Bauhaus-Universität Weimar

Cultural Heritage on Mobile Devices:
Building Guidelines for UNESCO World Heritage Sites' Apps

DOCTORAL THESIS DEVELOPED BY

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Abstract in German / Zusammenfassung

Der technische Fortschritt und der Zugang dazu bieten ein ertragreiches Szenario für die Innovation und Entwicklung mobiler Anwendungen (Apps). Daraus ist eine Vielzahl von zu Verfügung stehenden Apps entstanden, die Informationen über touristische Reiseziele bereitstellen, insbesondere solche mit einem kulturellen Hintergrund, etwa die, die zum UNESCO Welterbe/Weltkulturebe (auf Englisch *WHS – World Heritage Sites*, fotan so genannt in dieser Arteit) gehören. Allerdings haben nicht alle Apps die gleiche Effizienz.

Um eine erfolgreiche App entwickeln zu können, sollten gleichzeitig die Benutzerfreundlichkeit der Aspekte und Funktionen in Betracht gezogen werden, als auch Zuverlässigkeit ihrer Inhalte. Obwohl die Richtlinien für eine mobile Benutzerfreundlichkeit weit verbreitet sind, sind diese jedoch generisch. Keine Richtlinie ist eindeutig auf Orte des Kulturerbes zugeschnitten, schon gar nicht auf Standorte, die sich im Freien befinden.

Ziel dieser Arbeit ist es, diese Literaturlücke zu schließen und gleichzeitig nahe zu bringen, wie bestimmte Richtlinien angepasst und ausgebaut werden könnten, um bessere WHS-Erlebnisse im Freien zu schaffen. Die Arbeit geht empirisch vor am Beispiel der deutschen Stadt Weimar, die mit ihren Altstadt- und Bauhaus-Standorten als Freiluft-WHS gilt. Deutschland ist das fünftbedeutsamste Land der UNESCO-Liste und bekannt für sein technologisches Profil und der Zugang dazu. Dieses Land als geeignete Umgebung für den empirischen Ansatz zu wählen ist ein guter Ausgangspunkt, um Erfahrungen zu sammeln für innovative Projekte, die mit Apps das Kulturerbe erschließen.

Um eine Reihe neuer Richtlinien für Freiluft-WHS (*auf Englisch: Open-Air WHS*) aufstellen zu können, wurden im Rahmen dieser Arbeit Richtlinien aus akademischen Quellen mit branchenüblichen Richtlinien verglichen, gewonnen aus einer umfangreichen Auszug verfügbarer Apps, die sich den WHS in Deutschland widmen.

Im branchenüblichen Ansatz wurden WHS-bezogene Apps ausgewählt, die auf dem deutschen App-Markt erhältlich sind (für iOS- und Android-Geräte). Deren Eigenschaften und Gebrauch wurden aus der Nutzersicht betrachtet. Daraus ließen sich Gemeinsamkeiten ableiten innerhalb der aktuellen Funktionen und Tools, mit denen WHS beworben werden. Die Analyse förderte Richtlinien hervor fand aus der Layout-, Navigations-, Design- und der

Inhaltsperspektive. Daraus wurde eine Prototyp-App erstellt, die dem in der Branche verzeichneten Stand der Technik entspricht.

Während die Richtlinien aus der Branchenübersicht einen Beobachtungsansatz der Leistungen verfolgten, bezogen die aus der Literaturrecherche gewonnenen Richtlinien einen systematischen Ansatz des akademischen Materials. Der literaturbasierte Ansatz wurde aus Veröffentlichungen zur Benutzerfreundlichkeit mobiler Apps gewonnen, die in Forschungsdatenbanken erhältlich sind. Zusätzlich wurden in führenden Unternehmen für die Entwicklung von mobilen Betriebssystemen (iOS und Android) bereits vorhandene Modelle zur Nutzerfreundlichkeit sowie offizielle Richtlinien einbezogen, die unterschiedliche Ansätze sowie Ansichten für das Design mobiler Schnittstellen verbinden und kombinieren und die für WHS genutzt werden könnten.

Unter Rücksichtnahme der Vielfalt der Besucherprofile in Weimar wurden auch Studien über Nutzeroberflächen für ältere Nutzer eingeschlossen. Obwohl die Leitlinien sich nicht auf didaktische Funktionen konzentrieren, wurden auch Studien über das mobile Lernen in der Studie mitaufgenommen, sofern die Nutzeroberfläche Teil des Studienziels war. Diese Entscheidung wurde getroffen, weil die Stadt Weimar auch jugendliche Studenten als Besucher hat, die die historischen Sehenswürdigkeiten der Stadt besuchen und kennenlernen. Allgemein konzentrierte sich diese Ausarbeitung auf klare Anweisungen, die in Richtlinien umgesetzt werden könnten. Die Analyse beschränkte sich jedoch nicht auf die Auswahlliste der Studienobjekte und wurde extrapoliert, unter Berücksichtigung relevanter Referenzen, die in den für die Stichprobe ausgewählten Veröffentlichungen zitiert wurden.

Wann immer eine Leitlinie oder Empfehlung gefunden werden konnte, wurde diese, verfahrensgemäß in eine Tabelle eingefügt, einer ähnlichen Struktur folgend zu den aus der Übersicht der App-Industrie gewonnenen Richtlinien. Um den Erkenntnissen der Literaturrecherche zu entsprechen, wurden neue Kategorien hinzugefügt. Im Großen und Ganzen bestätigten einige Richtlinien des literarischen Ansatzes die Anweisungen des branchenorientierten Ansatzes, andere widersprachen diesen. Dadurch konnte ein neuer Satz von Leitlinien entstehen, die gegeneinander getestet wurden.

Der Inhalt beider Prototypen (branchen- und literaturbasiert) wurden ausgearbeitet, um das WHS in Weimar anzusprechen. Dabei wurden Inhalte abgerufen, die auf der offiziellen touristischen Website der Stadt und in der größten Kulturstiftung Weimars, der *Klassik Stiftung*, verfügbar sind.

Die Nutzung zweier verschiedener einfache Prototypen bot die Möglichkeit, auch andere Funktionen zu testen wie z. B. verschiedene Arten der Anzeige von Karten und Inhalten. Zur Überprüfung und Gegenüberstellung der verschiedenen Leitlinien, wurden ein aufgabenbasierter Test und eine vergleichende Bewertungsumfrage durchgeführt. Tester aus verschiedenen Altersgruppen führten in beiden Prototypen eine Reihe vordefinierter Aufgaben aus und beantworteten einen Fragebogen, wobei die in beiden Versionen vorgestellten Funktionen und Formate verglichen werden konnten. Die Fragen sollten anhand eine Auswahl vordefinierter Antworten von Nutzern beantwortet werden, ideal für eine statistische Auswertung, insbesondere zum Thema Benutzerzufriedenheit. Auch offene Fragen, zur Leistung persönliche Beiträge der Tester, wurden angeboten. Diese Methode war ausschlaggebend dafür, beide Richtliniensätze (Industrie vs. Literaturrecherche) gegeneinander zu vergleichen und zu analysieren, So konnte ein idealer Ansatz gefunden werden für Richtlinien von Apps, die sich mit Welterbestätten unter freiem Himmel befassen. Auch weitere Empfehlungen, die sich aus der Bewertung ergaben, konnten hinzugefügt werden.

Das Ergebnis führt zu einem umfassendem Satz von Richtlinien, die in zukünftigen touristischen Open-Air-Apps angewandt werden können, die sich mit Weltkulturerbestätten befassen.

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Abbreviations and Acronyms

App – Application (for mobile devices, in this research context)

AR – Augmented Reality

BYOD – Bring Your Own Device

BYOT – Bring Your Own Technology

GmbH – Gesellschaft mit beschränkter Haftung (company with limited liability)

GmbH & Co. KG – Kommanditgesellschaft (limited partnership with a GmbH)

GNTB – German National Tourism Board

GPS – Global Positioning System

ICT – Information and Communications Technology

NFC – Near-Field Communication

PDA – Personal Digital Assistant (also known as Palmtop)

POI – Point of Interest

QR Code – Quick Response Code

UI – User Interface

UNESCO – The United Nations Educational, Scientific and Cultural Organization

VR – Virtual Reality

WHS – World Heritage Site

Abstract

Technological improvements and access provide a fertile scenario for creating and developing mobile applications (apps). This scenario results in a myriad of Apps providing information regarding touristic destinations, including those with a cultural profile, such as those dedicated to UNESCO World Heritage Sites (WHS). However, not all of the Apps have the same efficiency. In order to have a successful app, its development must consider usability aspects and features aligned with reliable content. Despite the guidelines for mobile usability being broadly available, they are generic, and none of them concentrates specifically into cultural heritage places, especially on those placed in an open-air scenario. This research aims to fulfil this literature gap and discusses how to adequate and develop specific guidelines for a better outdoor WHS experience. It uses an empirical approach applied to an open-air WHS city: Weimar and its Bauhaus and Classical Weimar sites. In order to build a new set of guidelines applied for open-air WHS, this research used a systematic approach to compare literature-based guidelines to industry-based ones (based on affordances), extracted from the available Apps dedicated to WHS set in Germany. The instructions compiled from both sources have been comparatively tested by using two built prototypes from the distinctive guidelines, creating a set of recommendations collecting the best approach from both sources, plus suggesting new ones the evaluation.

Keywords

Interface design; world heritage sites; usability; App; mobile devices.

Format

This thesis is following the Harvard referencing style.

Acknowledgements

This work is dedicated to the memory of Prof. Dr Jens Geelhaar, a gentle and sharp mentor.

Your welcoming support made this research possible.

Chapter 1 – Introduction

It is far behind the time when the options to experience a cultural or historical place were necessary to visit a museum or buy a print guide to check the information about the monuments and historical buildings in a city. Despite the importance of these institutions and options, the technology allows expanding the concept one step further, and the cities itself can be considered open-air museums.

The spread and importance of mobile devices on every-day activities are well known and documented, but its use for cultural preservation is still not explored in the same depth, from the effectiveness perspective. For instance, this can be a two-way process involving the tangible and intangible elements of cultural heritage: from the heritage-source (as a museum) to the user, and from the user providing content for the heritage-source. This research focuses mostly on the first task but also contemplates the collaborative relations and dynamics between the content promoters and users, applied on mobile devices.

It is important because the mobile devices, specifically smartphones, have acquired more importance in the last two decades and have now an essential role in the society and its potential to explore cultural elements is not a recent finding.

> "[m]ost of the current communication processes are based on the use of mobile devices. Some of the most used are tablet pc, pocket pc, smart-phone, PDA (Personal Digital Assistant), and iPod. (...) Adapting the power of these technologies to the field of cultural heritage allows the broadcast of local heritage to a worldwide level" (Cutrí et al., 2008, p. 440).

It has been now more than ten years since the mobile devices have supplanted the preference of the users as an interface to check the latest news (Indvik, 2010). However, its use for cultural and touristic purposes does not follow the same speed adoption. As same as happened to the

newspapers, whose page shrank to fit the mobile devices, the technology can bring the world on a small scale of a mobile screen by enhancing the possibilities for museums and galleries. In fact, the efficient use of portable technology can add elements to the real world and has the potential to change the perception and to turn the entire city into an open-air museum. There are no more limitations on space, opening hours, or staff to provide the visitors with a complete and empowered cultural experience.

There are already some advances regarding the application of these technologies for cultural heritage activities, such as historical Apps (listed later). However, some questions remain regarding its use, especially about how they are affecting experiences and promotion of heritage sites. For instance, some aspects of cultural preservation should be considered:

> "There are many issues in the presentation of culture. One is the definition of culture itself, the second issue is to understand how culture is transmitted, and the third is how to transmit this cultural knowledge to people from another culture. In the case of virtual heritage, a fourth also arises, exactly how could this specific cultural knowledge be transmitted digitally?" (Champion, 2011, p. 131).

From this perspective, there are, in essence, two aspects of the cultural heritage to be preserved: the tangible and the intangible elements. The tangible one can be divided in "Immovable heritage" – being land or land-based resources, such as buildings –; and "Movable heritage", including touchable resources that can be detachable and transported from one place to another, as objects, documents, etc. The intangible heritage is the non-material elements, such as culture, stories, language, dance, etc. (Ontario – Ministry of Municipal Affairs and Housing, n.d.).

Mostly, the developed applications and games using mobile devices to interact with urban spaces are dealing with the tangible elements of the culture. However, mobile applicability could work for intangible and tangible elements to enhance the knowledge regarding it (Champion, 2011, pp. 130–131). So far, it is also essential to point the full range of different digital applications available (Laurillard apud Pachler et al., 2009, p. 309), plus social and shared networks as YouTube, Twitter, etc. that could be used for heritage preservation's purposes.

To do so, one possibility is to turn the published digital data (on public virtual spaces of the web) into information, adding a proper contextualisation for it. Some initiatives in this direction,

including galleries, museums and other agents involved in the cultural heritage preservation process, can be already identified. They are mostly being developed for conceptual artists or even for computer sciences experts, based on filters and algorithms. But there is still space for further investigations in this regard.

The present research aims to contribute with the important debate on how technologies can enhance culture, and it does it by analysing how mobile Apps are dealing with Cultural Heritage content generated from cultural institutions and the users. It reflects on what the industry offers but mostly, it concentrates on the best practices and on the construction of clear and objective guidelines to be applied to cultural mobile Apps. It checks the affordances and suggests how they can be used to guide future developments regarding format, features, and interface design, taking in consideration industry and academic-literature sources.

The main research question focuses on how to build effective guidelines that can be set for mobile Cultural Heritage, from design and content perspectives, using industry and academic knowledge to enhance the effectiveness of Apps and help on the cultural preservation.

1.2 – Thesis Development

The thesis is divided into seven main chapters. The first one is an introduction to the goals and concepts that will drive this research.

Chapter 1
Introduction

Chapter 2
Cultural
Heritage

Chapter 3
App Overview
& Guidelines

Chapter 4
Prototypes
Development

Chapter 5
Prototypes
Evaluation

Chapter 6
WHS Mobile
Guidelines

Chapter 7
Final
Considerations
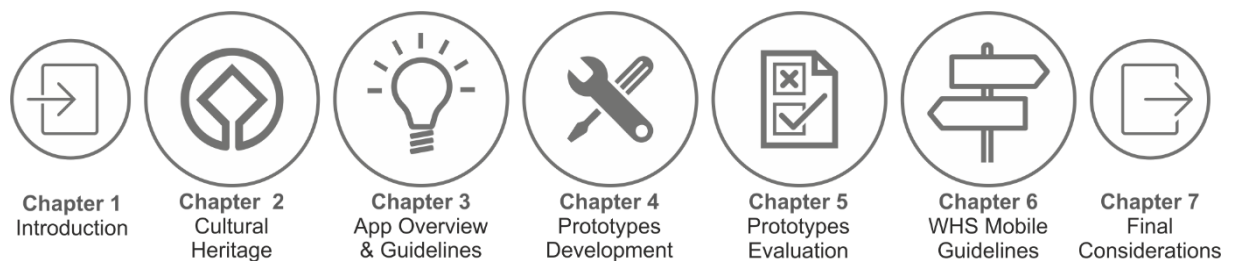
Figure 1.1: Thesis' structure

The second chapter is dedicated to the Cultural Heritage concepts that are being applied across this research, showing what type of cultural preservation can be found and applied for mobile devices. It will also explain why the UNESCO World Heritage Site's List was chosen and how this content is applied to Weimar City. This chapter also presents state of the art for mobile Apps designed for cultural heritage purposes, how they are being used, and which are the best practices that can be taken from the market analysis.

