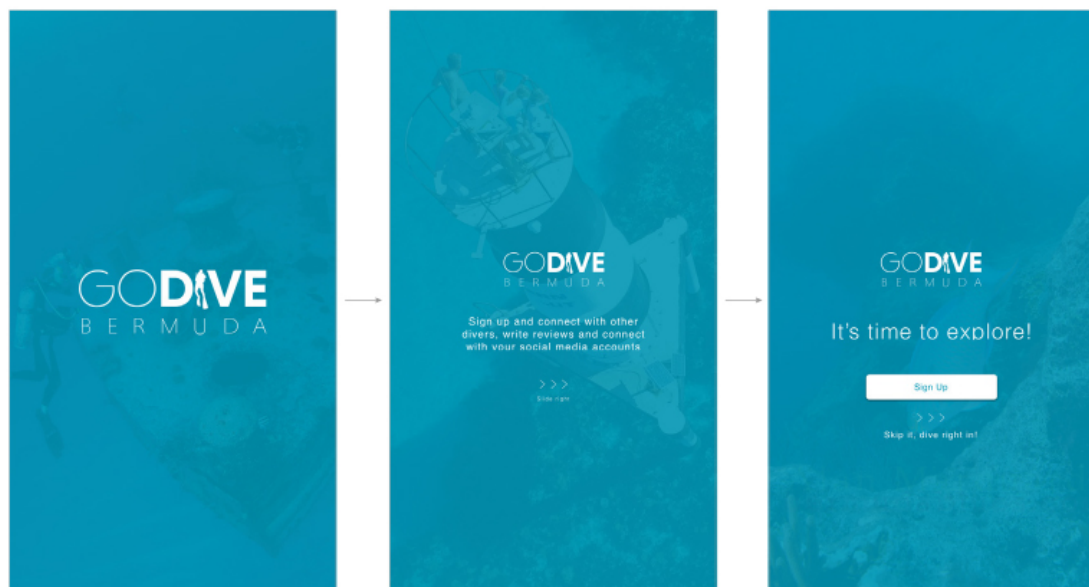


Figure 12. Updated download introductory screen.

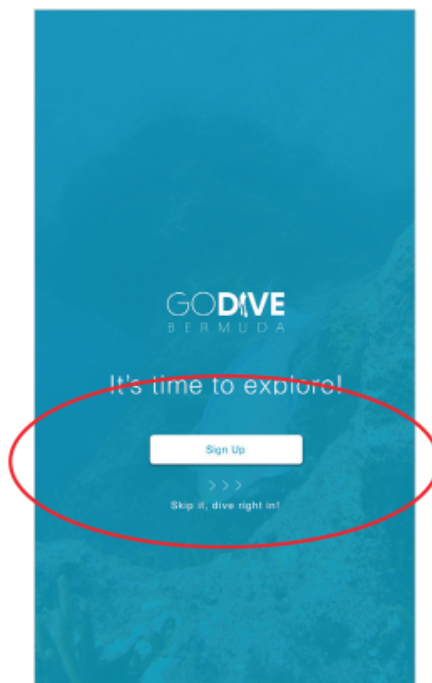
Final user tests and the focus group exercise determined that a simplified set of introductory app download screens for users would suffice (Figure 13). When the user swipes left for the second introductory page they are presented with information about

the Go Dive app. This information tells the user if they sign up they can record their dives, read and write reviews and connect with other divers. The final introductory page introduces the 'Sign Up' button for users that are then interested in becoming members and having an account. Although the aim of the app is to gain as many members to contribute to the app with reviews, diving records and an online community, there is the option on the final introductory page to skip sign up and continue as a guest. Users felt this was extremely important for multiple reasons. If tourists were first time divers or first time visitors to Bermuda and were unsure of their intentions, being able to download and explore the app without commitments would allow them to gain more interest in the content or opportunities that the app offers. Many user test participants vocalized that if apps and websites required them to sign up, they would not sign up, and likely not use the app again. Therefore, they reported being happy with the option to skip signing up.

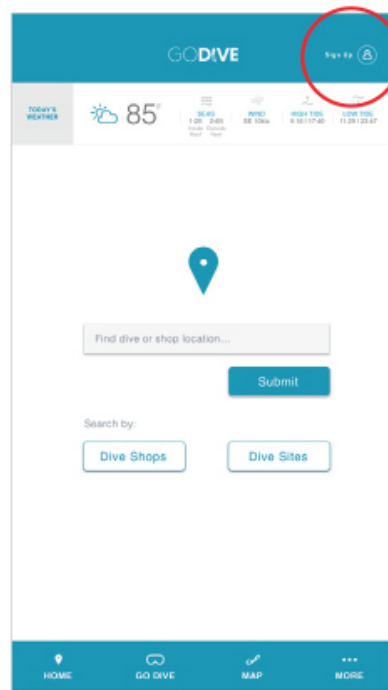


*Figure 13.* Final version of download introductory screens with branding.

**Sign up/Sign in icon.** In order for users to gain complete access to the app, including the ability to write reviews and create a dive log book, they have to create an account. There are two ways to sign up for an account. Firstly, users can immediately sign up on the introductory screens when they first download the app (Figure 14). By choosing this route the user is taken through the sign up forms immediately before accessing the app. Whereas secondly, if the user chooses to skip the initial sign up after download, they have the opportunity to sign up whenever they choose from the top right corner of the screen (Figure 15).



*Figure 14.* Final user initial sign up via the introductory page with branding.



*Figure 15.* Final user sign up via the home page access with branding.

The introductory pages were simplified, making it much easier for users to find the sign up action button. The sign up button was kept on the third introductory screen as the main call to action. All the other information on the introductory pages was deemed unnecessary throughout the user testing as users did not read the information. Removing this information ultimately provided a much stronger and visually appealing welcome for the user. Having less information and a more focused directive, the users began to focus, read the short text and make their sign up decision in a more concise manner than was witnessed in previous user tests.

Of the users that chose to skip the initial sign up process and explore the app, three were unable to associate the icon resembling a person for sign up, or did not see it on the page (Figure 16). One user commented that they looked to see if there was a sign up or if the icon had a 'sign up' pop up when the mouse hovered over the icon so they would know that was the right place, but did not see that. Instead, users would initially go

to the navigation bar or to the settings page to see if it was listed. Users did not relate to the icon as a sign up reference for a profile. Many stated they would need more information, such as words accompanying the icon until they got used to the app. Therefore, the words 'Sign Up' were included next to the icon in the top right corner of the app to provide a stronger wayfinding ability for the user (Figure 16). Users then found it easy to determine where they would go to sign up when they were ready. This also initiated the repetition for users to automatically go to the icon when needing any profile related content, rather than searching through the navigation.

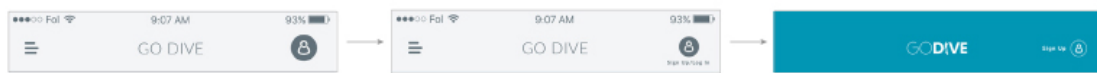


Figure 16. Three stage development of the user profile icon.

Once users decide to sign up via the main app and complete the sign up process the 'Sign Up' text would disappear. The user has now signed up therefore, the written prompt is unnecessary as excessive information confuses the user. Based on user feedback, when the user is signed in, the generic default icon will display and the profile picture the user uploaded when they signed up will appear (Figure 17). Some users may have an individual account as well as a business account, therefore, the ability to sign in and out of both accounts is necessary. When a user has signed out of their account, the 'Sign In' label will reappear with the default icon. For users who have already signed up, when 'Sign Up' is selected there will be a 'Sign In' option alongside it. This will enable users to either re-sign in to their account or if they are creating a new account the user then begins the sign up process again, choosing an individual or business account. This creates another connection for the user to maintain their wayfinding through the app.



Figure 17. Left: A non-signed in user header. Right: A signed in user header.

Users have the option to sign up as either an individual account or a dive shop account. Once they've selected an option, users are asked for their name and email, followed by a final page where they're asked to fill in more information about themselves or the dive shop. The progression for signing up for an individual account is shown in Figure 18.

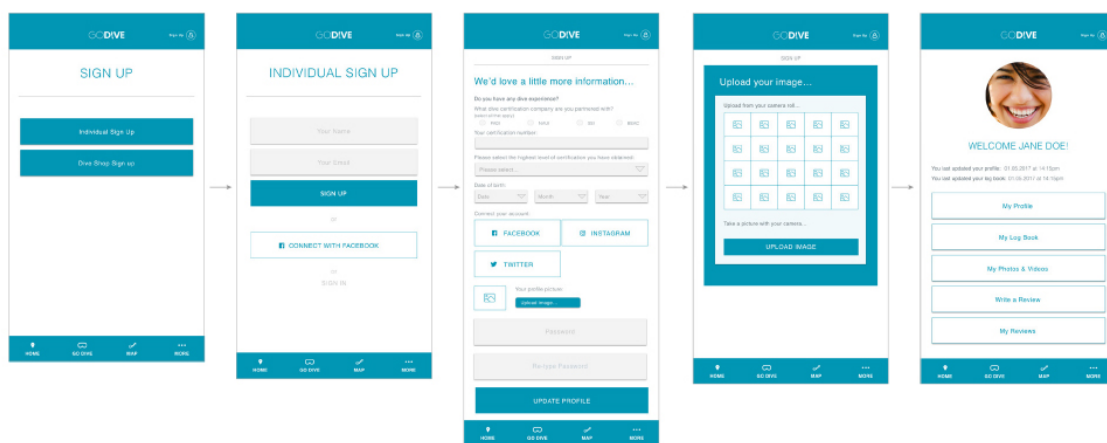


Figure 18. Individual user sign up final progression with branding.