The third chapter shows how Apps' industry/market can provide a set of guidelines to be tested against a set of guidelines collected from the literature-review of mobile usability tests. These two sets of guidelines will serve as the basis of the creation of prototypes, from technical and design perspectives.

The fourth chapter shows how the prototypes were developed, based on the third chapter's extracted guidelines, with a more technical-oriented overview.

The fifth chapter is dedicated to the usability test of the created mobile cultural heritage App for Weimar, showing the test workflow and results.

The sixth chapter describes the data interpretation from the usability tests and how its results helped on the creation of the mobile guidelines.

The last chapter is the seventh, with final considerations and the discussion of future developments.

Chapter 2 – Cultural Heritage

Travel and tourism industry is responsible for US$7.6 trillion to the global economy and is responsible for one in ten of all jobs on the planet. "This was equal to 10.2% of the world's GDP" (WTTC, 2017, p. 2). It is hard to measure how much of this total refers exclusively to the World Heritage Sites (WHS) tourism-related business but is not wrong to assume that history, architecture, and nature are on the top of the list. In this math, there is a new component in the recent decades: technology and, within this scope, intercommunication technologies (ICTs), such as mobile Apps (Schieder et al., 2013), playing an essential role to enhance the experience. However, before addressing the relation between heritage & mobile, it is crucial to understand what heritage means and how it affects tourism and mobile content production.

Heritage can be defined as "our legacy from the past, what we live with today, and what we pass on to future generations" ("UNESCO World Heritage Centre – World Heritage," n.d.); it can be presented as cultural or natural (or even mixed) heritage, and its preservation and dissemination are important vectors to local and global identity. "It includes all aspects of the tangible and intangible environment resulting from the interaction between people and places through the time" (Alvarez et al., 2016, p. 25).

Its importance has been discussed at national and international levels over the years, and in 1945 the United Nations (UN) created a specialised agency focused on education and intercultural understanding and heritage protection, the United Nations Educational, Scientific and Cultural Organization, known as UNESCO ("Introducing UNESCO | UNESCO," n.d.). On 16 November 1972, UNESCO created and adopted the World Heritage Sites (WHS) list, taking

in consideration the protection at the national level of cultural and natural heritage. The WHS list is always changing, adding (or withdrawing[1]) new sites every year.

> UNESCO seeks to encourage the identification, protection and preservation of cultural and natural heritage around the world considered to be of outstanding value to humanity. This is embodied in an international treaty called the Convention concerning the Protection of the World Cultural and Natural Heritage, adopted by UNESCO in 1972. ("UNESCO World Heritage Centre – World Heritage," n.d.)

There are WHS recognized in 167 countries, being the majority representing sites and areas of cultural heritage interest, with 869 locations, in contrast with natural heritage with 213 sites. There are also 39 "mixed" heritage sites combining natural and cultural characteristics. Usually, the WHS list is updated annually, in July.
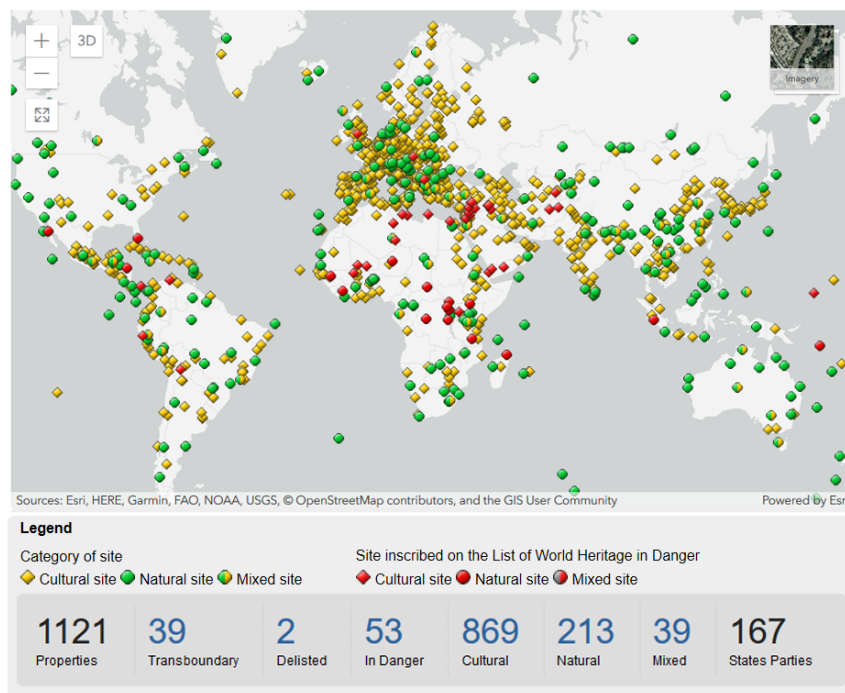
Figure 2.1: UNESCO's World Heritage Sites by July 2020 [2]

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[1] On the UNESCO's WHS history, just two locations were withdrawn from the list, due disrespecting the conversation and protection of its legacy: Dresden Elbe Valley / Germany in 2009 ("UNESCO World Heritage Centre – Dresden is deleted from UNESCO's World Heritage List," n.d.) and Arabian Oryx Sanctuary / Oman in 2007 ("UNESCO World Heritage Centre – Oman's Arabian Oryx Sanctuary : first site ever to be deleted from UNESCO's World Heritage List," n.d.).

[2] *Source: Image retrieved and modified from http://whc.unesco.org/en/list/*

The WHS list is spread across the globe, but the numbers change among the countries. From the list of countries with WHS, the top five are Italy (55 sites: 50 cultural and five natural), China (55 sites: 37 cultural, 14 natural and four mixed), Spain (48 sites: 42 cultural, four natural and two mixed), Germany (46 sites: 43 cultural, three natural) and France (45 sites: 39 cultural, five natural and one mixed) aligned. If we consider just the cultural sites from UNESCO's list, Germany goes to the second position. The numbers do not mean that one country has more relevant heritage sites than others. Still, it shows the commitment of local and national organisations that organised and collected enough evidence and material to meet the official criteria to apply and subscribe to be a WHS.

With this information in mind, it is possible to affirm that in Germany the WHS recognition plays an important role. Every year, new candidate sites are applying to figure in the UNESCO list, maintaining the country in a top position regarding cultural and natural attractions.

2.1 – World Heritage Sites in Germany

The majority of the WHS in Germany are distributed on the Cultural Heritage category, with 43 sites spread across the country, in contrast with three Natural Heritage sites, as illustrated in *Figure 2.2.* The Cultural Heritage sites englobe churches, old town centres, factories and other remarkable spots, with different touristic characteristics.

Some government initiatives were created to support the German WHS. From 2009 to 2014 the German Federal Ministry of Transport, Building and Urban Development (BMVBS)[3] maintained the National Investment Programme UNESCO World Heritage Sites[4], spending circa 22 million Euros in federal funding for developing and maintaining the listed WHS (Galland et al., 2016, p. 85). In 2014, the National Investment Programme moved to the Federal Ministry for Environment, Nature Conservation, and Nuclear Safety Building (BMUB)[5].

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[3] Bundesministerium für Verkehr, Bau und Stadtentwicklung

[4] http://www.welterbeprogramm.de/

[5] Bundesministerium für Umwelt, Naturschultz, Bau und Reaktorsicherheit

Cultural Heritage Sites
01 – Aachen Cathedral (1978)
02 – Speyer Cathedral (1981)
03 – Würzburg Residence with the Court Gardens and Residence Square (1981)
04 – Pilgrimage Church of Wies (1983)
05 – Castles of Augustusburg and Falkenlust at Brühl (1984)
06 – St Mary's Cathedral and St Michael's Church at Hildesheim (1985)
07 – Roman Monuments, Cathedral of St Peter and Church of Our Lady in Trier (1986)
08 – Frontiers of the Roman Empire (1987)
09 – Hanseatic City of Lübeck (1987)
10 – Palaces and Parks of Potsdam and Berlin (1990)
11 – Abbey and Altenmünster of Lorsch (1991)
12 – Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System (1992)
13 – Maulbronn Monastery Complex (1993)
14 – Town of Bamberg (1993)
15 – Collegiate Church, Castle, and Old Town of Quedlinburg (1994)
16 – Völklingen Ironworks (1994)
18 – Bauhaus and its Sites in Weimar, Dessau and Bernau (1996)
19 – Cologne Cathedral (1996)
20 – Luther Memorials in Eisleben and Wittenberg (1996)
21 – Classical Weimar (1998)
22 – Museumsinsel (Museum Island), Berlin (1999)
23 – Wartburg Castle (1999)
24 – Garden Kingdom of Dessau-Wörlitz (2000)
25 – Monastic Island of Reichenau (2000)
26 – Zollverein Coal Mine Industrial Complex in Essen (2001)
27 – Historic Centers of Stralsund and Wismar (2002)
28 – Upper Middle Rhine Valley (2002)
29 – Muskauer Park (Park Muzakowski) (2004)
30 – Town Hall and Roland on the Marketplace of Bremen (2004)
31 – Old Town of Regensburg with Stadtamhof (2006)
33 – Berlin Modernism Housing Estates (2008)
35 – Fagus Factory in Alfeld (2011)
36 – Prehistoric Pile Dwellings around the Alps (2011)
37 – Margravial Opera House Bayreuth (2012)
38 – Bergpark Wilhelmshöhe (2013)
39 – Carolingian Westwork and Civitas Corvey (2014)
40 – Speicherstadt and Kontorhaus District with Chilehaus (2015)
41 – The Architectural Work of Le Corbusier, an Outstanding Contribution to the Modern Movement (2016)
42 – Caves and Ice Age Art in the Swabian Jura (2017)
43 – Archeological Border Complex of Hedeby and the Danevirke (2018)
44 – Naumburg Cathedral (2018)
45 – Erzgebirge/Krušnohoří Mining Region (2019)
46 – Water Management System of Augsburg (2019)
Natural Heritage Sites
17 – Messel Pit Fossil Site (1995)
32 – Primeval Beech Forests of the Carpathians and the Ancient Beech Forests of Germany(2007)
34 – The Wadden Sea (2009)

Figure 2.2: UNESCO's World Heritage Sites in Germany by July 2019 [6]

From the perspective of a content producer for technological applicability, another German governmental initiative will have a more substantial influence on the creation of mobile guidelines for WHS: the GNTB – The German National Tourism Board.

2.1.1 The German National Tourism Board's Heritage Division of WHS

The German National Tourism Board ("The GNTB," n.d.) is a national marketing organisation that acts on behalf of the Federal Government, promoting Germany's tourism. The organisation understands that every WHS has its characteristics and differences when compared to another, demanding different touristic and informational strategies. Dividing them into natural and cultural categories is not enough to enclose the tourist attraction's specificities that a visitor might find when searching for UNESCO WHS. As the WHS plays an essential role for the

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[6] Image retrieved and modified from:
https://upload.wikimedia.org/wikipedia/commons/9/9c/Deutschland_UNESCO_Welterbest%C3%A4tten.png

German Tourism, the cultural heritage sites were divided by GNTB into further sub-categories applied to the German profile:

- Churches & Abbeys;

- Historical Town Centres;

- Castles & Palaces;

- Industrial Heritage;

- Other World Heritage Sites;

- Nature, Gardens & Landscapes.

The GNTB division of WHS in Germany differs from the UNESCO, but they are not necessarily conflicting. Four Cultural Heritage sites from UNESCO list ("Garden Kingdom of Dessau-Wörlitz", "Upper Middle Rhine Valley", "Muskauer Park" and "Bergpark Wilhelms-höhe") were placed together within three UNESCO Natural Heritage sites ("Messel Pit Fossil Site", "Primeval and Ancient Beech Forests" and "The Wadden Sea") under the category "Nature, Garden & Landscape".
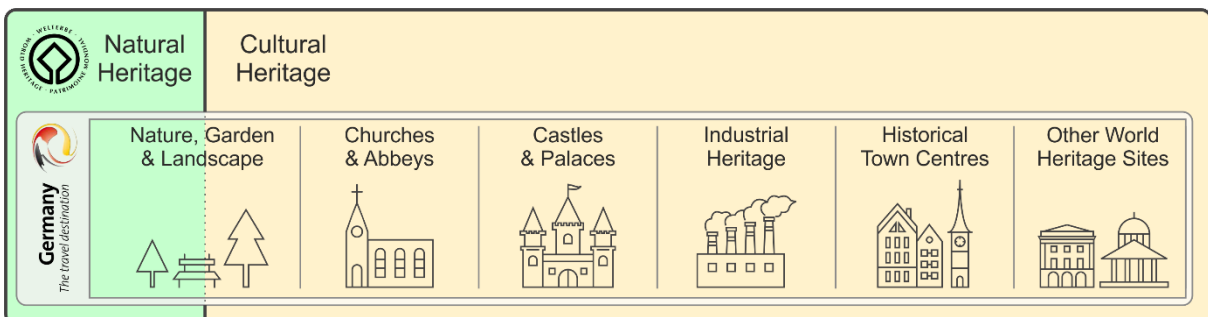
Figure 2.3: World Heritage Sites according to the GNTB, inside the UNESCO division

Despite this merge, the GNTB has a more detailed expansion to identify and to describe the characteristics and needs of each type of WHS placed in Germany. This division can be helpful when developing guidelines for mobile Apps, considering each type of WHS has different needs. For instance, an App for a church would be different from an App for a historical town centre: a church App would imply indoor navigation. In contrast, a historical town centre would need open-air navigation, helping to move from different buildings and monuments.

Taking into consideration the different types of WHS, it is easier to define what kind of WHS will be the target in this research, as the focus of the empirical approach is in the city of Weimar.

2.2 – World Heritage Sites in Weimar

Weimar is one of few cities in Germany having more than one UNESCO's WHS, with several locations and buildings spread inside and around the city. The cultural value makes it an excellent example to apply this research.

Most of the WHS in Weimar are under the "Klassik Stifftung Weimar" [7] control and care, being one of the largest cultural foundations in Germany ("About us," n.d.). This organisation's level serves to illustrate how the heritage topic is supported in the German culture, especially in Weimar.

The Weimar's WHS are divided into two different entries at UNESCO list, the "Bauhaus Sites" with three locations, and "Classical Weimar" with ten locations (with more than one building, in some cases), as following.

2.2.1 – The Bauhaus Sites

The "Dessau and Weimar – The Bauhaus Sites" was added to the WHS list in 1996, englobing Bauhaus related locations in the cities of Weimar, Dessau and Bernau. This WHS was modified in July 2017, including Bernau on the list of cities ("UNESCO World Heritage Centre – New Inscribed Properties (2017)," n.d.).

> Between 1919 and 1933, the Bauhaus School, based first in Weimar and then in Dessau, revolutionized architectural and aesthetic concepts and practices. The buildings put up and decorated by the school's professors (Walter Gropius, Hannes Meyer, Laszlo Moholy-Nagy and Wassily Kandinsky) launched the Modern Movement, which shaped much of the architecture of the 20th century. ("Bauhaus and its Sites in Weimar, Dessau and Bernau – UNESCO World Heritage Centre," n.d.)

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[7] "Klassik Stifftung Weimar" can be translated as "Weimar Classics Foundation"

In Weimar, it includes the following buildings/locations:

- Hauptgebäude der Bauhaus-Universität / *Main Building Bauhaus University*

- Ehemalige Kunstgewerbeschule / *Former School of Arts and Crafts*

- Haus am Horn

2.2.2 – Classical Weimar

The Classical Weimar was added to the WHS list in 1998, focused – but not exclusively – on Goethe and Schiller's legacy.

> In the late 18th and early 19th centuries the small Thuringian town of Weimar witnessed a remarkable cultural flowering, attracting many writers and scholars, notably Goethe and Schiller. This development is reflected in the high quality of many of the buildings and of the parks in the surrounding area. ("Classical Weimar – UNESCO World Heritage Centre," n.d.)

The "Classical Weimar" sites are spread in the old town and the outskirts of the city. The buildings/locations are:

- Goethes Wohnhaus (Frauenplan) / *Goethe's Home*

- Schillers Wohnhaus / *Schiller's Home*

- Herderstätten (Stadt-Kirche St. Peter & Paul, Herders Wohnhaus, & Altes Gymnasium Weimar) / *St. Peter and Paul (Herder Church), Herder House, & Old Grammar School*

- Weimarer Stadtschloss / *City Palace*

- Wittumspalais

- Herzogin Anna Amalia Bibliothek / *Historical Library*

- Park an der Ilm mit Römischem Haus, Goethes Gartenhaus & Goethes Garten am Stern / *Park on the river Ilm with Roman House, Goethe's Garden House*

- Schloss & Schlosspark Belvedere Schloss & Schlosspark Ettersburg / *Belvedere Palace & Belvedere Park and Orangery & Etterburg Palace and Park*

- Schloss & Schlosspark Tiefurt / *Tierfurt Mansion and Park*

- Historische Friedhof Weimar mit Fürstengruft / *Historical Cemetery and Ducal Vault*

Although it was added after the Bauhaus entry, the Classical Weimar can be considered the city's main tourist attraction. If deemed the voted-based list on the popular website/app TripAdvisor, from the top ten attractions of Weimar, eight are related to the Classical Weimar ("The Top 10 Things to Do in Weimar 2017 – TripAdvisor," n.d.).

2.2.3 – Selected UNESCO Criteria

Every WHS should meet at least one of the ten official criteria ("UNESCO World Heritage Centre – The Criteria for Selection," n.d.)[8]. The official criteria for WHS used in Weimar, in comparison with the UNESCO's ones are:

UNESCO Cultural Criteria	Bauhaus Criteria	Classical Weimar Criteria
(ii): to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;	(ii): The Bauhaus building in Dessau is a central work of European modern art, embodying an avant-garde conception directed towards a radical renewal of architecture and design in a unique and widely influential way.	
(iii): to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeaRed;		(iii): The high artistic quality of the public and private buildings and parks in and around the town testify to the remarkable cultural flowering of the Weimar Classical Period.
(iv): to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;	(iv): The Bauhaus itself and the other buildings designed by the masters of the Bauhaus are fundamental representatives of Classical Modernism and as such are essential components of the image of their period of the 20th century.	

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[8] The complete set of criteria by UNESCO can be found at their official website: http://whc.unesco.org/en/criteria/.

UNESCO Cultural Criteria	Bauhaus Criteria	Classical Weimar Criteria
(vi): to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria);	(vi): The Bauhaus architectural school was the foundation of the Modern Movement which was to revolutionise artistic and architectural thinking and practice in the 20th century.	(vi): Enlightened ducal patronage attracted many of the leading writers and thinkers in Germany, such as Goethe, Schiller, and Herder to Weimar in the late 18th and early 19th century, making it the cultural centre of the Europe of the day.

Table 2.1: *Comparison between UNESCO official criteria applied for each WHS in Weimar*

The used criteria from the WHS in Weimar follows the tendency of other WHS in Europe. The used criteria for Bauhaus (ii, iv, iv) and Classical Weimar (iii, iv) are among the top five most used in all the Europeans WHS, which leads to the idea that some of the proposed mobile guidelines could serve not just for Germany but could have a broader application.
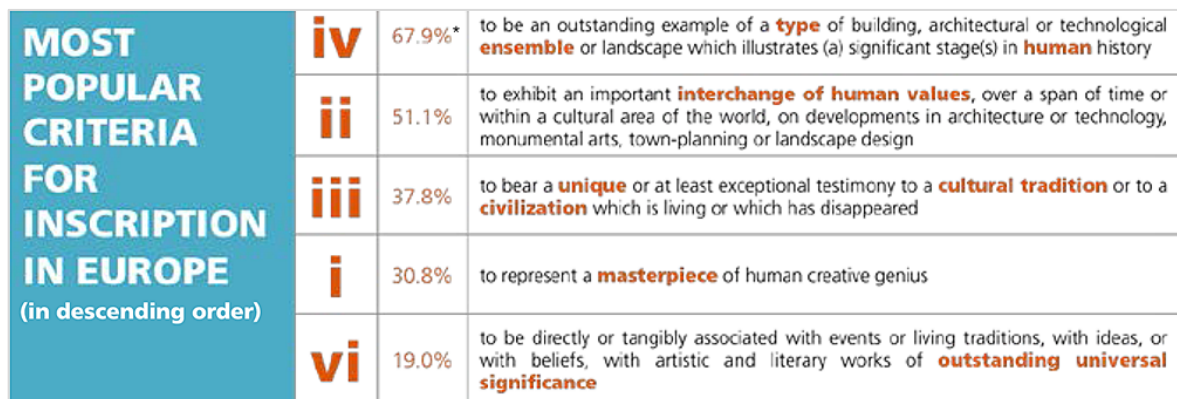
Figure 2.4: *Most popular criteria for inscription in Europe (Galland et al., 2016, p. 31)*

2.2.4 Weimar WHS Profile

The Weimar WHS are included in the "cultural heritage", but according to the GNTB division, both WHS in Weimar felt on "Other World Heritage" category, which can be too vague as a description. Taking in consideration the touristic characteristics, inside the perspective of creating mobile guidelines applied in Weimar, it would serve for both GNTB categories "Other World Heritage Sites" and "Historical Town Centre", where it is possible to identify common needs/profile:

- More than one building/monument;

- Need to move through the city/directions;

- Placed in the urban scenario;

- Getting cultural information regarding each listed site.

UNESCO	**Natural Heritage**	**Cultural Heritage**					
GNTB	Nature, Garden & Landscape		Churches & Abbeys	Castles & Palaces	Industrial Heritage	Historical Town Centres	Other World Heritage Sites
	• Messel Pit Fossil Site • Primeval Beech Forests of the Carpathians and the Ancient Beech Forests of Germany • The Wadden Sea	• Garden Kingdom of Dessau-Wörlitz • Upper Middle Rhine Valley • Muskauer Park (Park Muzakowski) • Bergpark Wilhelms-höhe	• Aachen Cathedral • Speyer Cathedral • Pilgrimage Church of Wies • St Mary's Cathedral and St Michael's Church at Hildesheim • Abbey and Altenmünster of Lorsch • Maulbronn Monastery Complex • Cologne Cathedral • Monastic Island of Reichenau • Carolingian Westwork and Civitas Corvey • Naumburg Cathedral	• Würzburg Residence with the Court Gardens and Residence Square • Castles of Augustusburg and Falkenlust at Brühl • Palaces and Parks of Potsdam and Berlin • Wartburg Castle	• Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System • Völklingen Ironworks • Zollverein Coal Mine Industrial Complex in Essen • Water Management System of Augsburg	• Hanseatic City of Lübeck • Town of Bamberg • Collegiate Church, Castle, and Old Town of Quedlinburg • Historic Centres of Stralsund and Wismar • Old Town of Regensburg with Stadtamhof	• Roman Monuments, Cathedral of St Peter and Church of Our Lady in Trier • Frontiers of the Roman Empire • Bauhaus and its Sites in Weimar, Dessau and Bernau • Luther Memorials in Eisleben and Wittenberg • Classical Weimar • Museumsinsel (Museum Island), Berlin • Town Hall and Roland on the Marketplace of Bremen • Berlin Modernism Housing Estates • Fagus Factory in Alfeld • Margravial Opera House Bayreuth • Prehistoric Pile Dwellings around the Alps • Speicherstadt and Kontorhaus District with Chilehaus • The Architectural Work of Le Corbusier • Caves and Ice Age Art in the Swabian Jura • Archaeological Border complex of Hedeby and the Danevirke • Erzgebirge / Krušnohoří Mining Region

Table 2.2: *German WHS distributed in UNESCO and GNTB classifications*

Inside the GNTB division, the guidelines created for "Other WHS" and "Historic Old Town" would cover 19 sites from the total of 44 German WHS, achieving 43% of the UNESCO list in Germany.

2.3 – Cultural Heritage & Tourism

Cultural tourism stands in a strategic place in Germany, where the country lists in the first place as a cultural travel destination for Europeans ("Facts, Figures, Information 2015," 2016). The cultural tourism in Germany is not limited to the WHS list, but it is possible to say that the foundations and organisations which take care of official WHS help to promote and protect these sites. Also, the status of being a WHS can generate financial influx to the locations (Galland et al., 2016, p. 30).

In Weimar, cultural tourism is one of the main reasons visitors choose the city as their destination. According to the official city marketing company, Weimar GmbH (Dietrich, 2014)[9], the ten reasons for visiting the city are:

1. Arts and Culture;

2. Sights;

3. Architecture and City itself;

4. Tradition and History;

5. Image;

6. Landscape and Nature;

7. Frequent visits;

8. Atmosphere;

9. Nearby;

10. Word-of-mouth.

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[9] Information collected with approximately 400 visitors, during April and May of 2013, sent by email from Weimar GmbH, through the e-mail dietrich@weimar.de, at 3rd June 2014. No updated information was given since from Weimar GmbH.

Related to activities in the city, the visitors answered:

- 94% Sightseeing

- 79% Restaurant and Cafés

- 65% Museums and Exhibitions

- 58% Strolling Around

- 54% Regional Food and Drinks

- 53% Shopping

- 47% Guided Tours

- 35% UNESCO World Heritage

- 33% Theatre

- 26% Relaxing

The statistics show that cultural tourism is one of the main factors that attract visitors to Weimar. However, the UNESCO WHS acknowledgement is not evident, even though the sites are signalised with logos displayed on the facades and entrances of the listed attraction, as seen in *Figure 2.4*. Despite the lack of awareness, one cannot exclude that the tourists' reasons to visit the main attractions in Weimar share the same values that led the sites to be recognised by UNESCO.

Figure 2.5: Example of WHS logos at public signs in Weimar

The recognition of the WHS logo is an issue and is not always part of the public knowledge (Poria et al., 2011). This issue does not affect the proposed mobile guidelines. However, it must be considered when planning touristic promotions, by not just relying on the UNESCO icon, but on clarifying why the place should be included in a tour.

2.4 – Mobile & Cultural Heritage

UNESCO refers to the use of ICT and mobile devices by focusing on learning and education purposes ("Mobile Learning | UNESCO," n.d.). The organisation promotes annually a "mobile learning week" ("Mobile Learning Week | UNESCO," n.d.). However, mobile Apps' use and development do not receive the attention proportional to its importance and is not highlighted in the possibilities of mobile usage. Nevertheless, UNESCO does imply the possibilities of using mobile devices:

> Mobile technologies, perhaps more so than any other ICT, have a track record of maximizing informal and non-formal learning opportunities. Education policies should thus focus not only on school, college or university education, but also embrace learning that happens outside these formal contexts *(Vosloo, 2012, p. 32)*.

UNESCO also supports what they define as "Sustainable Tourism" (Centre, n.d.)[10], where the use of mobile Apps could fit as supporting and promoting WHS (Schieder et al., 2013, p. 19). However, despite the suggestion of the importance of mobile technology for touristic activities, there is no official recommendation or guidelines for using mobile or any other form of ICT. So far, there is no "grammar" to define the rules on designing dedicated applications for cultural heritage sites, giving the creation of mobile guidelines for WHS covered in this work an extra appeal.

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[10] http://whc.unesco.org/en/tourism

2.4.1 – Mobile Interactions beyond dedicated Apps

This thesis targets WHS Apps, but there are other ways to interact and promote cultural heritage by using mobile tools and features that are not necessarily dedicated Apps on smartphones. It is possible to find examples of mobile applications being used to interact with cultural spaces, including indoor experiences from museums using QR code readers, NFC technology-based information and even from initiatives such as BYOD (Hornecker and Ciolfi, 2019, p. 23).

Some of these examples can be integrated into specific WHS Apps interface, or serve as inspiration for creative solutions for cultural heritage content in general.

2.4.1.1 – Interactions through Social Media

In Germany, social media platforms have a modest penetration of 41% in comparison with 68% of smartphone penetration. Still, nevertheless, the country presented a growth of 14% of active social media users from January 2016 to January 2017 ("Digital in 2017: Western Europe," n.d., pp. 79–81) and the number is increasing ever since across different platforms, especially among the younger population.
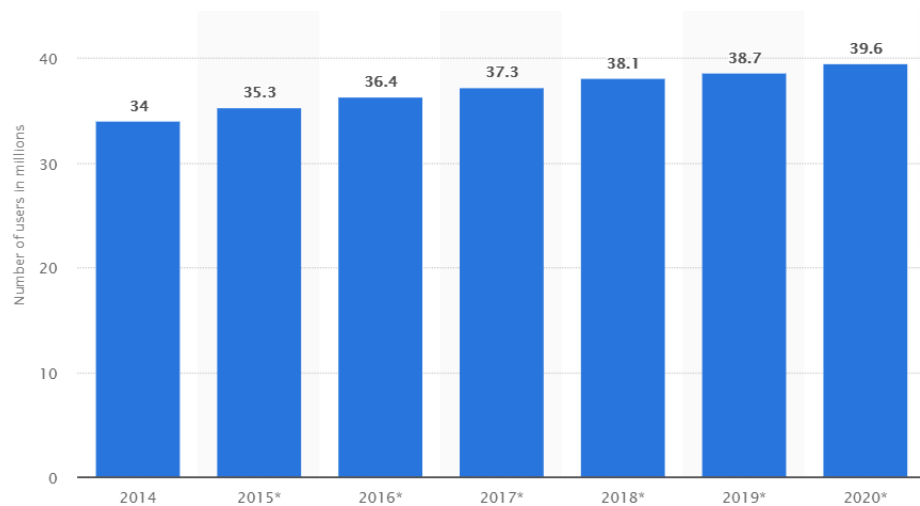
Figure 2.6: Number of social network users in Germany from 2014 to 2020 (in millions)(Statista, 2015)

The use of social media is not as strong among the adult population as it is on the youth one; it reveals a field to be explored (Figure 2.6). Young audiences can be engaged in cultural activities by using mobile devices and social networks, as such activities already belong to their routine and lifestyle. Despite the differences in social media adoption among distinct age groups, the general number of social network users in Germany increases every year (see Figure 2.5), and

as a consequence, its use for WHS promotion should be encouraged. Although it sounds quite an obvious recommendation in a society more and more reliant on social platforms, there is still space for improvement – and research – in this specific area.