If a user selects the dive shop account sign up, their progress can be seen in figure 19. For the initial sign up process, following the first user test, all users reported that the sign up pages and forms were easy to follow and the questions asked were important and relevant. Three users suggested adding extra content. Thus, for the final version of the dive shop account sign up, the store number and cancellation policy of the dive shop, text insert fields for tour names, and cost and duration of tours were added. For the final version for the individual account sign up, the certification for the British Sub-Aqua Club (BSAC) as a qualification option was added.



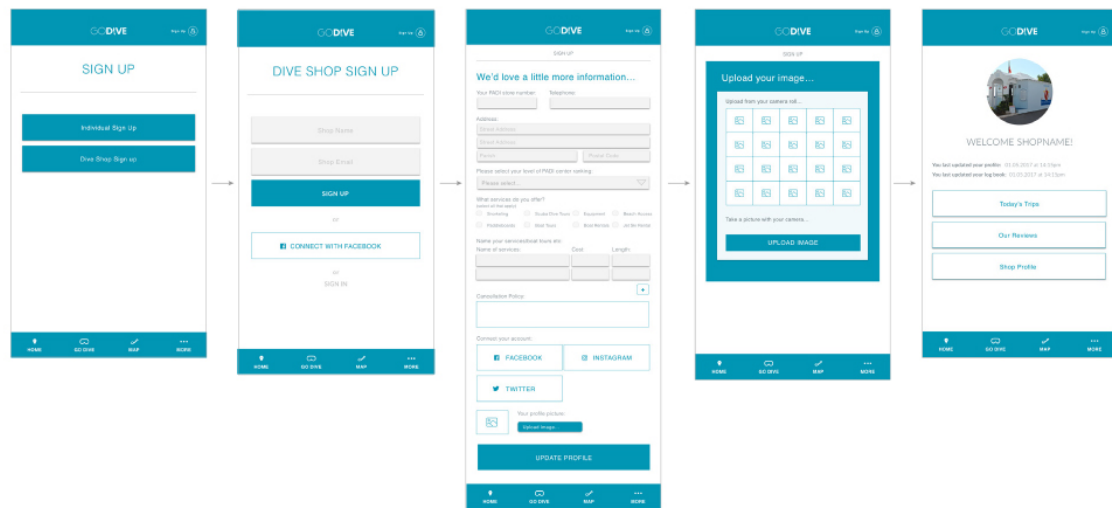


Figure 19. Dive shop account sign up progression with branding.

**Profile Pages.** After signing up for an individual account, users are directed to a personal profile page. Many users found this beneficial and encouraging that the information they previously input would be held in a profile page. Many did not expect there to be a full user profile with all their information displayed. During testing, users suggested a rearrangement of the profile's sub-navigation content – Log Book, My Photos & Videos, My Reviews, and My Profile - suggesting that 'My Profile' should be the first option in the sub-navigation, so that when selecting it, they may view and edit their profile page (Figure 20). User two suggested one other change, which was to have 'Write a Review' under a separate tab rather than its previous location under the 'My Reviews' tab. Users found having 'Write a Review' within the 'My Reviews' page was confusing, as they were unsure if it was only the reviews they had already written, or if it included the capability to write a review. The original profile page was four tabs, whereas the final design consists of five rearranged tabs.

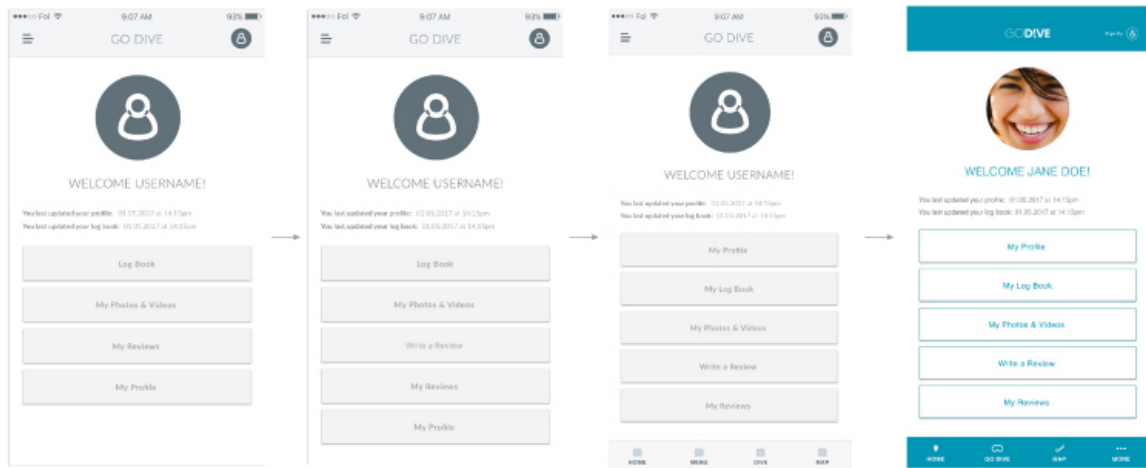


Figure 20. Individual user profile page design progression.

Dive shop profile pages maintained their original content as users found it appealing for the profile to be simple (Figure 21). This is because many shops and their employees may not have much time to update information regularly or input content for the daily trips they may have scheduled. This therefore, reiterates the need for the app to be as quick and easy to navigate as possible in order to encourage continued and frequent use by the dive shops.

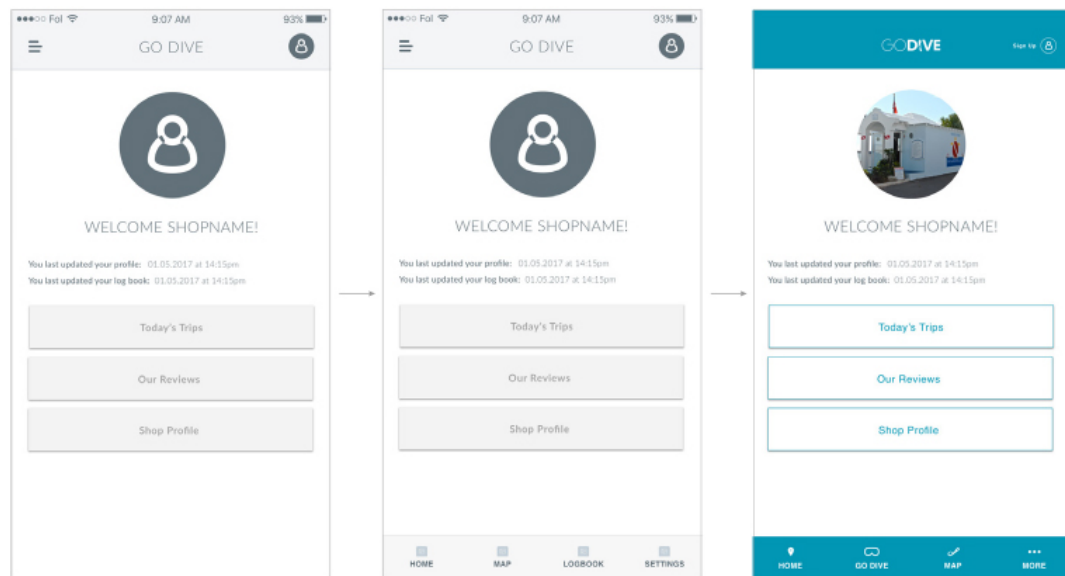


Figure 21. Dive shop profile page design progression.

**Navigation.** The original navigation layout before testing began was from a “hamburger menu” in the top left corner of the screen. A hamburger menu is a reference to a small icon with three horizontal lines, that upon clicking provides a pop out menu showing the navigation headings as originally determined by the card sorting exercise (Figure 22). The card sorting exercise provided vital user feedback on which sub-navigation should go into which navigation headers. Each navigation category had multiple sub-navigations within it provided by the card sorting exercise. As anticipated, navigation content and titles were adjusted throughout the user testing process. Although card sorting creates a strong base in creating the navigation initially, the user testing provided real users’ thoughts that resulted in adjustments to the navigation titles and sub-navigation content.

During the first four tests, a sub-navigation ‘Environmental Programs’ was added under ‘Bermuda’, and the ‘Services’ title under ‘Dive’ changed to ‘PADI, Tours & Services’ (Figure 23). This was a change to help both language flow and adding PADI in order for the content to be easier for the user to find. For non-divers or users unfamiliar

with PADI, including it in the page title told users it is important content. During the next four user tests, navigation titles were refined for better user experience (Figure 24).