However, there are some positive examples already in place. One of the projects showcasing the use social media for WHS it is "goUNESCO"[11], supported by UNESCO, which aims to increase the awareness regarding WHS through several activities, including the use of the hashtag (#) *makeheritagefun* on different social media platforms, such as Facebook[12], Twitter[13], and Instagram[14] . The project asked the public to use the hashtag on their favourite social media and engage by posting content such as pictures, videos and text to index. The project "Make Heritage Fun"[15] ("#makeheritagefun hashtag on Instagram • Photos and Videos," n.d.) run from July to December 2016 in several locations around the globe. Still, the use of the *makeheritagefun* persisted after the official period of the project.

The use of hashtags to attract a young audience's participation is also the strategy used on the App "Welterbe", the official German WHS App (detailed in the next chapter). The application suggests the use of the hashtag *#welterbegermany* on Instagram[16], displaying the users' photos inside the App. The *#welterbegermany* was also used on Facebook and Twitter, but just the Instagram pictures are available inside the App.

Another common social media feature is the use of the "check-in" option, showing where the user is on a specific moment. Despite the commonly applied strategy for trivial locations, such as restaurants and shops, the check-in also highlights touristic attractions (as any WHS). Its use may call attention to the place for their friends and followers. In posts open to the general public, it can also help create a database of user-generated content for that specific attraction, offering a sneak peek on the experience from multiple perspectives.

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[11] www.goUNESCO.com

[12] https://www.facebook.com/hashtag/makeheritagefun

[13] https://twitter.com/hashtag/makeheritagefun

[14] https://www.instagram.com/explore/tags/makeheritagefun/

[15] http://officialchange.com/gounesco-internship-program-application-process/

[16] https://www.instagram.com/explore/tags/welterbegermany/

2.4.4.2 – Interactions through non-dedicated Apps

Non-dedicated Apps are popular among users exploring WHS. Applications developed to offer a broader range of touristic information, working as digital travel guides, provide options to explore popular points of interest, and it is possible to find examples using Weimar as well. For example, TripAdvisor[17] offers a "near me now" and "things to do" option to help the user to explore a touristic destination; and Triposo[18] includes similar features such as "nearby", "see and do" and "get to know". Those options usually show the city's main touristic attractions, including WHS (when available), but without emphasising the UNESCO factor.

Another popular non-dedicated App is Google Maps ("Top Grossing Apps and Download Statistics iOS Store | App Annie," n.d.). It also presents a "share location" feature. In addition, if the user searches inside the map using the key-word "attractions", the main sightseeing will be displayed, based on the user's GPS location (if the feature is available on the hardware). The search results will include nearby WHS, if available.

2.4.4.3 – Interactions though non-smartphone devices

As shown, mobile technology is not new to the cultural heritage sphere. Despite the popularisation of the smartphones in the last decade, offline portable devices are a common feature offered by museums and other structures for multimedia guided tours for several years. Guides for museums are another form of using PDA devices, prevalent before the advent of smartphones, to access digital cultural heritage content, such as *smartmuseum* project[19]. Despite losing its popularity in detriment of smartphones, the PDA is still a cheap option (Johnson, 2017) that institutions may use inside museums or outside guides.

Despite the ubiquitous presence of smartphones, their remaining popularity relies on a simple user interface and efficiency, as they are tailored considering the specificities of the place they are intended to be used. The content is generally distributed in a linear format, dictating the sequence of the activities to be developed in the place and, sometimes, even suggesting the pace of the visit. Audio tours are the most traditional format, but some experiences aggregating video

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[17] https://www.tripadvisor.com

[18] https://www.triposo.com/

[19] http://smartmuseum.eu/

or only text and pictures can be easily spotted. In this case, they mostly work as closed web platforms, based on local servers or even on the gadget's storage disk.

2.5 – Considerations

The combination of mobile devices and its use for cultural settings can be explored in myriad ways, from audio tours to information accessible from QR codes, from engaging storytelling formats to simplistic check-ins on social media. The use of dedicated Apps might offer advantages for cultural visitors, such as incorporating different technologies and formats in a controlled narrative setting.

Around 85% of the travellers just decide on the leisure activities they will engage on after arriving at the chosen destination (Google, 2016). Consequently, a dedicated App can represent an extension of services, helping tourists with official and trustworthy information. In an era of information overload, a careful curation can be decisive in providing a better experience on the city's available activities. It prevents the access to trustworthy official information from being limited by the entrance to the tourist office (with strict opening hours) or with the possibility of carrying a piece of out-of-date printed information (Souffriau et al., 2008).

As it happens in different life areas, tourists are increasingly adopting smartphone Apps on their travels (Dickinson et al., 2014). Offering a dedicated attraction App might be an ideal solution to provide information about WHS in the city, that tourists might not be aware of their existence or their value as a UNESCO heritage. It also works as a digital take-off point, from where the tourist can be sure to have the latest and the most accurate information concentrated in one single place, the App.

Chapter 3 – Apps Overview and Guidelines

Mobile media plays an essential role in society, especially in the way people communicate with each other (Love, 2005, p. 7). The impact on tourism is also important (Wang et al., 2012), enabling context-aware services and navigation.

The use of mobile internet already has suppressed the desktop internet almost a decade ago (Fling, 2009, p. 33), and the percentage of people using smartphone in Germany is increasing every year ("Consumer Barometer – Germany," n.d.) (Koptyug, 2019). The high rate of adoption turned mobile the preferable platform for different activities that used to take place in analogical supports, such as reading news (Indvik, 2010) and travelling tools (maps, reservations, check-in). Smartphones can run specific software for each task, the so-called Apps.
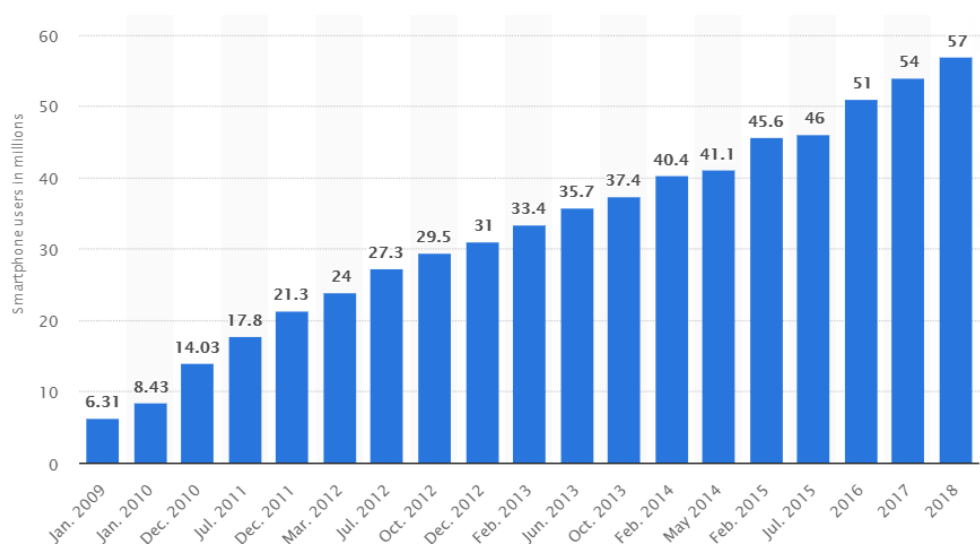
Figure 3.1: *Number of smartphone users in Germany from January 2009 to 2018 (in millions), by Koptyung 2019.*

Nowadays, the word App is well known. It is often associated with smartphones but its origin and use remotes way before the so-called smartphone era. To understand its meaning, and how

it evolved to how we use it nowadays, this section offers a brief introduction. It goes through the definitions to summarise what characterises an App and the available types.

The word App is an abbreviation for "Application". According to the Oxford Dictionary, the conventional definition of "application is: "A program or piece of software designed and written to fulfil a particular purpose of the user" ("application – definition of application in English from the Oxford dictionary," n.d.). The same dictionary defines App as "an application, especially as downloaded by a user to a mobile device" ("app – definition of App in English from the Oxford dictionary," n.d.). This work follows the idea that an App is a piece of software developed for mobile devices, being built-in by manufacturers or developed by third-part to be downloaded by the users.

In fact, some scholars explore the idea that is the possibility of downloading Apps and using the new piece of software, changing the purpose of the gadget, what makes the mobile phones smart. "What makes these phones truly smart is that they enable you to install applications beyond those offered by your carrier, which means hundreds of Apps rather than a handful to choose from, and total control over the phone's functionality" (Kirschner, 2005). For instance, the equipment can make calls but it can also assume the function of a GPS, a calculator, or even a tourist guide.

> [m]ost of the current communication processes are based on the use of mobile devices. Some of the most used are tablet pc, pocket pc, smart-phone, PDA (Personal Digital Assistant), and iPod. (...) Adapting the power of these technologies to the field of cultural heritage, allows the broadcast of local heritage to a worldwide level *(Cutrí et al., 2008, p. 440)*.

Apps can be found in official markets by category or keywords, or on third-part developers sites spread through the web. The Apps are part of the activities related to mobile devices, applied in a large variety of services and functions, being available in dozens of categories on official App markets, for all kind of purposes. Most of the available categories are similar among popular mobile platforms (Android, iOS, Windows), as seen in table 3.1.

Common Categories	Android	iOS	Windows Phone
	Android Wear		
	Art & Design		
	Auto & Vehicles		
	Beauty		
Books	Books & Reference	Books	Books & reference
Business	Business	Business	Business
		Catalogues	
	Comics		
	Communication		
			Developer tools
	Dating		
Education	Education	Education	Education
Entertainment	Entertainment	Entertainment	Entertainment
	Events		
Finance	Finance	Finance	Personal Finance
Food & Drink	Food & Drink	Food & Drink	Food & dining
Games [20]	Games	Games	Games & Entertainment
			Government & politics
Health & Fitness	Health & Fitness	Health & Fitness	Health & fitness
	House & Home		
Kids & Family	Family	Kids	Kids & Family
	Libraries & Demo		
Lifestyle	Lifestyle	Lifestyle	Lifestyle
		Magazines & Newspapers	
Medical	Medical	Medical	Medical
Navigation & Maps	Maps & Navigation	Navigation	Navigation & maps
			Multimedia design
Music	Music & Audio	Music	Music
News	News & Magazines	News	News & Weather
	Parenting		
Personalisation	Personalisation		Personalization
Photo & Video	Photography	Photo & Video	Photo & Video
	Video Players & Editors		
Productivity	Productivity	Productivity	Productivity
		Reference	
			Security
Shopping	Shopping	Shopping	Shopping
Social	Social	Social Networking	Social
Sports	Sports	Sports	Sports
Travel	Travel & Local	Travel	Travel
Utilities & Tools	Tools	Utilities	Utilities & tools
Weather	Weather	Weather	News & Weather

Table 3.1: *Categories of Apps available for Android, iOS, and Windows Phone, by May 2018*

It is possible to observe that the word "tourism" is not a category on the main Apps' stores, despite their frequent use as a cultural and tourism tool. Dedicated Apps for this purpose are placed on "travel" or even "education" categories.

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[20] At Windows Apps' page, the "Games & Entertainment" is located apart from the Apps categories. On Android and iOS, the game category presents other sub-categories, such as "arcade", "adventure", "racing", and many other gaming description options, showing a different highlight for this category if compared to the common categories. "Kids & Family" also has a similar treatment, presenting sub-categories such as "Ages 5 & Under", "Ages 6-8", "Ages 9-11, among other

3.1 – App Overview

The possibility to download and install an App became a common action with the release of iOS and Android markets; however, Apps have been around before the modern smartphones (mobile devices with a touchscreen interface, Internet access, GPS, camera, third-part Apps, among several features), being available on PDAs and old models of cell phones (Woyke, 2014, p. 2). However, at that moment, the Apps were limited to built-in features, such as the notorious "snake" game from Nokia 6110 (1997), and other functional applications as an alarm, calendar, etc.

Even before the smartphones, some operating system such as OS Palm, common in some PDAs, allowed the user to install a third-party application. The game-changer for Apps popularity and functionality was the iPhone, released in 2007, opening the possibility to run thousands of different applications from third-party developers. Before that, the market leader was the RIM Blackberry, a popular mobile phone with a QWERTY keyboard instead of only numbers, a screen occupying half of the front side's length, in a design largely copied by other competitors (West and Mace, 2010).

Apple's device was the first to introduce a bottom-up UI for touch screen, elevating the human-computer interaction to a new level. Before the iPhone, basically "anyone working their way through a lengthy series of drop-down menus, or trying to type accurately on a tiny keyboard, finds the experience frustrating, and may also be unable to access parts of the Internet" (Curwen, 2010, p. 115).

3.1.1 – The Smartphone Era

The Apple founder, Steve Jobs, used the word "smartphone" as a reference to the new iPhone in the talk he gave to introduce the new gadget ("[HD] Steve Jobs – iPhone Introduction in 2007 (Complete) – YouTube," n.d., p. at 3'40"). For many, that was the beginning of the smartphone era, but the term "smartphone" itself appeared before 2007. Fling (2009, pp. 1–10) suggests that it began at least five years before, in 2002, when devices with a larger screen, Wi-Fi, analogical QWERTY Keyboard and PDA style arrived in the market, being a previous mobile generation to the touchscreen era. In reality, the gadgets that emerged after the first iPhone combine much

of the already existent features, but changed the way one interacts with the information, mostly because of the touchscreen.

Another classification in use refers to hardware with touch-screen feature are the *phablets* (Phone + Tablets), being a combination of a smartphone with bigger screen size. It was originally used in 2010 to refer to the *Dell Streak 5* device running Android OS 1.6 ("phablet Definition from PC Magazine Encyclopedia," n.d.). In 2011, the phablets got popularised with the release of Samsung's Galaxy Note. However, nowadays, this separation is not so emphatic for marketing purposes.

In general, it is possible to say that smartphones were not born on one specific occasion. They are still a cumulative process, combining previous functionalities from PDAs with new technologies such as a multi-touch screen.

3.1.2 – App Market

The advent of the touch-screen era, and consequently the release of Apps' databases, such as [Apple] App Store and [Google] Android Market[21], changed the mobile scenario with built-in and several third-party downloadable Apps. This combination - allowing endless customisations, allied with technological advances – turned the term "smartphone" a common sense to refer exclusively to portable pocket-size devices with a touch-screen. So, in this research, anytime when "smartphone era" is mentioned, it includes only such sort of devices with a touch-screen.

3.1.2.1 – iOS – App Market

The Apple App Store was released on 10 July 2008, with 502 Apps available. On March 2017, it was estimated around 2.2 million Apps available for download, being the second most popular market (Statista, 2017a).

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[21] Re-branded as Google Play in 6 March 2012

3.1.2.2 – Android – Google Play

On 22 October 2008, the Android market was released with a modest number of 62 Apps (Siegler, n.d.). Due to its open-source platform, this situation changed very fast; in March 2017, it was estimated 2.8 million Apps available (Idem), being the largest market on the global range. On 6 March 2012, the Android Market was re-branded as Google Play.