During these tests, it was also determined that ‘Rules & Regulations’ would be combined with ‘Environmental Programs’ and be renamed ‘Environmental Protection’ (Figure 24).

During the focus group users were pleased with the branding of the menu that provided visual icons to accompany the menu pages. This helped users determine their decision quicker as the icons provided visual references rather than the user manually reading through the menu options (Figure 25).

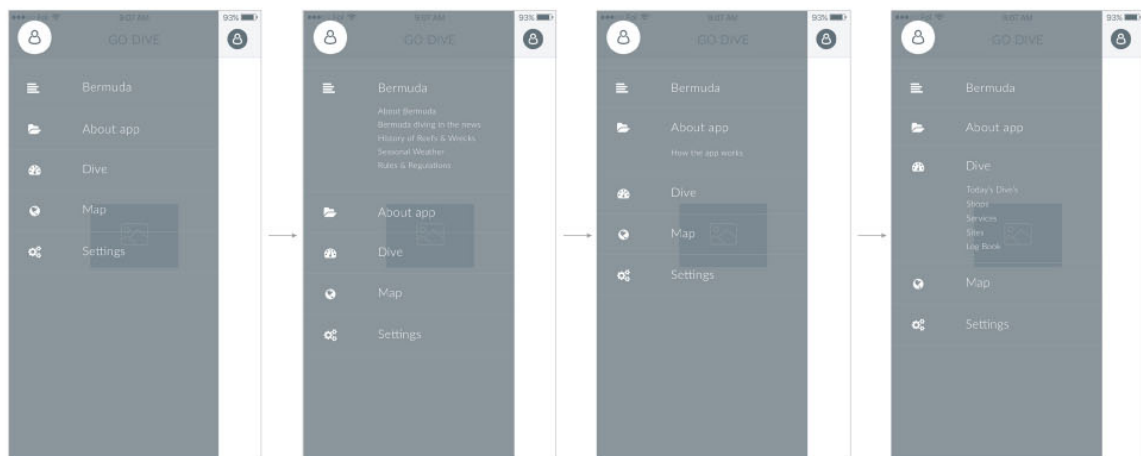


Figure 22. Original hamburger navigation.

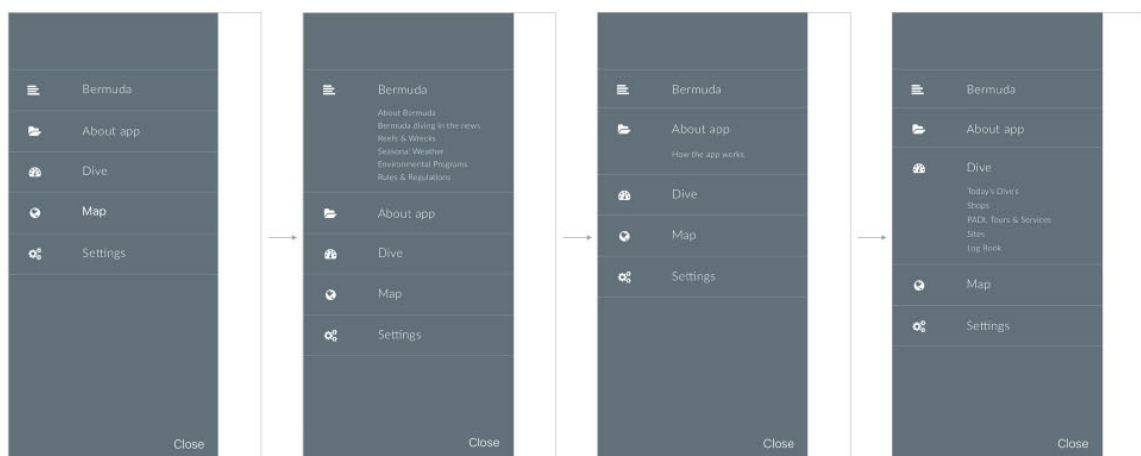


Figure 23. Version two of the hamburger navigation.

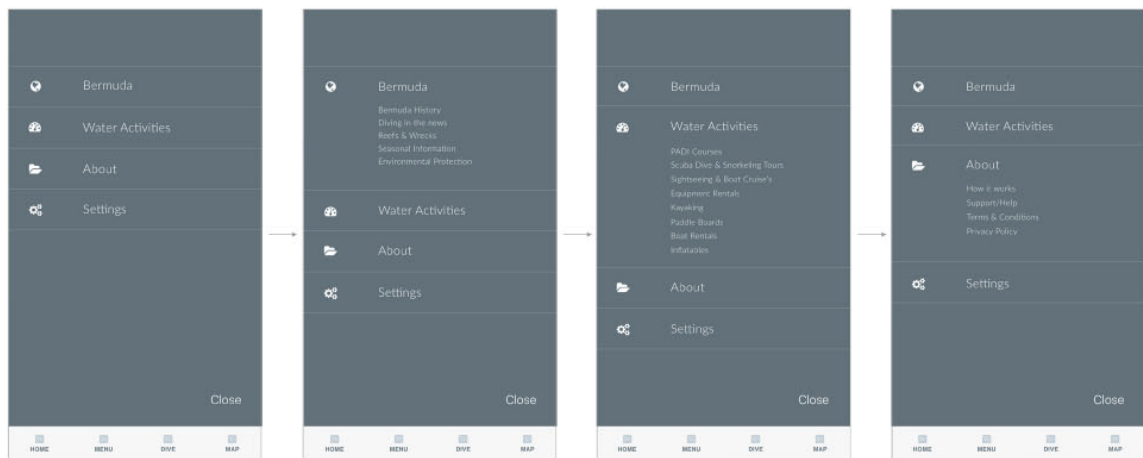


Figure 24. Version three of the hamburger navigation.

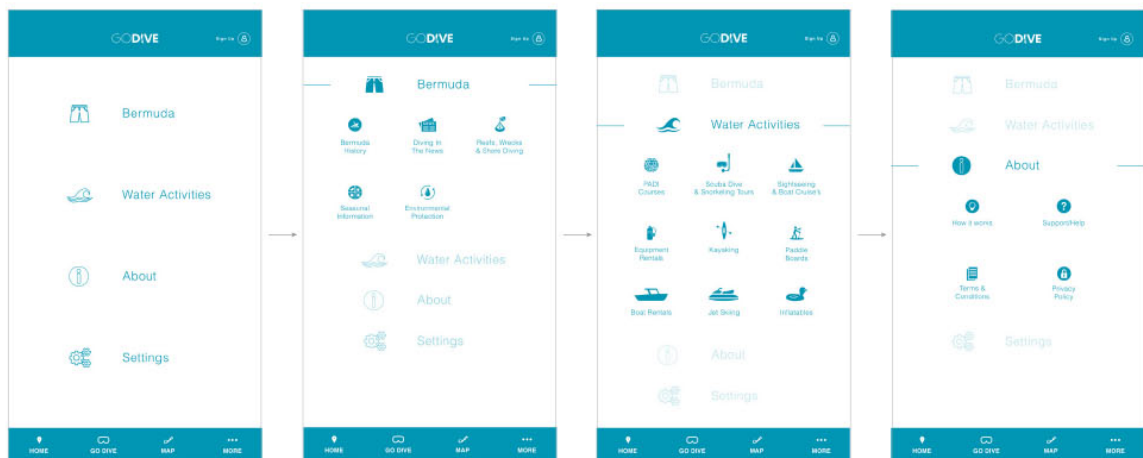
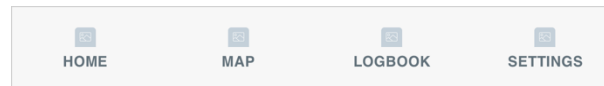


Figure 25. Final hamburger navigation content with branding.

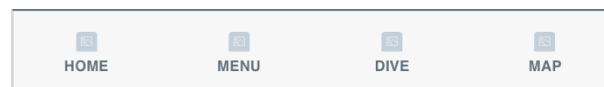
During the first four tests, it was apparent users were not finding the menu via the hamburger icon at the top left of their screen as easily as was intended. Therefore, a menu bar along the bottom of the screen was added as a static footer bar after user four (Figure 26). The hamburger menu was maintained for the edited navigation, with the additional footer navigation supplementing it, by adding a Home, Map, Logbook and Settings button. The Home button directed users to the initial search page. Map pointed to the interactive map which shows all the dive sites and shops around the island. The Logbook tab gave users a single tap access to their logbook for easy input after each dive they

completed. Settings completed the footer navigation as many users expressed the desire to go directly to the settings page after initial download to fix their settings, such as notifications and sounds.



*Figure 26.* Original footer navigation.

With the new footer navigation and initial hamburger menu in place two more user tests were conducted. Both users chose to work with the hamburger menu while not interacting with the footer menu at all. One user reported at the end of their test that they would suggest better navigation categories on the footer menu. The footer navigation was then changed to Home, Menu, Dive and Map (Figure 27).



*Figure 27.* Version two of the footer navigation.

The Home and Map tabs maintained the same linked pages as before, yet moved locations. The menu tab replaced the hamburger menu, and the Dive tab directed to a newly created Dive page that combined all the dive related content together (Figure 30).

During user tests six to ten, users still struggled with working with a main navigation and the hamburger as a second navigation, although two users reported that after using the app for a few minutes they eventually found their way around. By test eleven, the footer navigation was edited for a final time, resulting in the footer reading; Home, Go Dive, Map and More (Figure 28). The Dive tab was renamed to Go Dive and moved from the third to second position, Map moved from the fourth to third tab, and More became the final tab. The More tab was linked to the hamburger icon menu, but as users were now only using the footer navigation, the hamburger icon was eliminated. This navigation provided access to all the same content the original hamburger icon did, but in an easier, clearer and more user-friendly way (Figure 29).

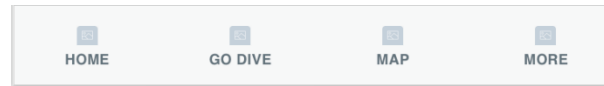


Figure 28. Version three of the footer branding.

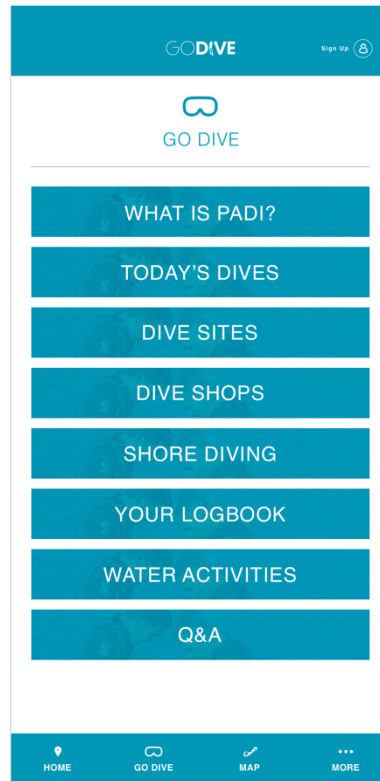


Figure 29. Final footer navigation with branding.

In addition to the main navigation development, sub-navigation titles were edited, consolidated or rearranged to a more appropriate category throughout the user testing. Changes from the first user test to the final focus group were developed as shown through four different stages of updates (Figure 22-25).

It was observed during testing that users were unable to understand the concept of the 'Dive' navigation easily. The 'Go Dive' category was created for dive enthusiasts, and focused on dive information only, but due to many dive shops providing water activities and other excursions it became apparent that water activities information needed to be included. Therefore, the final navigation includes 'Water Activities' under the 'More' button, and also a link from within the 'Go Dive' page (Figure 30).

From the main footer navigation, 'Go Dive' offers quick access to all the dive related material. The Go Dive tab opens a list that was originally listed under 'Dive' in the hamburger menu with various links to dive information, also including 'Your Logbook', 'Water Activities', and a 'Q&A' which provides users with answers to dive questions they may have (Figure 30). This page consolidates all the dive related material, thereby allowing users to find information in fewer page clicks.



*Figure 30.* Final ‘Go Dive’ menu with branding.

The original navigation had an ‘About App’ with a sub-navigation of ‘How the App Works’. The user testing provided context that this section needed to be developed. Participants recommended that ‘How It Works’, ‘Support/Help’, ‘Terms & Conditions’, and ‘Privacy Policy’ became the new pages under the ‘About’ section, creating a more effective product which contained the required information only. There was no unnecessary information to distract or confuse the user (Figure 31).



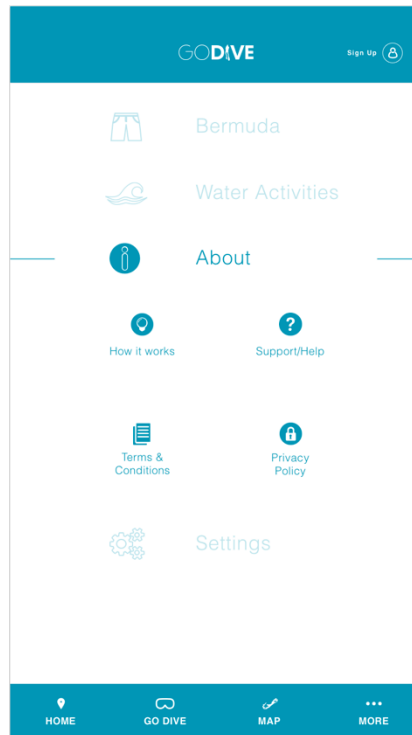


Figure 31. Final ‘About’ navigation screen with branding.

During the focus group, users found the footer menu to be quick and easy to navigate the entire app. All tasks were completed using the main footer navigation without trouble locating anything.

**Home Page.** The original home page for the app provided users with a search bar and submit button. Although the app has many levels of information for users who are interested, it was important to keep the home page as simple as possible for users that just need to come and search a dive site, dive shop or business quickly. After the first user test, it was evident that some users may not know what they were searching for, let alone a name or place to type into the search bar. Therefore, incorporation of two buttons that users could search by, Dive Shops or Dive Sites was added to the home screen (Figure 32). Users found this very useful on multiple occasions, reporting they would use the two buttons a lot when browsing, or if unsure of exactly what they were looking for.

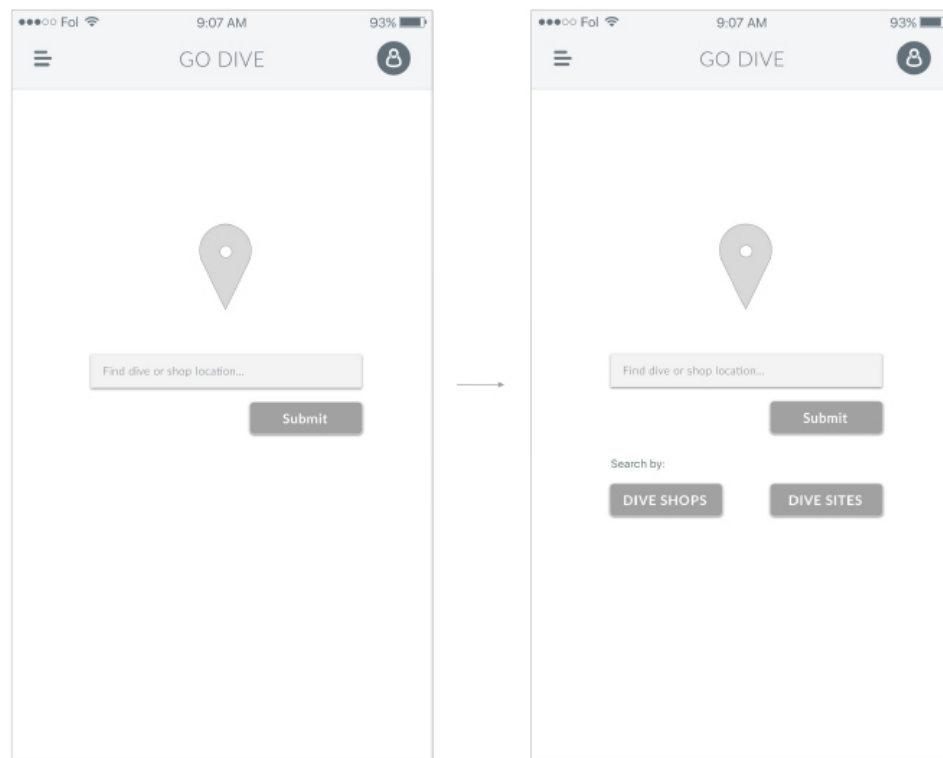


Figure 32. Original and version two of the 'Home' screen development.

Throughout the testing users found the home page simple and easy to use. During user test nine, the user mentioned wanting to see what the current weather was. As this content was not in the app the user suggested it would be good for it to be located on the home page or somewhere simple and obvious where the user didn't have to look for it. Following the ninth user test the daily weather was added to the top of home page screen. The information shown included the weather conditions (sun, cloud, rain, etc.) and weather variables such as wind direction and speed, high and low tide times and seas inside and outside of the reef. Following this addition to the home page the final three users and the focus group commented that the daily weather on the home page was of added benefit.

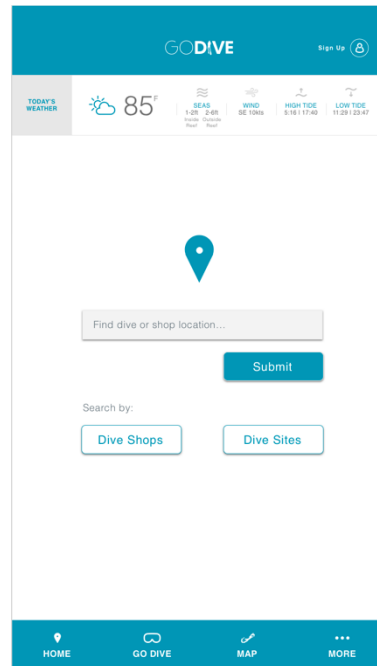


Figure 33. Final 'Home' screen with branding.