3.1.2.3 – Other Mobile Markets

The mobile App market is not exclusive to Apple iOS and Google Android. There are other operating systems (OS) with their own markets, such as BlackBerry OS, Symbian OS, webOS, Firefox OS, Ubuntu Touch (Strain, n.d.). Still, some of them did not resist the competition with the most popular OS and had been discontinued. It is important to stress that Windows Phone – whose development ended in 2017 and the platform closed in 2020 - used to occupy the third position on the market share with alleged over 500.000 Apps on 30 September 2014 ("Microsoft now has over 500,000 Apps in its Windows Phone and Windows stores," n.d.), getting over 660.000 on March 2017 (Statista, 2017a), as illustrated on Figure 3.2.
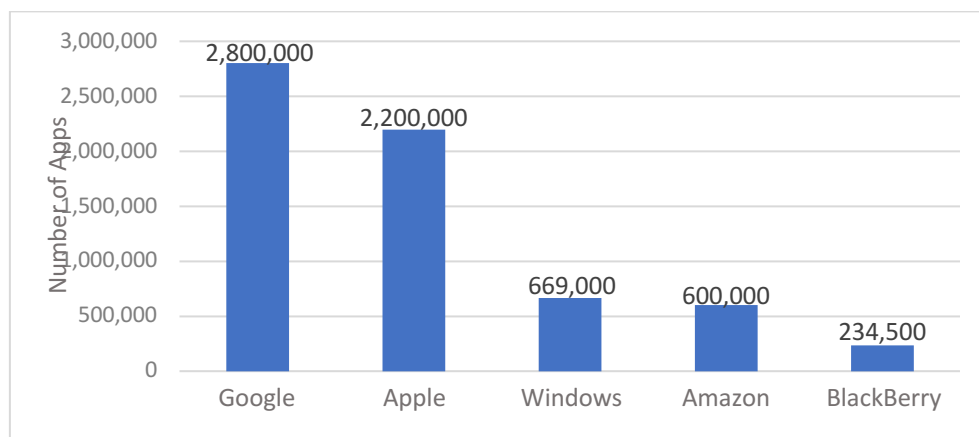
Figure 3.2: *Number of Apps available in leading App stores as of March 2017, by Statista.*

3.2 – Market Numbers

It is possible to relate the importance of the App's markets based on the penetration of each mobile OS. Nowadays in Germany, the most popular mobile OS – in terms of sales (Statista, 2017b) by January 2017 – it is the Android (75.5%), followed by iOS (21.3%) and Windows (2.9%).
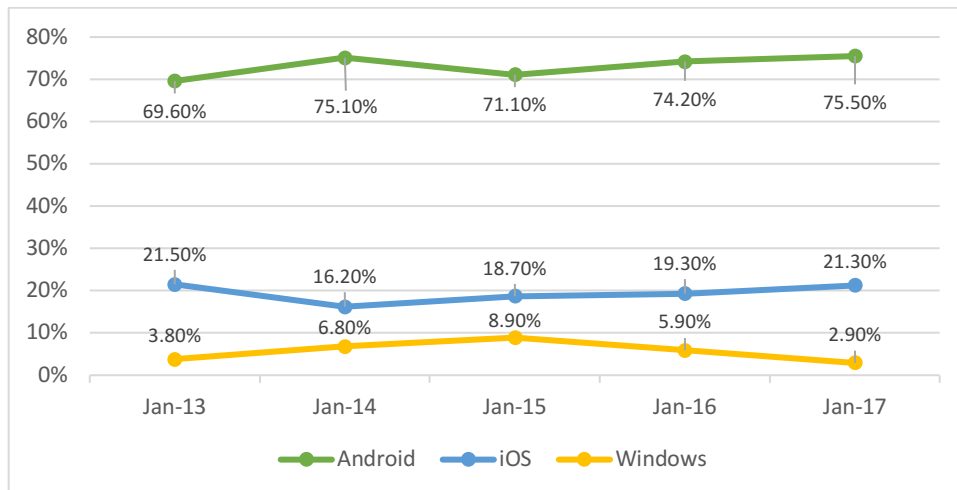
Figure 3.3: Share of smartphone OS sales in Germany from 2013 to 2017

The popularity of Android OS can be attributed in reason of its platform being utilised by several fabricants, such as Samsung, LG, Sony, Motorola, HTC, Huawei, even Google (with Nexus and Pixel), just to mention a few, with a broad range of device prices.
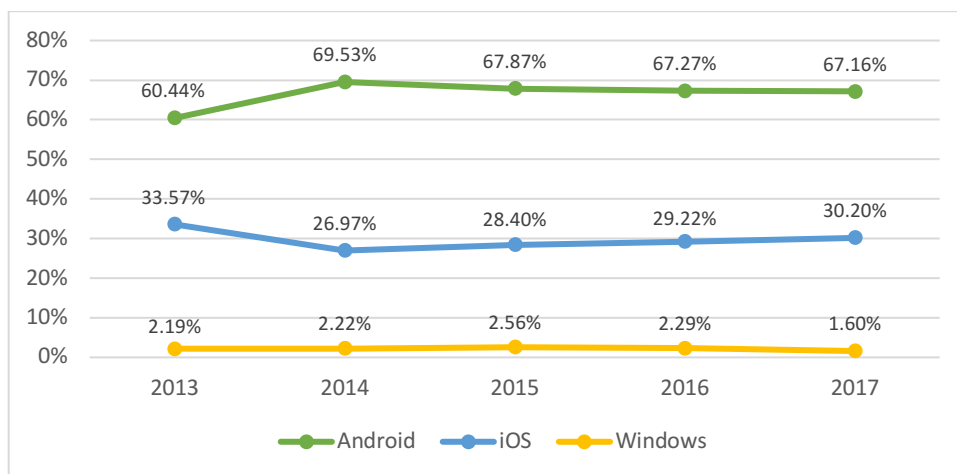
Figure 3.4: Market share of smartphone OS in Germany from 2013 to 2017 [22]

Considering it, from the development perspective, it does not make sense is to create an App exclusively for one OS. If an App is developed for Android and iOS, it will englobe more than 90% of the German (and global) mobile market.

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[22] Retrieved and modified from Statista (Statista, 2017c), displaying the period from 2013 to 2017, based on the top 3 mobile OS in Germany by January 2017.

3.3 – Dedicated World Heritage Apps

The focus of this research is on Apps dealing specifically with cultural heritage content. As previously discussed, Germany is the 4th position in the "World Heritage Sites" from the UNESCO's list ("UNESCO – Statistics on States Parties," n.d.), with 46 recognized sites (43 cultural places and three natural ones), being in the second position when just considering the cultural heritage sites (more details in Chapter 2).

Germany is also well known for its technological potential. This scenario reflects on services using digital formats being available for different purposes, such as information, education, entertainment, just to mention a few, applied to several devices, such as mobile devices, web-based services, interactive screens, etc.

This combination makes Germany a perfect scenario to gain experience and access for innovative projects using mobile devices for cultural heritage. As said, the 37 cultural sites are spread along with Germany. However, two of these sites (Bauhaus and its Sites in Weimar and Dessau; and Classical Weimar) are situated in Weimar – a place where this research is based, and another one (Wartburg Castle) is in a range of less than 90km from Weimar. Those sites are easily accessible, being a perfect sample opportunity for in loco use.

3.4 – Empirical Approach and Methods

The research uses a mixed-method approach to suggest new guidelines to build mobile applications specifically designed for WHS purposes. It combines several selected qualitative and quantitative studies integrated. Going more specifically into mobile usability guidelines, it is possible to find studies addressing this topic, but instead of tackling WHS, they are applied in a more diverse range of scenarios. Based on the previous sections, that offered a contextualisation on cultural heritage and the state of the art of mobile apps, this research provides from now on an empirical approach. This empirical part will be divided into three distinct moments: an analysis on apps applied for German WHS, a systematic review of academic literature, and the combination of the acquired expertise to create prototypes and test the different guidelines.

The first approach offers a comprehensive analysis of Apps dedicated to WHS sites in Germany available in the official App repositories and submits them to a classification based on affordances, identifying features, elements and their use in the mobile application. It uses the premise of affordances, a concept initially elaborated by Gibson (2015, p. 119) in 1979, which discourse on the actionable properties between the actor (person or animal) and the surfaces (or environments). This concept has been used and adapted along the years, emphasising Don Norman's view on this matter, applied for screen-based interfaces. He defines affordance as the term that "refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (Norman, 2013, p. 9).

Another interesting view of affordances that happens to contextualise the perspective comes from technological e-learning approaches in which Bower (2008) classifies them into categories, such as Media (images, audio, video), Spatial (elements size in an interface), Temporal (recording/playing), Navigation (moving back, forward and search), Emphasis (highlights), Synthesis (a combination of mixed media), Access-Control (edit/download permissions), Technical (ability to adapt to different bandwidth and connections), Usability (intuitiveness of a tool), Aesthetics (appeal and appearance), and Reliability (robustness of a platform). It is very similar to the classification developed to analyse and summarise the features from a set of Apps. From this perspective, a review on the available Apps for WHS (as will be further discussed) revealed a set of guidelines used to create a prototype. The prototype was then tested against another one based on academic studies, as will be detailed in upcoming sections.

The second empirical approach uses a systematic literature review to identify the available articles discussing the topic and, by analysing the content, to extract another set of guidelines to build a second prototype, using a similar data structure from the first one – in order to have a better comparison between these two set of guidelines. The systematic literature review, utilising the meta-analysis method (Mullen, 2013) as the main umbrella, consisted of selecting academic publications and research outcomes that can contribute to the formation of literature-review guidelines applied for apps dealing with cultural places. The article selection used a set of search parameters combining "mobile usability" with keywords such as guidelines, App, heritage, travel guide, city guide and mobile interface. It was set a period of five years of publication, selecting the first 50 results for every search string, sorted by relevance. The literature-review approach is well known and used in academic studies (Shitkova et al., 2015).

Details on how the guidelines from the literature review have been constructed will be explored later.

Finally, two prototypes have been used to compare the approaches. Such method, called AB test, a well-known method to collect and summarising evidence (Lazar et al., 2010; Molleri et al., 2016), also helping to collect opinions and input from the users.

3.4.1 – App Selection

There are many models of smartphones and tablets available on the market, with different features and constraints: it forces one to decide for a certain specification in order to verify the features and affordances available on the Apps to be tested. However, considering the scenario discussed in the previous chapters, the criteria are more transparent. The iOS and Android OS together have more than 3 million published Apps, embracing 80% or the German mobile market share. For that reason, the Apps evaluated in this research have been developed for both: iOS and Android operational systems.

To retrieve the available apps, a set of keywords were defined and used to search within each one of the official repositories. The keywords used are:

1. UNESCO WHS in Germany
2. Official App market
3. Word search options:
   a. UNESCO Germany
   b. UNESCO Deutschland
   c. World Heritage
   d. Welterbe (World Heritage in German)
   e. The name of the WHS for Germany [23], in English and German versions.
      1. Aachen Cathedral / Aachener Dom
      2. Speyer Cathedral / Speyerer Dom

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[23] Based on the list available at http://whc.unesco.org/en/statesparties/de as stated in 2017. Since then, four more locations were added to the list: Archaeological Border complex of Hedeby and the Danevirke, and the Naumburg Cathedral in July 2018; and the Water Management System of Augsburg and the Erzgebirge-Krušnohoří Mining Region in July 2019, not being part of this research, in reason of prototype development and its test on June 2018.

3.   Würzburg Residence with the Court Gardens and Residence Square / Würzburger Residenz und Hofgarten

4.   Pilgrimage Church of Wies / Wallfahrtskirche "Die Wies"

5.   Castles of Augustusburg and Falkenlust at Brühl / Schlösser Augustusburg und Falkenlust in Brühl

6.   St Mary's Cathedral and St Michael's Church at Hildesheim / Dom und Michaeliskirche in Hildesheim

7.   Roman Monuments, Cathedral of St Peter and Church of Our Lady in Trier /
     Römische Baudenkmäler, Dom und Liebfrauenkirche von Trier

8.   Hanseatic City of Lübeck / Hansestadt Lübeck

9.   Palaces and Parks of Potsdam and Berlin / Schlösser und Parks von Potsdam und Berlin

10. Abbey of Lorsch / Kloster Lorsch

11. Mines of Rammelsberg, Historic Town of Goslar and Upper Harz / Water Management System /
     Bergwerk Rammelsberg, Altstadt von Goslar und Oberharzer Wasserwirtschaft

12. Town of Bamberg / Altstadt von Bamberg

13. Maulbronn Monastery Complex / Klosteranlage Maulbronn

14. Collegiate Church, Castle, and Old Town of Quedlinburg /
     Stiftskirche, Schloss und Altstadt von Quedlinburg

15. Völklingen Ironworks / Völklinger Hütte

16. Cologne Cathedral / Kölner Dom

17. Bauhaus and its Sites in Weimar and Dessau / Das Bauhaus und seine Stätten in Weimar und Dessau

18. Luther Memorials in Eisleben and Wittenberg / Luthergedenkstätten in Eisleben und Wittenberg

19. Classical Weimar / Klassisches Weimar

20. Wartburg Castle / Wartburg

21. Museumsinsel Berlin /Museum Island Berlin

22. Garden Kingdom of Dessau-Wörlitz / Gartenreich Dessau-Wörlitz

23. Monastic Island of Reichenau / Klosterinsel Reichenau

24. Zollverein Coal Mine Industrial Complex in Essen / Industriekomplex Zeche Zollverein in Essen

25. Historic Centres of Stralsund and Wismar / Altstädte von Stralsund und Wismar

26. Upper Middle Rhine Valley / Oberes Mittelrheintal

27. Town Hall and Roland on the Marketplace of Bremen / Rathaus und Roland in Bremen

28. Muskauer Park / Park Muzakowski

29. Frontiers of the Roman Empire: Upper German-Raetian Limes /
     Grenzen des Römischen Reiches: Obergermanisch-raetischer Limes

30. Old town of Regensburg with Stadtamhof / Altstadt von Regensburg mit Stadtamhof

31. Berlin Modernism Housing Estates / Siedlungen der Berliner Moderne

32. Fagus Factory in Alfeld / Fagus-Werk in Alfeld

33. Prähistorische Pfahlbauten um die Alpen / Prehistoric Pile dwellings around the Alps

34. Margravial Opera House Bayreuth / Markgräfliches Opernhaus Bayreuth

35. Bergpark Wilhelmshöhe / Bergpark Wilhelmshöhe

36. Carolingian Westwork and Civitas Corvey / Karolingisches Westwerk und Civitas Corvey

37. Speicherstadt and Kontorhaus District with Chilehaus /
     Hamburger Speicherstadt und Kontorhausviertel mit Chilehaus

38. The Architectural Work of Le Corbusier / Das architektonische Werk von Le Corbusier

39. Caves and Ice Age Art in the Swabian Jura / Höhlen und Eiszeitkunst im Schwäbischen Jura

4.   When the WHS refers to "Old Town" or "Parks" of a city, the used search term is "City Name" + UNESCO

5. Dedicated WHS Apps[24]

Following each one of the search criteria in both markets, a total of 29 Apps were found. Curiously, the searching criteria were broader than the end result, showing that there is still a vast space to explore regarding the development of dedicated Apps for WHS. The list of available Apps, by 25 July 2017, is the following:

#	World Heritage Site	App Name	Cost		OS	
			Free	Paid	iOS	And.
01	Aachen Cathedral	Aachener Dom	x		x	
02	Speyer Cathedral	Dom Speyer / Speyer Cathedral	x		x	x
03	Hanseatic City of Lübeck	(Quarterquest) Altstadt von Lübeck	x		x	x
04		iTour Lübeck English	x		x	x
05	Palaces and Parks of Potsdam and Berlin	Sanssoussi – The Park and its buildings	x		x	
06		Sanssoussi Palace Visitor Guide	x		x	
07	Town of Bamberg	ShowMe: Bamberg		x		x
08	Collegiate Church, Castle, and Old Town of Quedlinburg	Quedlinburger FachwerkAPP – Das Welterbe City-Guide	x		x	x
09	Völklingen Ironworks	Freizeitführer Saarmoselle	x		x	x
10	Cologne Cathedral	Der Kölner Dom	x		x	x
11		Der Kölner Dom – Ein Hörführer	x			x
12		Cologne Cathedral Tour Guide	x			x
13		WDR 360 VR	x		x	x
14	Bauhaus and its Sites in Weimar and Dessau	The topography of modernism	x		x	x
15		Bauhaus Archive	x		x	x
16	Museumsinsel Berlin	Museum Island Visitor Guide	x		x	
17	Garden Kingdom of Dessau-Wörlitz	WelterbeRegion	x			x
18	Zollverein Coal Mine Industrial Complex in Essen	UNESCO-Welterbe Zollverein App	x		x	x
19	Historic Centres of Stralsund and Wismar	Wismar Tourist Guide	x		x	x
20	Upper Middle Rhine Valley	Rheintour DE		x	x	x

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[24] In this case, as discussed in the previous sections, a "dedicated WHS App" is as an App specially developed for the WHS attraction. Generic touristic Apps are not considered as "dedicated"; the only exception is when the city centre (usually called an old town) is considered a WHS, in this case, a touristic App developed for that specific city might enter in the list if in its home screen there is an indication of UNESCO or WHS.