**Interactive Map.** An interactive map will be available for users to search all dive sites, dive shops and other related businesses such as The Aquarium, Bermuda Institute of Ocean Sciences (BIOS) and Bermuda Underwater Exploration Institute (BUEI) (Figure 34). Users can actively zoom in, zoom out or select a point on the map to find out more information. This functionality is a benefit for users not comfortable using the search bar. The interactive map capability was built in from the beginning of user tests and maintained its functionality throughout. However, due to wireframe capabilities the interactive map was unable to be tested as intended during user testing.

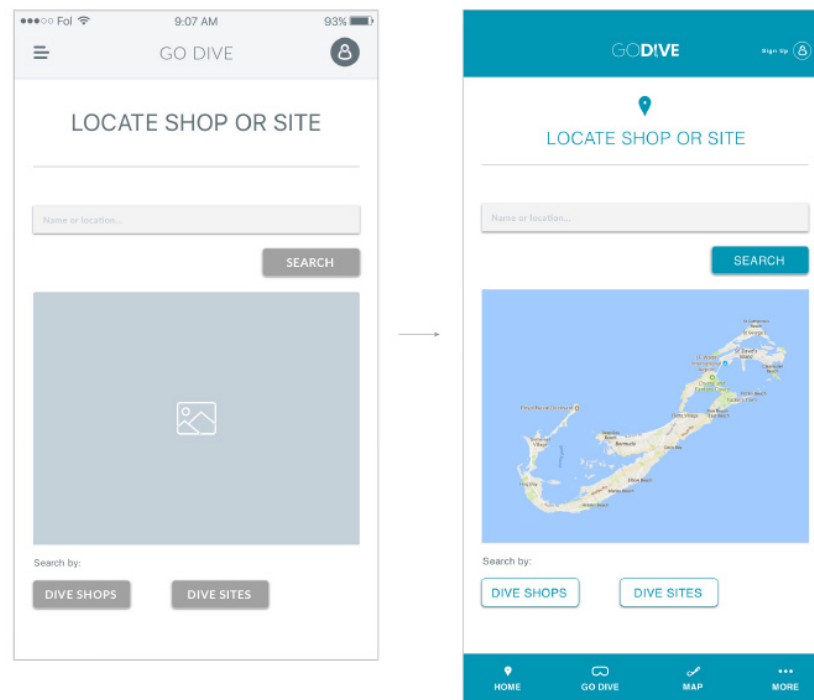


Figure 34. Original and final version of interactive ‘Map’ screen development.

**Dive Shop/Site Pages.** The information pages for both dive shops and dive sites were considered to be among the most important pages within the app. These pages aimed to provide as much information as possible in an easy and digestible way for the viewer. Dive shop listings were accessible via two different avenues. Users could either access them from the dive shops list under the ‘Go Dive’ navigation tab (Figure 35), or through the ‘Map’ tab where users could select a list of dive shops or dive sites rather than a specific search (Figure 36). Dive shop pages included contact information, services, picture gallery, and dive sites often visited (Figure 37). Many users mentioned the need for wanting a lot of imagery to look at on both the dive site and shop pages to get a feel for what they are most interested in. Users also recommended incorporating a shore diving section to each shop's profile. If users were interested in doing any shore diving, they were more likely to go to the shops pages to see if they offered shore diving, versus looking for a shore diving page specifically. Users also mentioned their interest in

being able to read reviews directly on the profile page rather than having to enter a 'Reviews' page.

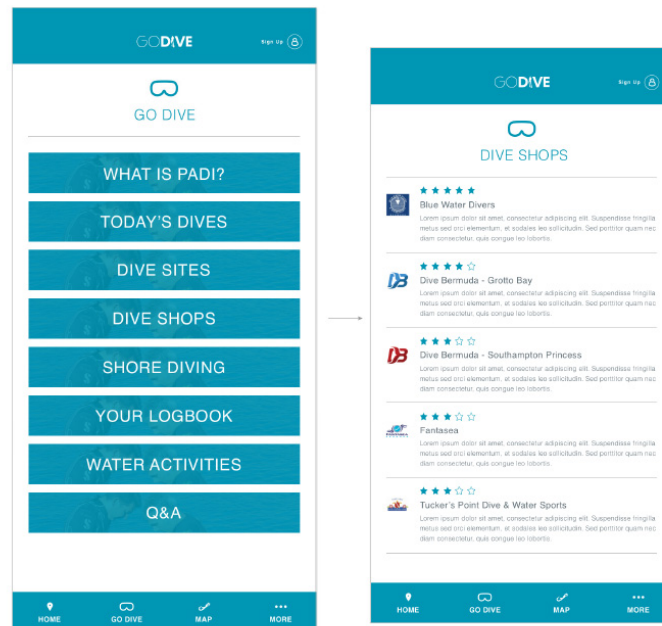


Figure 35. Final dive shop list from the 'Go Dive' tab with branding.

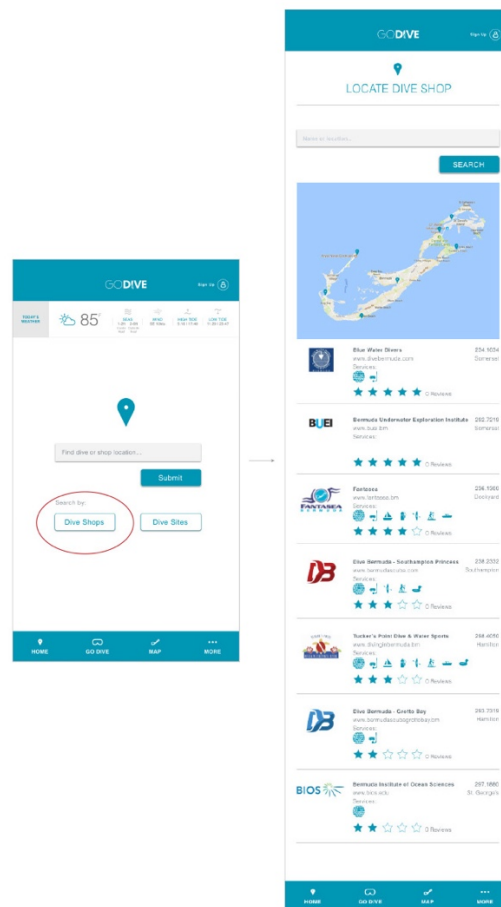


Figure 36. Final dive shop list from the dive shop search option through the 'Map' tab with branding.

## Mobile app development: The effect of smartphones, mobile applications and geolocation services on the tourist experience 60