#	World Heritage Site	App Name	Cost		OS	
			Free	Paid	iOS	And.
21	Frontiers of the Roman Empire: Upper German-Raetian Limes [25]	Virtuelle Limeswelten mobil	x			x
22		Limes Mittelfranken Mobil	x		x	x
23	Berlin Modernism Housing Estates	Gropius to Go	x		x	x
24	Prehistoric Pile dwellings around the Alps	Palafittes Guide	x		x	x
25	Bergpark Wilhelmshöhe	Bergpark	x		x	x
26	Carolingian Westwork and Civitas Corvey	Corvey	x		x	x
27		Welterbe – Guide to Germany	x		x	x
28	UNESCO Germany	World Heritage in Germany	x			x
29		world heritage – The UNESCO World Heritage sites	x		x	
19 WHS (from 38) **+ 3 UNESCO Germany**		**29 Apps**	Free	Paid	iOS	And.
			27	2	23	24
					Both: 17	

Table 3.3: *List of dedicated World Heritage Apps for Germany*

Some Apps retrieved following the search criteria were discarded as they did not offer WHS related content, being excluded from the research list. In some cases, they were "clickbait" Apps, to promote other content apart from the WHS, such as touristic tours or purchase-in features, using the UNESCO's attractions to convince the user to download the App. In other cases, some Apps running on web-based content presented problems to load the pages, not being functional enough to be analysed. So, they also have been deleted from the sample list.

The final list includes generic touristic Apps where it was possible to find WHS information, but not in evidence in its home screen. Usually, in this case, one needs to go navigate further into the App to discover if a WHS has been addressed.

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[25] For the Upper German Raetian Limes it was possible to find more Apps similar to the *Limes Mittelfranken Limes Mobil,* developed by same company (edufilm und medien Ges.mbH), but from the standard search string of using the official WHS name in German and English at official markets, just the two selected Apps were found for this heritage site.

World Heritage Site	App Name	Cost		OS	
		Free	Paid	iOS	And.
Cologne Cathedral	Cologne Cathedral (internet)[26]	x			x
	Germany: Cologne Cathedral	x			x
	Cologne Cathedral (Sure Naga Mounika)		x	x	
Bauhaus and its Sites in Weimar and Dessau	Luther Bauhaus Gartenreich	x			x
Luther Memorials in Eisleben and Wittenberg	Luther Bauhaus Gartenreich	x			x
	Luther-Souvenir Wittenberg	x		x	
	Lutherstadt Wittenberg App ONE	x			x
Garden Kingdom of Dessau-Wörlitz	Fremde Welt ganz nah	x			x
Mines of Rammelsberg, Historic Town of Goslar and Upper Harz / Water Management System	Goslar – Natur erleben	x		x	x
Monastic Island of Reichenau	History Quiz & Knowledge App	x			x
Upper Middle Rhine Valley	Rhine on Skates	x			x
Speicherstadt and Kontorhaus District with Chilehaus	Hamburg, Demo Speicherstadt	x			x
Wartburg Castle	Eisenach CityGuide	x		x	
Würzburg Residence with the Court Gardens and Residence	Würzburg – mobile travel guide	x		x	x
* several WHS locations, to be purchased separated inside the App	Artguide	x	x	x	x

Table 3.4: *List of excluded Apps*

3.4.2 – WHS App Analysis

An overview of the selected WHS Apps from an affordance perspective can provide information about what is being offered to the users, especially regarding content and features. This overview can help trace the common tools used for promoting a WHS and which features could be used as inspiration for building the prototype. The analysis retrieves possible guidelines from layout, navigation, design, and content perspectives. As said, the analysis will be later used to support a WHS prototype App based on the state of the art of the App market, to be tested in comparison with another version based on guidelines retrieved from academic literature.

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[26] The App "Cologne Cathedral (internet)", it is functional and WHS related, but it is an older version (last updated in 2011) of the "Der Kölner Dom", developed by the same company – Cologne Digital GmbH on behalf of the Cologne Cathedral Archdiocese, therefore this App will be not considered in the design analysis, due its newer version already be in the App list.

As an adjustment, when the retrieved App had more than one version, English, and German for instance, it will be considered the one with more information and features. The same occurs on different OS (Android or iOS). If the versions for each platform ended up to be precisely the same, it would be selected the English version for iOS.

The review of each one of the selected Apps starts with a brief presentation about the WHS evidenced by the App, followed by the technical information of the respective App(s) together with a screenshot of the main page and the analysis on layout, navigation, design, content and features. The complete overview and analysis of the WHS dedicated Apps are available in Appendix A.3.

3.5 – Market Overview Results

On the overview of the selected Apps, common features and content structure were analysed to serve as the source for building a guideline to be applied for a market-based prototype, to be later compared with an academic-literature-based prototype.

The selected Apps were analysed following the expert review technique, where "an individual expert review involves a single practitioner who is asked to provide feedback on the usability of a UI" (Wilson, 2014, p. 37). The analysis followed a set of criteria, and all the Apps have been scrutinised in regard to the same parameters. So, the App was mapped, and the content was distributed under subcategories, adapted from a study on usability guidelines for mobile websites and applications (Shitkova et al., 2015), but taking in consideration the singularities for mobile Apps. This approach created a structure to enable one to identify the usability guidelines; at the same time, it allowed to map the visual aspects and content structure from the official Apps for WHS in Germany. The subcategories of analysis were divided as it follows:

3.5.1 – Layout

The layout refers to how the visual structure is placed on the screen, without considerations on the design aspects.

L1 – Place Content in one screen

All the needed information is visually placed on the full screen, without the need to scrolling, swapping or dragging to access the content.

L2 – Vertical Scrolling

The screen, or part of it, presents a vertical scrolling.

L3 – Horizontal Scrolling

The screen, or part of it, presents a horizontal scrolling.

L4 – Consistency between different sections

The layout maintains the same visual structure when accessing different content sections of the App.

The following graphic summarises the outcomes of the layout's analysis:
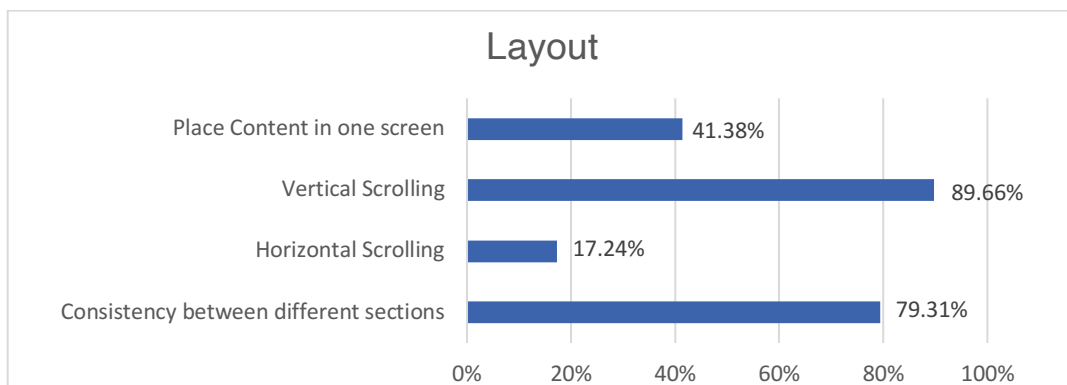
Figure 3.5: *Market-Based Layout Analysis*

3.5.2 – Navigation

The navigation category was analysed in a similar manner as the layout, not considering the design aspects, but mapping how the screen transitions and functionalities are presented, divided into quantitative (N1 and N2) and qualitative (N3 to N8) mapping.

N1 – Number of taps to WHS Information

Quantitative approach that determines the number of taps/clicks needed to reach proper WHS information.

N2 – Number of items on main navigation

The number of items placed in the main navigation of the app, offering access to the available (main) sections.
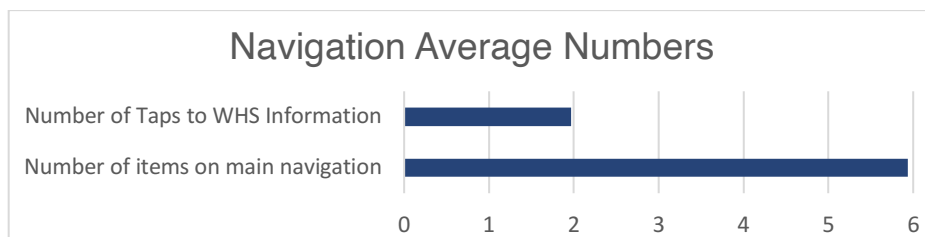
Figure 3.6: Market-Based Navigation Analysis 1

N3 – Navigation Menu visible

When changing sections, the main menu is always present.

N4 – One Level Navigation Menu

It refers to how the information is structured, by making the content accessible from the main navigation menu, without the need to click further.

N5 – More Levels

When the content goes further than just one screen from the main navigation, making the user tapping further inside the same section.

N6 – Self-explanatory menu

The items placed in the main menu are apparent enough to be understandable without further explanation, by referring to its purpose, without the need for further interpretation or guidance.

N7 – Enable gestures

Beyond common gestures as scrolling, the App also offers other interaction gestures, such as swapping, dragging, pinching, etc.

N8 – Presence of Back button

The App offers a back button on its interface. This can be signed as an icon, or as a "back" text, or even displaying the previous section name. Despite most Android smartphones having a "back" button on its physical device, this feature addresses the presence of a back button on the App interface.
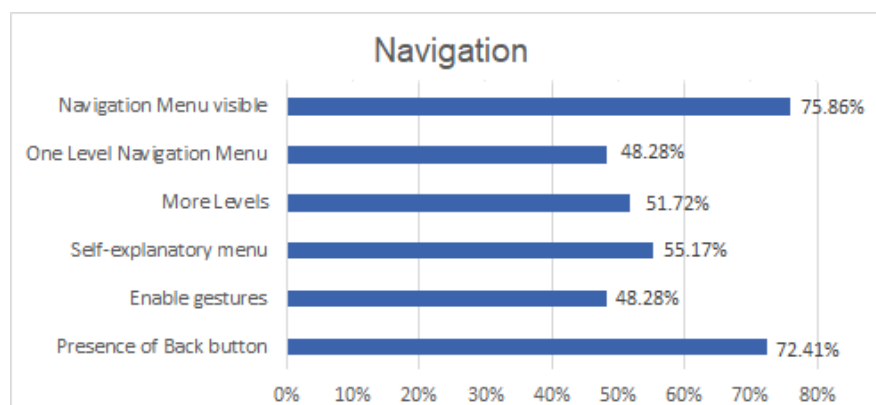
Figure 3.7: *Market-Based Navigation Analysis 2*

3.5.3 – Design

The design refers to how the layout and navigation are visually treated in the interface.

D1 – Limited user of colours

The App limits itself up to three different colours, including the background.

D2 – Wide range of use of colours

The App uses four colours or more.

D3 – Simple design

A simple design is reinforced by sparse use of colours, white space and limited graphic additions, the use of margins and blank spaces.

D4 – Polluted design

Polluted design is an unpleasant screen presentation by many factors, such as overcrowded elements in the same screen, use of photography as the background making the text hard to read, poor aesthetics choice.

D5 – Use of icons

The presence of icons to reinforce information, on main navigation or inside content.
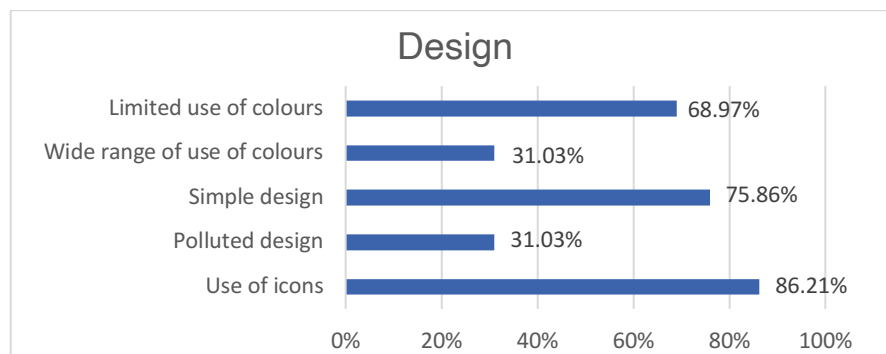
Figure 3.8: *Market-Based Design Analysis*

3.5.4 – Content

The content disposition follows a similar approach to the one used for the layout, but with emphasis on how the information is offered in terms of length, and the possible interactions with the content.

C1 – Long text

Three or more paragraphs of text referring/explaining the WHS, usually generating vertical scrolling.

C2 – Short text

One or two paragraphs regarding the selected WHS.

C3 – Information at start screen

When the App is opened, an introductory or explanatory text is presented to guide the users.

C4 – No information at start screen

When the App is opened, no information about it is displayed, leaving to the users to discover the purpose of it by themselves.

C5 – Prevent information loss

When back from a section, the App presents the previous information without any loss, especially on multi-level content.

C6 – Provides action feedback

The App clearly shows on its interface a visual feature regarding an activity, such as section highlight or downloading bar, for example.

C7 – Provides share options

The possibility to share information by e-mail, social networking or other communication channels.

C8 – Nearby

The App presents a possibility to search for related WHS places, sometimes shown as "nearby" or "around me", usually associated with GPS maps.

C9 – Tours

Text presenting tour(s)/routes to the users.