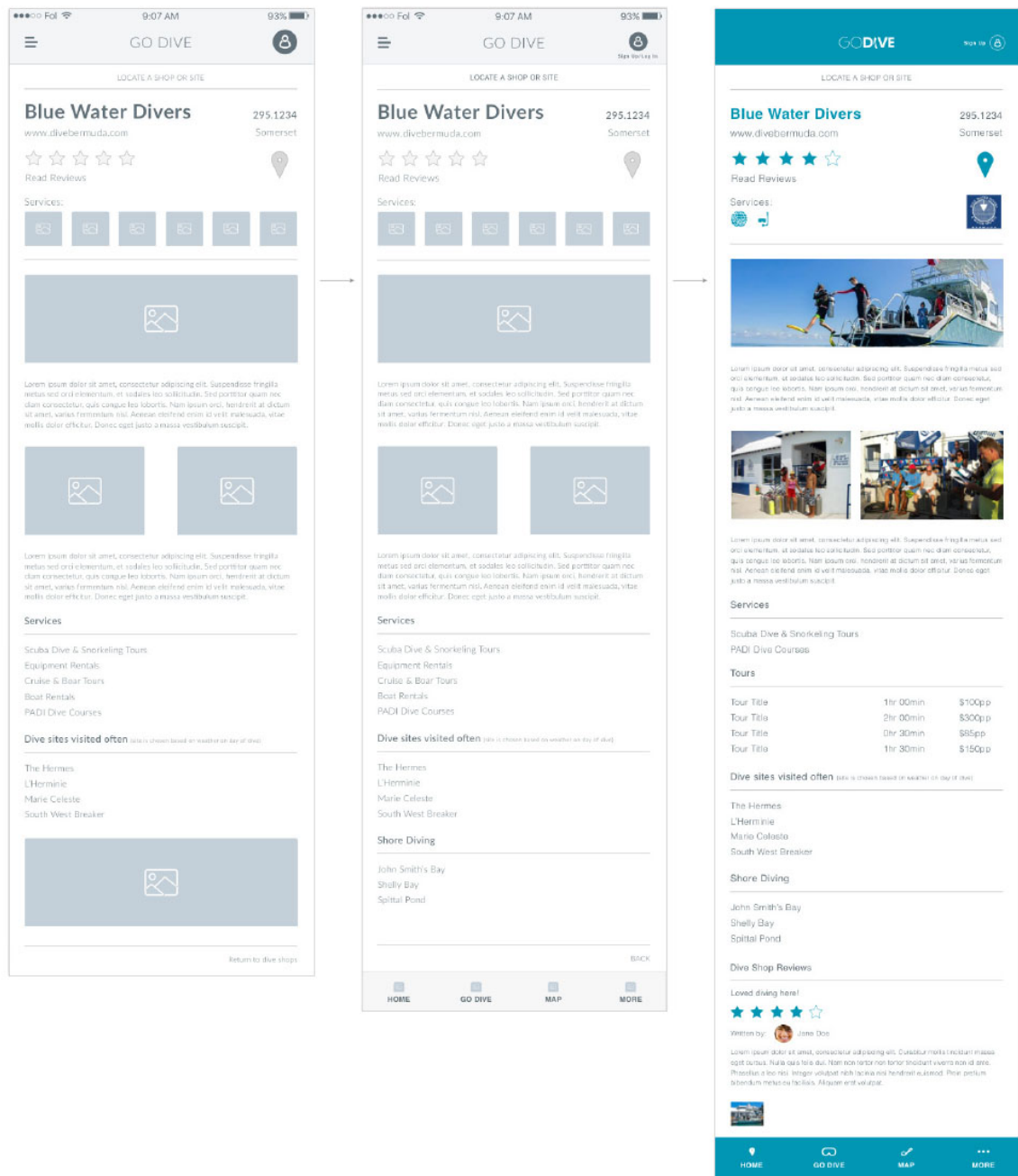


Figure 37. Dive shop profile progression.

Since the dive site pages hold a lot of information, it was important to provide the user with an easily digestible platform to read. The original wireframe consisted of

wrecks and reefs having titled pages each with the appropriate sites listed on a single page consecutively (Figure 38).



Figure 38. Original wrecks and reefs wireframe for user testing.



Users found some of the information to be helpful. However, a suggestion was made to include a 'what to expect at this site' (Figure 38), to give users more information and insight on what to expect at each dive site in preparation for their dive. Users also voiced interest in including dive site reviews directly on the dive site page, just as they had for the dive shop page. While watching users interact with the app through the testing it was observed that creating single pages for each dive site was necessary (Figure 40). Therefore, each dive site became its own page, with summary pages for each type of dive site - reefs, wrecks and shore diving - where each site was individually listed with an image for the user to easily review. Users found this layout with the gridded images and titles more visually appealing and exciting. It was easy for users to find the dive site they were looking for.

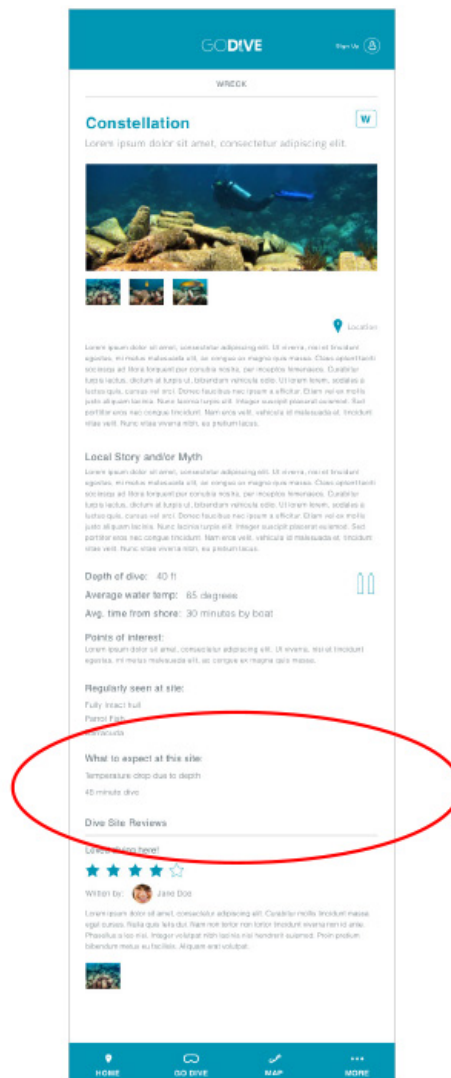


Figure 39. ‘What to expect at this site’ added to the dive site profile pages with branding.

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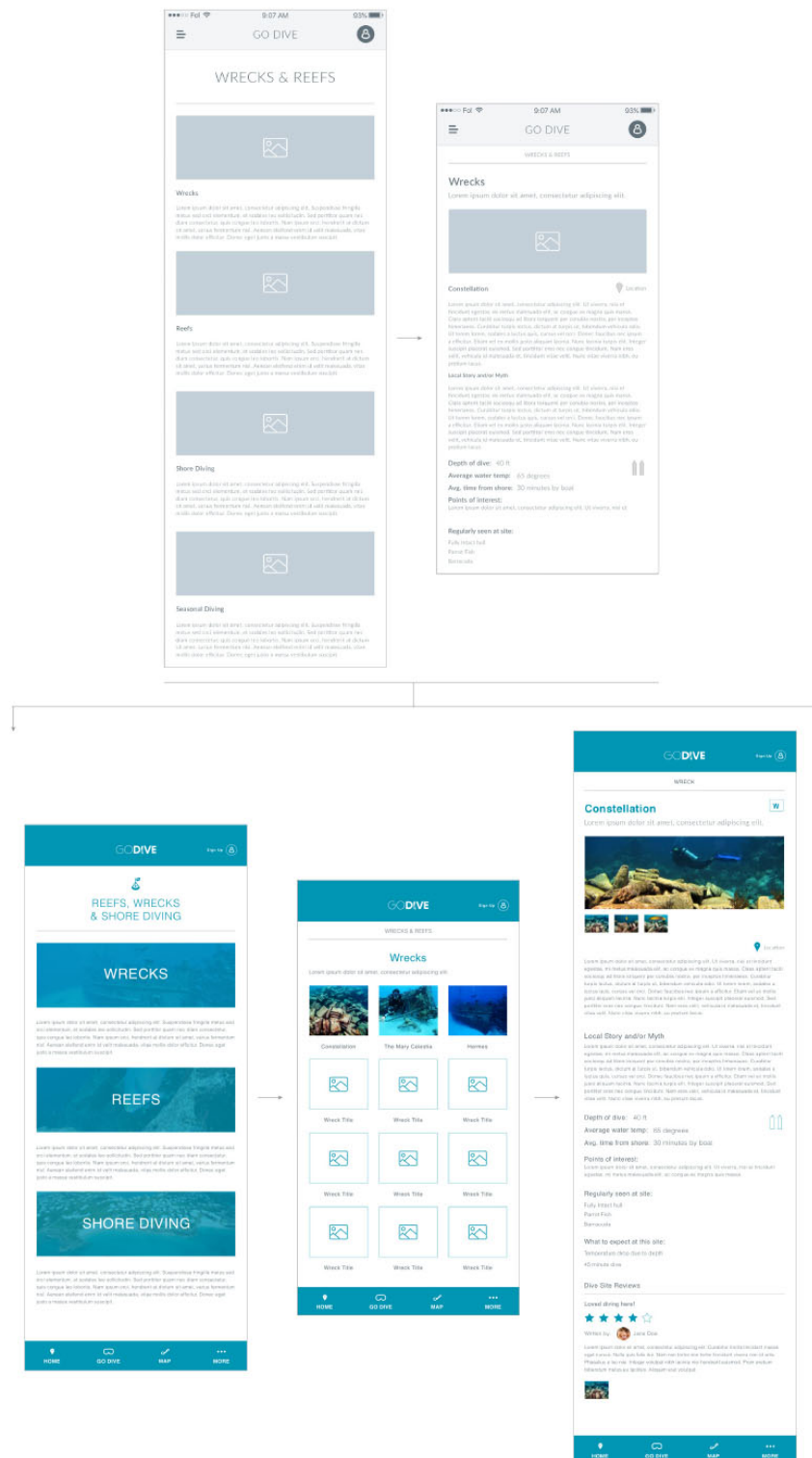


Figure 40. Dive site profile development.

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In order for users to have better wayfinding within the dive site categories an icon system was created. Icons were created that referenced each type of dive site (Figure 41) which was then added to the site's profile for reference. These icons were also included as a legend on the interactive map page (Figure 41) for users to be able to select the type of site they may be looking for. These icons, when selected, would therefore eliminate the other sites on the map to give the user specific information that they could use.

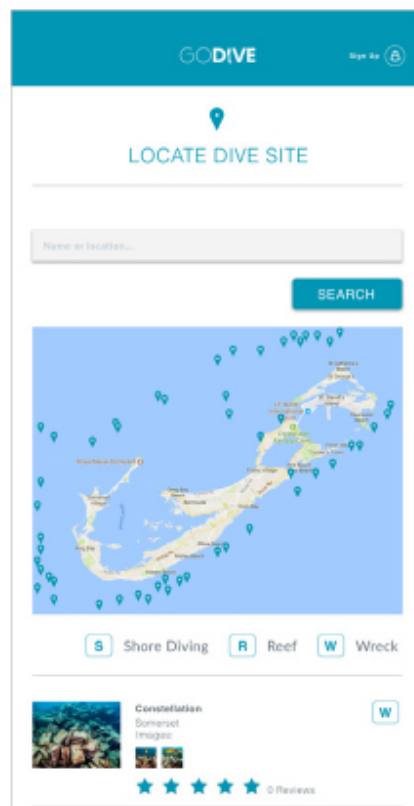


Figure 41. Dive site icon references with branding.

**Reviews.** Reviews were not in the original app wireframe at the beginning of testing. User eight recommended adding in reviews to all the dive site pages to help give users real world insight into personal experiences (Figure 42). Users with profiles are able to write a review where they can rate the experience out of five stars, write a short review and upload up to two images or videos per review (Figure 44). This suggestion

was mentioned and discussed in the focus group. Following the discussion, it was recommended that all reviews posted could be listed in their ranking order by dive sites or shops respectively due to their review ratings (Figure 43).



Figure 42. Dive site reviews with branding.

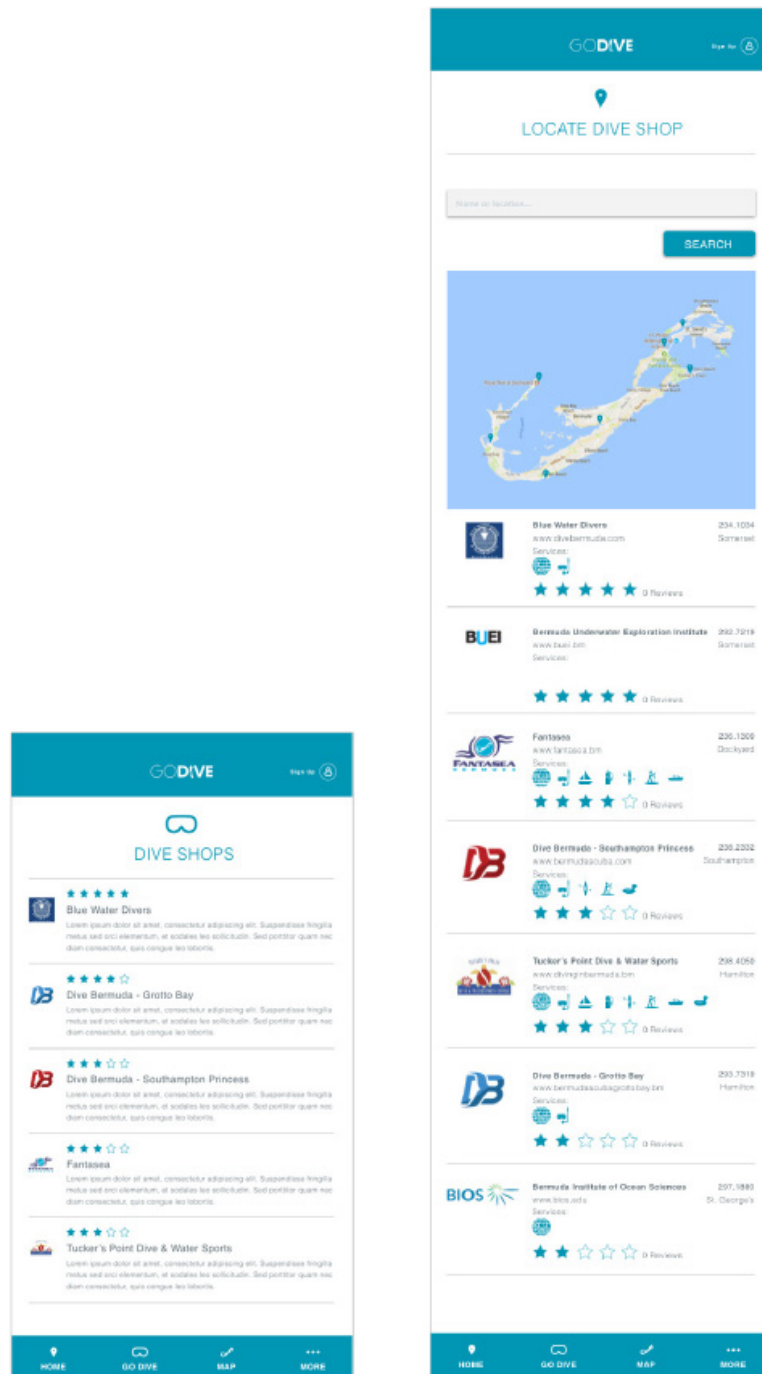


Figure 43. Dive shop reviews determining the order the shops are listed with branding.

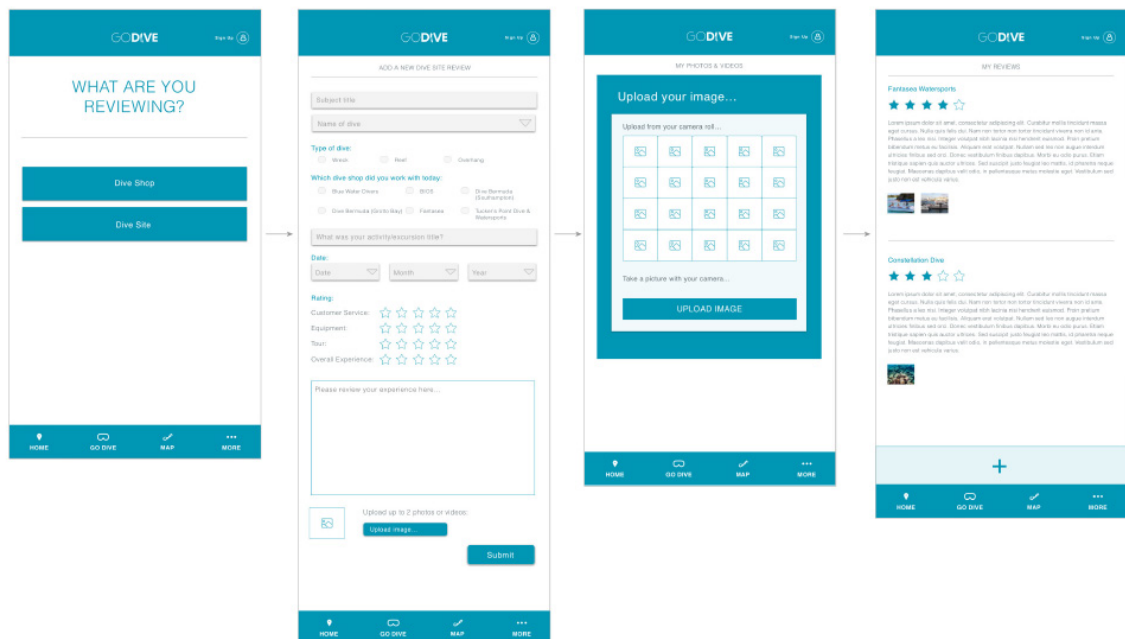


Figure 44. Writing a review.

In summary, the card sorting exercise created an initial base for the wireframes to start from. After each user test, edits were made to the app based on comments and feedback provided during the tests. 12 user tests were completed therefore, 12 rounds of edits were made to the wireframes. Not all areas received edits or development after every user test. The fully branded and designed app was then developed in preparation for the final focus group testing. The focus group provided feedback on what worked well, as well as talking about additional elements they would like to see to make their experience more valuable.

## Chapter 6: Discussion

Throughout the user testing process, constant development took place where participant feedback was considered and improvements were made. Through 12 user tests and a single focus group of eight participants, the Go Dive app saw 13 alterations. However, not all of the app was edited after every user test. Many sections received between three or four design alterations, eventually resulting in the final branded form of the app. The key areas that needed changes were the introductory screens, sign up icon, navigation, profile page sub-navigation, home page, interactive map and the dive shop and dive sites profile pages.

**Initial Download Screens.** It was determined that participants required less information when they first downloaded the app and were greeted with the welcome pages. The pages provided too much information, prompting some users to skip them. Thus, providing users with simplified pages that contain visuals, one sentence of information and a progress indicator to show page progression, encouraged focus on reading through the welcome pages without confusion.

Users found it appealing that they were not required to sign up and have an account with many stating they would not move further with the app if sign up or giving their email was necessary to continue. It is thought that the app would therefore retain more users, with the possibility of those users eventually creating accounts. Requiring email submission or sign up may provide contact details for companies to use during marketing and data collections, but can ultimately lose the user group if they are initially unready to submit their details. This information is important in helping to grow a user base for the app.