C10 – Links to external content

The App provides links to the accessed by third-party Apps, such as an official website(s), e-mail contact, linked telephone numbers.
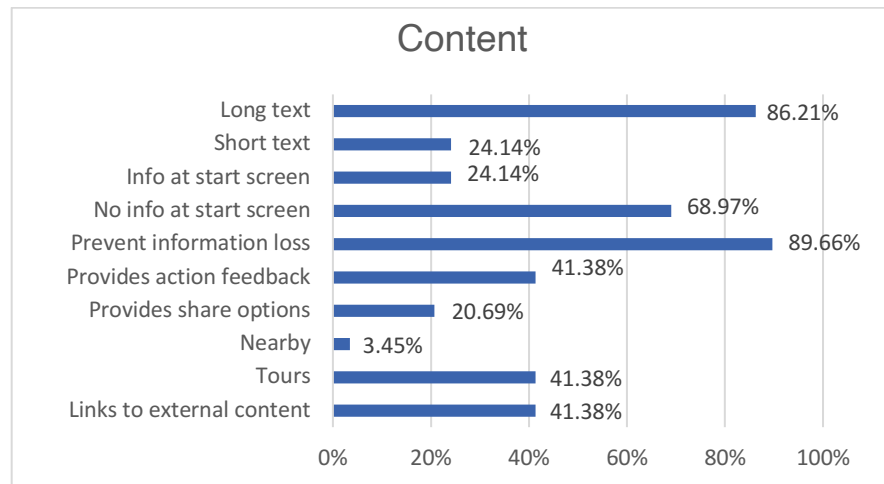
Figure 3.9: *Market-Based Content Analysis*

3.5.5 – Features and Media

Along with content, the *Features and Media* show which mediatic content format is used in the Apps.

F1 – Photo

The App uses photos or gallery as a content format.

F2 – Photo 360°

Presence of 360° photos, being navigated by the use of fingers or device gyroscope.

F3 – Map GPS

The presence of map to show the available WHS, with GPS related features (as Google Maps, for instance).

F4 – Map Static

They offer a static map, usually a map image without any further interaction.

F5 – Video

The presence of video(s) related to the WHS.

F6 – Audio

The use of audio to explain a WHS or to guide the user.

F7 – Animation Film

The use of animation (in video format) related to a WHS. The difference between this subcategory to the videos, is the production of a 3D or 2D animation, instead of a digital recorded film.

F8 – AR

The App has an Augmented Reality feature.

F9 – VR

The App has a Virtual Reality feature.

F10 – Game

Text the existence of any kind of game related to the WHS.
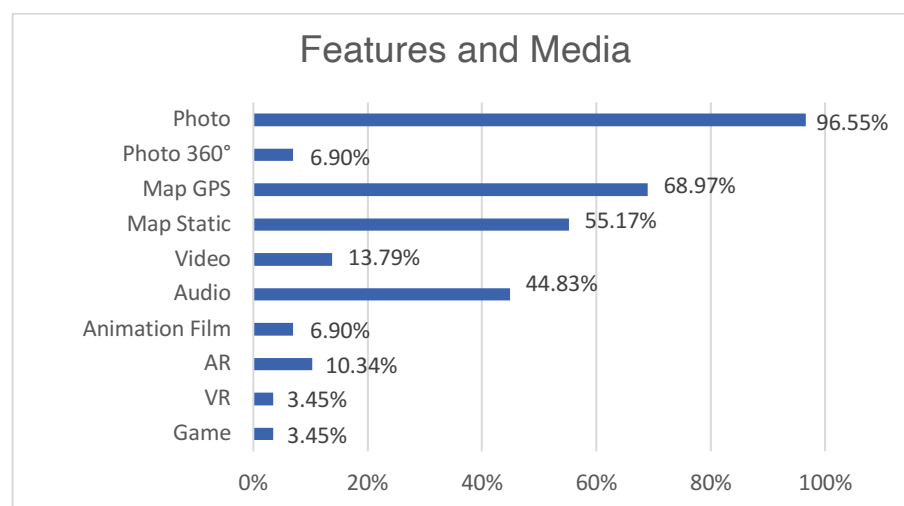
Figure 3.10: *Market-Based Features and Media Analysis*

Overall, the numbers offer a summary of that can be considered the most adopted media formats and features on the Apps for World Heritage Sites in Germany, being traced as common elements in dealing with WHS information.

3.5.6 – Market Overview Table

Table with the results of the Market review, divided in two pages:

	Apps:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total	Total %
Layout																																
L1	Place Content in one screen	x	x		x							x				x			x	x	x	x			x		x			x	**12**	**41.38 %**
L2	Vertical Scrolling	x	x	x		x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**26**	**89.66 %**
L3	Horizontal Scrolling		x			x							x				x										x				**5**	**17.24 %**
L4	Consistency between different sections		x	x	x		x	x		x		x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	**23**	**79.31 %**
Navigation																																
N1	Number of Taps to WHS Information	2	3	1	3	3	2	2	3	2	1	1	3	3	1	3	2	1	2	2	2	1	1	3	3	1	2	1	1	2	**2 (average)**	
N2	Number of items on main navigation	5	5	3	3	5	12	2	10	5	6	3	4	6	4	6	10	5	6	16	11	9	6	3	4	5	4	4	4	6	**6 (average)**	
N3	Navigation Menu visible	x	x		x	x	x		x	x	x	x		x	x	x			x	x		x	x	x	x	x	x	x	x		**22**	**75.86 %**
N4	One Level Navigation Menu	x		x	x		x	x	x	x		x			x		x										x	x	x	x	**14**	**48.28 %**
N5	More Levels		x		x							x		x	x		x		x	x	x	x	x	x	x	x				x	**15**	**51.72 %**
N6	Self-explanatory menu	x	x	x		x	x						x			x			x	x	x		x	x		x	x	x	x		**16**	**55.17 %**
N7	Enable gestures	x	x			x	x			x	x			x	x		x				x	x		x		x			x		**14**	**48.28 %**
N8	Presence of the Back button				x	x		x	x	x	x	x				x	x		x	x	x	x	x	x	x	x	x	x	x	x	**21**	**72.41%**
Design																																
D1	Limited use of colours		x	x	x		x	x		x	x	x		x	x	x	x	x	x	x			x	x		x	x	x			**20**	**68.97 %**
D2	Wide range of use of colours	x			x		x					x								x	x			x					x	x	**9**	**31.03 %**
D3	Simple design		x	x	x		x	x		x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x				**22**	**75.86 %**
D4	Polluted design	x			x			x		x		x								x				x					x	x	**9**	**31.03 %**
D5	Use of icons	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	**25**	**86.21 %**
Content																																
C1	Long text	x		x		x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**25**	**86.21 %**
C2	Short text	x	x				x					X		x					x		x										**7**	**24.14 %**
C3	Info at start screen	x				x	x								x		x	x			x										**7**	**24.14 %**
C4	No info at start screen		x	x	x				x		x	X	x	x		x			x	x	x		x	x	x	x	x	x	x	x	**20**	**68.97 %**
C5	Prevent information loss (when back)	x	x	x	x	x	x	x	x	x	x	x	X	x	x	x	x	x		x	x		x	x	x		x	x	x	x	**26**	**89.66 %**

	Apps:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total	Total %
C6	Provides action feedback			x			x			x		X		x	x	x	x					x			x	x	x				12	41.38 %
C7	Provides share options				x								x			x						x			x			x			6	20.69 %
C8	Nearby																			x											1	3.45 %
C9	Tours	x	x			x				x	x	X						x			x	x			x			x	x		12	41.38 %
C10	Links to external content		x				x		x			x			x	x	x			x		x					x		x		12	41.38 %

Features and Media

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total	Total %
F1	Photo	x	x	x	x	x	x	x	x	x	x	X	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	28	96.55 %
F2	Photo 360°	x												x																	2	6.90 %
F3	Map GPS	x	x	x		x		x	x	x			x		x		x	x	x	x	x	x	x	x	x		x			x	20	68.97 %
F4	Map Static	x	x	x		x	x			x	x	X			x	x		x	x		x	x	x				x				16	55.17 %
F5	Video												x		x					x			x								4	13.79 %
F6	Audio	x	x			x			x	x		X			x	x					x	x	x		x		x				13	44.83 %
F7	Animation Film													x						x											2	6.90 %
F8	AR						x										x		x												3	10.34 %
F9	VR													x																	1	3.45 %
F10	Game			x																											1	3.45 %

GNTB Category

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total	Total %
Nature, Garden & Landscape																	x			x					x					3	10.34 %
Churches & Abbeys	x	x						x	x	x	x																x			7	24.14 %
Castles & Palaces				x	x																									2	6.90 %
Industrial Heritage									x									x												2	6.90 %
Historical Town Centres			x	x			x	x														x								5	17.24 %
Other World Heritage Sites														x	x	x					x	x	x	x						7	24.14 %
All Categories (Apps with all WHS in Germany)																											x	x	x	3	10.34 %

Table 3.6: *The market/industry overview*

3.5.7 – Industry Overview Guidelines

The industry/market overview provided impressions and a comprehensive analysis from the available Apps for WHS in Germany. The data enable the development of a market-based prototype with the most common features and layout, creating an average model to be tested against the academic- literature-based prototype.
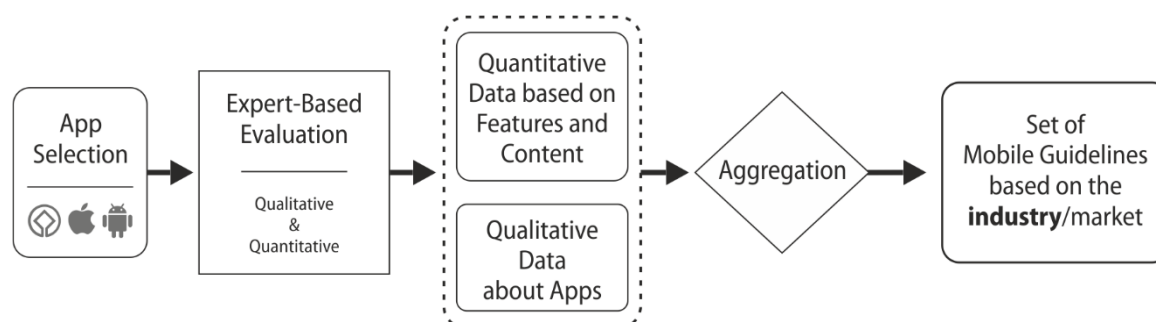
Figure 3.11: Schematics on the creation of the industry-based guidelines

This average model is based on the most popular elements presented on the evaluated Apps, taking in consideration Layout, Navigation, Design, Content Style, Features and Media. In this selection of market-based guidelines to build the prototype, only the elements that scored more than 50% on the evaluation were selected.

It is possible to point that, based on the available Apps dealing with World Heritage Sites in Germany, an average App would have the following aspects:

Layout

- The content is spread beyond the initial screen, creating vertical scrolling. (L2).

- The layout structure will be maintained among the sections (L4).

Navigation

- The number of taps to achieve WHS content from the initial screen is two. (N1).

- The number of items in the main menu would go from four to six (N2).

- The navigation menu is always visible among the sections (N3).

- The content will be spread in different levels, leaving the user to explore further in each section (N5)

- The main menu is self-explanatory, with direct meaning sections (N6).

Design

- The use of colours is limited up to three (D1).

- The design should be clean and not polluted (D2).

- The use of an icon to reinforce the menu and content should be present (D5).

Content

- The content should utilise long text, usually more than two paragraphs (C1).

- No need for introductory, or explanation text on the initial screen (C4).

- The prevention of content loss when backing from a section should be ensuRed (C5).

Features and Media

- Use photo/illustration along with the text, to reinforce the content (F1)

- Providing map in GPS and static versions (F3, F4)

These guidelines will shape the market-based prototype's structure and layout and how the content will be divided into it. The content will be elaborated addressing the WHS in Weimar, using the information available at the city's official touristic site ("Kulturstadt Weimar – UNESCO World Heritage," n.d.) [27].

3.6 – Guidelines from Literature Review

This section covers the creation of the second set of guidelines for WHS Apps, based on a review of academic literature. The guidelines will be later compared with the instructions extracted from the market overview.

The App market overview guidelines took an observational approach, aiming to generate a model that could represent the average content style and features based on the available WHS

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[27] https://www.weimar.de/en/culture/unesco-world-heritage/

Apps for Germany. The guidelines based on the academic literature will take in consideration a structured review of academic publications on mobile Apps' usability (available on research repositories such as ACM, IEEE, SAGE, JSTOR and Google Scholar), existing usability models (Nielsen, Schneiderman, Weinschenk and Barker, ISO 9241-11, and PACMAD), and official industry guidelines for mobile development from the leading mobile OS companies (Apple and Android). In summary, the generated guidelines took in consideration studies from the academia and official recommendations, connecting and combining different views and approaches into mobile interface design guidelines applied for WHS.

3.6.1 – Similar approaches

Guidelines can be used as recommendations to build mobile interfaces, but also to evaluate usability aspects on Apps. Generating guidelines and/or evaluation framework based on the literature review can have different approaches. In this case, the meta-analysis method (Mullen, 2013) can be seen as the main umbrella approach by combining several selected qualitative and quantitative studies, integrated into a statistical result. Going more specifically into mobile usability guidelines, it is possible to find studies addressing this topic, but instead of tackling WHS they are applied in a more diverse range of scenarios.

Nayeb (2013) created a usability evaluation framework, combining usability heuristics from renowned authors, like Nielsen, Schneiderman, and others. This elaborated framework was developed for the iOS operating system, aiming to be applied for Apps in general without any particular target group or topic. It is possible to find similar studies addressing to a specific target group based on age, such as elderly use (Petrovčič et al., 2017), dividing the discovered guidelines into screen-based interactive elements, menu and navigation elements, and touch-screen gestures possibilities. Another interesting approach is generating and comparing guidelines for different targets: platform, genre and generic, for mobile use (Ahmad et al., 2017).

Creating guidelines through the literature-based review is a common practice, as the mentioned examples illustrate, but what differentiates the approaches are the chosen elements to generate it. This research considers mobile usability in general, WHS mobile studies, industry recommendations (iOS and Android), studies on travel and city Apps, and mobile studies dealing with different age groups (such as teenagers and elderly), aiming to create a set of

guidelines that could be applied for promoting the WHS in Germany for a diverse range of target groups.

3.6.2 – Academic Literature Approach

The academic literature approach systematically extracted a set of guidelines from official documentation from the OS developers, added a layer of confirmed guidelines on studies of mobile Apps retrieved from peer-reviewed academic publications on trustworthy platforms such as ACM ("ACM Digital Library," n.d.), IEEE ("IEEE Xplore Digital Library," n.d.), JSTOR ("JSTOR," n.d.), SAGE ("SAGE Journals: Your gateway to world-class journal research," n.d.), and Google Scholar ("Google Scholar," n.d.).
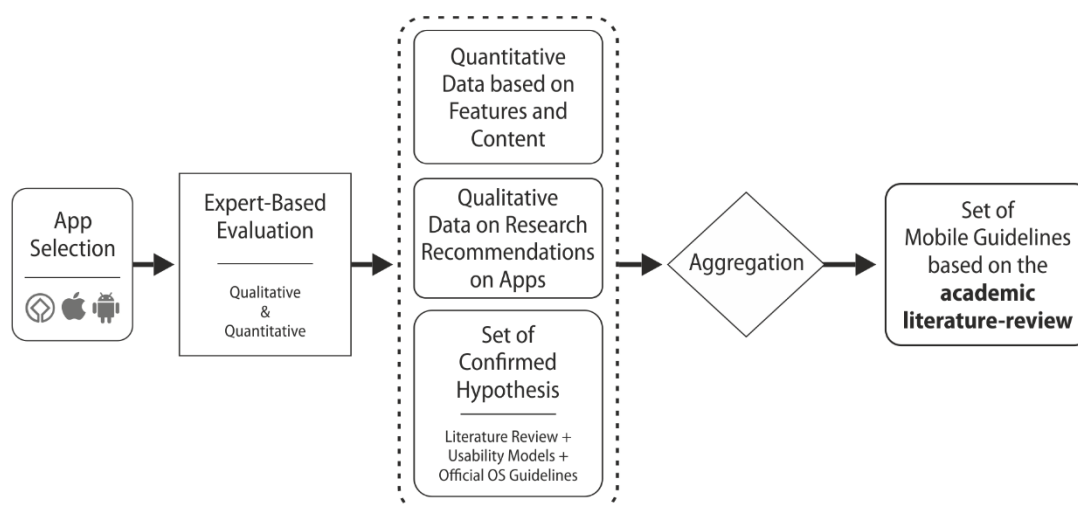
Figure 3.12: Schematics on the creation of the literature-review guidelines

To find studies and research outcomes that can contribute to the formation of literature-review guidelines for mobile Apps dealing with cultural places, a set of search parameters were applied:

- Search Strings:
    - "Mobile usability" AND "Guidelines"
    - "Mobile usability" AND "App"
    - "Mobile usability" AND "Heritage"
    - "Mobile usability" AND "Travel Guide"
    - "Mobile usability" AND "City Guide"
    - "App guidelines"
    - "Mobile interface guidelines"

- ▪ Since 2013, covering a period of five years of publications, considered enough for a literature review (DePoy and Gitlin apud Cottrell and McKenzie, 2010, p. 53)

- ▪ The first 50 results sorted by relevance were analysed in each platform and based on their abstract/description were selected or discarded according to the relevance for content analysis.