**Sign Up Icon.** The need for icons was a key finding during the user testing. Users were unable to relate to the original sign up icon by itself, resulting in users not using that functionality and looking for it elsewhere within the app. Providing users with a sign up label to accompany the icon for easier wayfinding for users new to the app, eliminated



the confusion of finding where to sign up. Once users had signed in, the visual design element to remove the 'Sign Up' label and replace the generic icon with the users uploaded profile picture, was easier for users to relate to and gave them an immediate sense of where to locate their profile. However, it is believed an important design element to have the 'Sign In' label return to the icon if a user signs out of their account. This is to ensure that a new user on a device that has already signed in to the app (eg. public computer, friend's phone, etc.), receives the same ease of wayfinding as any current user, regardless of device.

The ease of switching between accounts in the app is important as some users may be required to have access to multiple accounts, and may find the time to complete a task integral in their decision to use the app. Therefore, the design of a simple sign in and out for users is imperative for a smooth and quick transition.

**Navigation.** The navigation development during the testing was one of the areas with the most development in terms of content, design and functionality. The hamburger menu was used in the original wireframe menu. It was evident through the testing that content rearranging and navigation titles needed to be developed and changed multiple times to find the right titles for users to immediately understand. The content and title changes impacted users understanding of the navigation but the hamburger menu did not work smoothly enough and was too content heavy. Popular apps such as Facebook and Instagram both have footer navigations where users only interact with the bottom navigation to access other pages. A footer navigation was added to relieve some of the content from the hamburger menu. During the transition period where both menus were being used, the user tests provided key insight on further developing the navigation to the single footer bar. Simplification and more direct titles provided users with a final navigation that was reported to be easy to use to complete the required tasks during the testing. User testing revealed that content needed to be titled with consideration for international users who were not familiar with local programs or names. For example,

“The Lionfish Program”, which is a local environmental program, was unclear to non-locals. The user testing provided vital feedback for the design development of the app.

The aim throughout the design process of the app was to give users the ability to find the information they are looking for in the least number of clicks or amount of time possible. The creation of visual icons for the navigation in the final design phase of the app provides users with visual references to content. Bellman et al. (2011), stated that app development that is branded and designed well results in higher levels of engagement by users. During the focus group, the users found the icons helped the visual ease of the page to the eye and ultimately helped them make quicker decisions as they did not need to read content when visual references were available.

**Profile Page Navigation.** Users expressed how the order of their profile page sub-navigation worked best for them, which influenced changes that helped following users use the navigation without confusion. A significant change was made to the design when a user suggested separating 'Write a Review' from the 'Reviews' tab in the individual user profile. The user stated that they would not think to go into the 'Reviews' tab to write a review, and that adding an additional sub-navigation for “Write a Review” would create less confusion, and ultimately fewer clicks for the user. Design incorporation based on this feedback created a positive response in subsequent tests, where users reported that it was easy to navigate all areas of their profile page.

The dive shop profile page was designed to provide the user with the least number of clicks and information as possible, as time was frequently mentioned as an element of importance when using the app. It was reported that giving the shop profile only three sub-navigation items, with only two requiring input, would allow employees to quickly update "Today's Dives" if necessary. It was essential to keep the dive shop profile as simplified as possible as users that worked in the dive community reported that they would not spend much time on editing or working in the app. Therefore, providing simplicity was key in maintaining interest for this user group.

**Home Page.** The design development of the home page created easier search options for users and still maintained simplicity. One user commented that they would not have known what to type in the search bar so they would have liked to have been able to do a more generalized search for dive shops or sites. Two buttons were added on the home page for search capabilities for users that may not want to input their own content, but instead search all the dive shops or sites in Bermuda generically. These design elements were included, yet did not complicate the simplicity of the home page design, as it simplified the user journey by adding an additional click, but cutting out their requirement to know what keywords were best to search.

The weather forecast became a fixed design element that is continuously updated in real time. Two users mentioned their interest in wanting the daily weather on hand in the app. Requiring users to search for this information would create frustration when a simple design solution would suffice. Cantoni et al. (2010), stated that the need for instantaneous information and real time results is what tourists now expect. Placing a static daily weather banner on the home page where users could quickly view and move on with their task from the home page, provided users with simple, yet important information immediately on the home page. This was especially beneficial for the tour operators and people who worked in the marine field who wish to get up to date information on the go. The focus group also mentioned they were happy to see the weather information directly on the home page.

**Interactive Map.** The interactive map function was unable to be user tested along with the rest of the app due to development capabilities of the prototype. However, due to a GPS and technology lag in Bermuda, many interactive maps may not be reliable. Therefore, it is imperative in design development and app development that the map's Application Programming Interface (API) is accurate for not only the land base content but the reefs and wrecks surrounding the island. Cantoni et al. (2010), stated that delivering location based services are crucial in mobile technology now. Therefore, the

misplacement of these dive site locations would provide users with the incorrect information and render the app inadequate for their needs.

**Dive Shop/Site Pages.** User testing provided confirmation that imagery should be the initial focus of the profile pages for the dive shops and dive sites. Users mentioned that they always look at the pictures on travel sites first. Thus, designing the profile pages with the images first and foremost was important.

Dive shop and dive site reviews were originally included on the profile page as a link for users to click to be taken to the review page of the viewed profile. During testing users reported that they would prefer the reviews directly on the profile page. This design change eliminated extra clicks for the user and provided them with the key information they were looking for directly all on the profile page.

The dive sites section of the app evolved multiple times throughout user testing. The original design was for users to enter the dive sites page, which provided a sub-navigation of wrecks, reefs and shore diving. Clicking on wrecks directed users to a single list of all the wrecks around Bermuda. This layout created heavy content pages for users and did not provide them with a simple way to find a dive site. Design changes were made to provide users with a further sub-navigation list within each dive category (wrecks, reefs and shore diving) where the dive sites are listed by their name with an accompanying image. Users were then able to enter the specific profile page of the dive site they were interested in which provided them with simplified content that served their needs better. Although this design layout required users to make extra clicks, it simplified content heavy pages that users would likely not have maintained engagement with.

During the final user tests and branding development, wayfinding icons were included for the dive sites. These icons—small rounded squares with the letter W, R or S for wrecks, reefs and shore diving respectively—were placed both on the interactive map page for users to select an icon if they only wanted to view a specific site, and on each profile page. The icons helped provide users with reference points for them to use to as necessary. Icons proved important for better user wayfinding and helped users associate

content with related content within different pages of the app. These design elements allow users to maintain their attention on their original task rather than spending time trying to figure out the content.

In summary, providing users with the easiest and simplest design solutions for the content, in order to maintain interest and return visits, is key in user testing and app development. Simple developments such as navigation page placement, icon incorporation and labeling, can provide users with a completely different and more satisfying experience, that ultimately could make the difference between a one time versus a return user.

## Chapter 7: Conclusion

Bermuda is considered a world class location for scuba diving. Hundreds of shipwrecks scattered around the island's waters are home to an abundance of marine life. The reefs also provide divers with a vibrant ecological system to explore.

Due to the progression of technology and the smartphone, particularly its influence on the tourist experience, there is a need for a scuba diving mobile application that provides enthusiasts with easily accessible information related to the various dive shops and dive sites. Information would be filtered via geolocation technology which offers users quick and accurate search results and targeted location information. Geolocation is now an integral part of app development that some may consider imperative for a successful app.

Consumer trending in smartphones use and app downloads before travel, combined with strong influences on user experience, prove the importance of creating an app that is of a high standard both in visual design and interactivity, in order to gain repeat users. The literature also shows that app crashes and unrelated content were key factors in poor customer reviews. Therefore, ensuring that the app is seamless and stable is key during development, as well as ensuring the content of the app satisfies the target audience's needs. Studies show that smartphones assist tourists in making informed decisions and sharing experiences. As users will have such a variety of needs for informational and functional uses, it is important to provide them with the right recommendation system to fit their requirements. Tourists rely on their mobile devices for information and recommendations both in the pre-booking stage and in real time on their adventures. Further research is needed to determine whether collaborative filtering, content-based filtering or knowledge-based recommendations is best suited for the app. Also, it may be beneficial to provide tourists an alternative when their service is disrupted due to travel or they are outside of Wi-Fi range. This warrants consideration for providing tourists with an app that is accessible both online and offline. Although all

features may not be accessible when offline, providing the opportunity to maintain offline access to information is rare, but growing in many apps today. When connected online, access to live updates, social media integration and geolocation will be essential.

Currently, there is a lack of literature specific to Bermuda in relation to smartphones, mobile apps, geolocation functionality, and the tourist experience. Further research is needed to clarify the relationship between these technologies and the tourist experience in Bermuda. Based on the findings of the current review, the Go Dive app should provide historical information including images and videos, geolocation services, social media capability, and be available for both online and offline usage.

User testing provided essential feedback for developing the Go Dive app, in terms of content and structure that offered users the tailored content they were seeking. The testing enabled the app to provide user requested information rather than business orientated content, for example, the number of minutes to a specific dive site or how to get involved in an environmental program. Providing an app that caters to the specific needs of the user and is designed and branded accordingly, will help to gain repeat users of the Go Dive app.

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Appendix A: Final  
sitemap page layout for  
the Go Dive app