Search results on articles found at academic digital libraries, for each search string and time setting, between 18th and 20th December 2017.

	ACM Digital Library	IEEE Xplore Digital Library	JSTOR (* Journals and Reports)	SAGE Journals	Google Scholar
mobile usability guidelines	6937	12	7	217	23500
mobile usability app	6825	26	8	169	15100
mobile usability heritage	6623	4	1	21	3020
mobile usability travel guide	7752	3	1	123	5450
mobile usability city guide	9217	1	2	128	6650
app guidelines	1814	14	88	581	40500
mobile interface guidelines	10790	20	29	402	37700

Table 3.7: *Search results*

3.6.2.1 - Selected Articles

The academic literature review aimed to find guidelines and interface recommendations for mobile applications to build a literature-based prototype to be tested compared to the market-based one. For this intent, studies made on mobile web sites were included, as they address the interface design on mobile screens. Medical and health studies were included just when they addressed mobile interface design and usability and not therapeutic issues.

Also, studies tackling mobile interaction with public spaces were included, as the prototype App will deal with interaction in the city of Weimar. The same applies for context-aware and location-based mobile interactions.

Taking into consideration the broad range of visitors in Weimar, the selection also included studies on interface mobile for elderly users. In addition, although the prototype is not a proper learning tool, studies on mobile learning were also included, as far the interface was the research target, as the city of Weimar also deals with teenager students visiting and learning about the heritage attractions of the city. Overall, the selected articles covered aspects that

could be translated into guidelines. Vague recommendations, such as "create an appealing design" were not considered for being too open for different interpretations.

Based on their titles and abstract, 249 academic publications on mobile usability and mobile cultural heritage were identified but thirteen were not accessible due subscription and/or accessibility issues (despite five of them providing a two-pages preview for free), totalising a 5.2% rate of waste in the original selection, making the final number of selected academic works for reading equals to 236 publications [28].

Beyond those covering App interface and usability, the selected readings dealt with topics such as cultural heritage, mobile tourism, mobile health, mobile learning, older adults, just to mention a few examples. Based on the readings' keywords provided by the authors (when available) a word cloud was generated to illustrate the wide range of selected topics, as seen in figure 3.12.

Figure 3.13: *word cloud generated from the used keywords from the reading selection – when available* [29]

3.6.2.2 - Search and selection of Guidelines

Each one of the selected publications was read and systematically analysed against the same classification as the mobile Apps to find and extract guidelines that could be used for cultural heritage Apps. When a guideline or recommendation was found, it was placed in a table

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[28] The complete list with the selected 249 readings is available at Appendix, section A.4

[29] The word cloud was generated using Microsoft Word add-in "Pro Word Cloud", including keywords that appeared more than two times. The use of "_" between the words was included just to generate the cloud.

following the same structure from the guidelines extracted from the app-market-overview, if fit, but also by adding new categories to correspond to the literature review findings. In addition, the analysis was not restrained to the selection list, taking in consideration also references inside the publications, cascading the approach to retrieve the most relevant publications on the field.

This literature-review based guidelines reinforced some and confronted other instructions found on the market-based review, creating a new set of guidelines to be tested against. When conflicting guidelines were found (for instance: one author claiming that texts should be longer, and another that should be short), the one with the majority of supports (more than one author endorsing it) was selected; in case of a tie (equal sum of authors endorsing opposite views), an expert-based overview technique was implemented to decide which one would be selected for the academic-literature guidelines' list, based on the proximity with the research topic.

The found guidelines were fit in the following table, using the common ones with the market-based selection with the addition of new literature-based guidelines, distinguished with an asterisk (*) mark.

Code	Guidelines	Authors
	Layout	
L1	Place Content on one screen / minimising-avoiding scrolling	(Shitkova et al., 2015) (Miniukovich et al., 2017) (Antoun et al., 2017) (Kumar and Mohite, 2016) (Kaur and Haghighi, 2016) (Díaz-Bossini and Moreno, 2014) (Petrovčič et al., 2017) (Carmien and Manzanares, 2014) (Ahmad et al., 2017) (Silva et al., 2014)
L4	Consistency between different sections (it may include the way the tasks are performed in different sections)	(Miniukovich et al., 2017) (Antoun et al., 2017) (Ropponen, 2016) (Kumar and Mohite, 2016) (Zamri and Al Subhi, 2015) (Díaz-Bossini and Moreno, 2014) (Nayebi et al., 2013) (Cota et al., 2014) (Carmien and Manzanares, 2014) (Inostroza and Rusu, 2014) (Ahmad et al., 2017) (Jailani et al., 2015)
L5 *	Orientation: provide session title	(Cota et al., 2014) (Ahmad et al., 2017)
L6 *	Providing a search bar	(Nayebi et al., 2013) (Cota et al., 2014) (Ahmad et al., 2017)
	Navigation	
N1	Number of Taps to WHS Information	(Cota et al., 2014)
N3	Navigation Menu visible	(van Biljon and Renaud, 2016) (Inostroza and Rusu, 2014) (Ahmad et al., 2017) (Jailani et al., 2015)
N4	One Level Navigation Menu	(Shitkova et al., 2015) (Zamri and Al Subhi, 2015) (Petrovčič et al., 2017)
N6	Self-explanatory menu	(Shitkova et al., 2015) (Costa et al., 2016) (Ropponen, 2016) (Kumar and Mohite, 2016) (Petrovčič et al., 2017) (Cota et al., 2014)
N8 *	Presence of the Back button	(Ahmad et al., 2017) (Silva et al., 2014) (Jailani et al., 2015)
	Design	
D1	Limited use of colours	(Hoehle et al., 2016a) (Ropponen, 2016) (Kumar and Mohite, 2016) (Ross and Gao, 2016) (Kaur and Haghighi, 2016) (Díaz-Bossini and Moreno, 2014) (Nayebi et al., 2013) (Cota et al., 2014) (Ahmad et al., 2017) (Silva et al., 2014)
D3	Simple design	(Shitkova et al., 2015) (Antoun et al., 2017) (Kumar and Mohite, 2016) (Ross and Gao, 2016) (Zamri and Al Subhi, 2015) (Díaz-Bossini and Moreno, 2014) (Nayebi et al., 2013)

Code	Guidelines	Authors
D5	Use of icons	(Shitkova et al., 2015) (van Biljon and Renaud, 2016) (Kumar and Mohite, 2016) (Ross and Gao, 2016) (Hincapie et al., 2016) (Zamri and Al Subhi, 2015) (Kaur and Haghighi, 2016) (Díaz-Bossini and Moreno, 2014) (Joyce et al., 2014) (Hoehle et al., 2015) (Nayebi et al., 2013) (P. E. Kourouthanassis et al., 2015) (Petrovčič et al., 2017) (Carmien and Manzanares, 2014) (Cruz Zapata et al., 2014) (Silva et al., 2014) (Jailani et al., 2015)
D6 *	Space between buttons or other clickable items	(van Biljon and Renaud, 2016) (H. K. Kim et al., 2016) (Antoun et al., 2017) (Hoehle et al., 2016a) (Ropponen, 2016) (Kaur and Haghighi, 2016) (Hoehle et al., 2015) (Petrovčič et al., 2017) (Carmien and Manzanares, 2014) (Ahmad et al., 2017) (Silva et al., 2014)
	Content	
C2	Short text	(Shitkova et al., 2015) (Miniukovich et al., 2017) (Kumar and Mohite, 2016) (Zamri and Al Subhi, 2015) (Díaz-Bossini and Moreno, 2014) (Carmien and Manzanares, 2014) (Inostroza and Rusu, 2014) (Ahmad et al., 2017) (Silva et al., 2014) (Jailani et al., 2015)
C3	Info at start screen	(Alkhafaji et al., 2017) (Costa et al., 2016) (Joyce et al., 2014) (P. E. Kourouthanassis et al., 2015) (Cota et al., 2014) (Ajibola and Goosen, 2017)
C5	Prevent information loss (when back)	(Shitkova et al., 2015) (Zamri and Al Subhi, 2015) (Nayebi et al., 2013) (Cota et al., 2014) (Ajibola and Goosen, 2017) (Inostroza and Rusu, 2014)
C6	Provides action feedback (in some cases, confirmation before deleting/uploading)	(Shitkova et al., 2015) (van Biljon and Renaud, 2016) (Zamri and Al Subhi, 2015) (Nayebi et al., 2013) (P. E. Kourouthanassis et al., 2015) (Cruz Zapata et al., 2014) (Ahmad et al., 2017)
C9	Tours / Routes	(Baker and Verstockt, 2017) (Gavalas et al., 2016)
C11 *	Focus / Only display essential information, no more than needed	(Inostroza and Rusu, 2014) (Cruz Zapata et al., 2014) (Ahmad et al., 2017)
C12 *	Clickable buttons with tactile feedback or sound (for Elderly)	(van Biljon and Renaud, 2016) (Ropponen, 2016) (Petrovčič et al., 2017) (Silva et al., 2014) (Carmien and Manzanares, 2014)
C13 *	Considering the surrounding environment	(Alkhafaji et al., 2017) (Joyce et al., 2014) (P. E. Kourouthanassis et al., 2015)
C14 *	Provide notification of location-based (it can be incorporated into the C17 guideline)	(Alkhafaji et al., 2017) (McGookin et al., 2017) (Galatis et al., 2016) (Hermansson et al., 2014)
C15 *	Use of visual clues for visited POI	(Hincapie et al., 2016)(Hincapie et al., 2016)(Hincapie et al., 2016)(Galatis et al., 2016) (Ahmad et al., 2017)
C16 *	Screen font large (for Elderly) / optimal size (it can be incorporated into the C17 guideline)	(van Biljon and Renaud, 2016) (H. K. Kim et al., 2016) (Miniukovich et al., 2017) (Antoun et al., 2017) (Ropponen, 2016) (Ahmad et al., 2017) (Silva et al., 2014) (Kaur and Haghighi, 2016)
C17 *	Allowing personalization / configuration	(Zamri and Al Subhi, 2015) (Alkhafaji et al., 2016) (Nayebi et al., 2013) (Inostroza and Rusu, 2014) (Silva et al., 2014) (Ropponen, 2016)
	Features and Media	
F1	Use of Aesthetics graphics (related to "Photos" of market-based guidelines)	(Hoehle et al., 2016a) (Kumar and Mohite, 2016) (Ross and Gao, 2016) (Hincapie et al., 2016) (Alkhafaji et al., 2016) (Díaz-Bossini and Moreno, 2014) (Hoehle et al., 2015) (Petrovčič et al., 2017) (Carmien and Manzanares, 2014) (Cruz Zapata et al., 2014) (Ahmad et al., 2017) (Silva et al., 2014) (Jailani et al., 2015)
F9	Use of AR (if the App idea allows it)	(Hincapie et al., 2016) (tom Dieck and Jung, 2015) (Chung et al., 2017)

Table 3.8: *Selected Literature Review Categories.*

The academic literature-based guidelines have some items in common with the market-based one, but with more new orientations regarding the content. When comparing both guidelines, it is possible to find those exclusive for each model, making a comparison viable for the prototypes.

Code	Guidelines	Market-Based	Literature-Based
Layout			
L1	Place Content in one screen / minimising-avoiding scrolling		■
L2	Vertical Scrolling	■	
L4	Consistency between different sections	■	■
L5	Orientation: provide session title		■
L6	Providing a search bar		■
Navigation			
N1	Number of Taps to WHS Information	2	╱
N2	Number of items in the main navigation (average)	4 to 6	╱
N3	Navigation Menu visible	■	■
N4	One Level Navigation Menu		■
N5	More Navigation Levels	■	
N6	Self-explanatory menu	■	■
N8	Presence of the Back button		■
Design			
D1	Limited use of colours	■	■
D3	Simple design	■	■
D5	Use of icons	■	■
D6	Space between buttons or other clickable items		■
Content			
C1	Long text	■	
C2	Short text		■
C3	Info at start screen		■
C4	No info at start screen	■	
C5	Prevent information loss (when back)	■	■
C6	Provides action feedback		■
C9	Tours / Routes		■
C11	Focus / Only display essential information, no more than needed		■
C12	Clickable buttons with tactile feedback or sound (for Elderly)		■
C13	Considering the surrounding environment		■
C14	Provide notification of location-based (incorporated into C17)		■
C15	Use of visual clues for visited POI		■
C16	Screen font large (for Elderly) / optimal size (incorporated into C17)		■
C17	Allowing personalization / configuration		■
Media and Features			
F1	Photos / Aesthetic graphics	■	■
F3	Map GPS	■	╱
F4	Map Static	■	╱
F9	AR (if the App idea allows it)		■

Table 3.9: *Guidelines comparison (market and literature-based)*

One of the features that were not detailed on the literature-based is regarding the maps. On the market-based findings, it was suggested to offer an offline map along with the GPS one. Still, such orientation was not found on the literature-based, making this specific feature open to new test possibilities.

For the AR feature, the selected studies commonly addressed issues using this technology, but just a few of them recommended it for a mobile application. It is possible to say that AR it is indeed an interesting feature for a mobile App, but using such technology demands an exclusive and complex development on navigation, interaction, and on dealing with camera-based recognition– which is not the purpose of this research.

Following are the similarities between the market and literature-based guidelines:

Layout
The layout structure will be maintained among the sections (L4).
Navigation
The navigation menu is always visible among the sections (N3).
The main menu is self-explanatory, with direct meaning sections (N6).
Design
The use of colours is limited up to three (D1)
The design should be clean and not polluted (D2)
The use of an icon to reinforce the menu and content should be present (D5)
Content
The prevention of content loss when backing from a section should be ensuRed (C5)
Features and Media
Use photo/illustration along with the text, to reinforce the content (F1)

Table 3.10:   *Guidelines similarities*

Despite some similarities, both extracted guidelines (market vs literature-review) present more differences, in terms of quantity, creating a proper scenario for prototype comparison.

The main differences between the market and literature-review guidelines:

Market-based	Literature-review-based
Layout	
The content is spread beyond the initial screen, creating vertical scrolling. (L2).	Place content on one screen / minimising or avoiding scrolling (L1)
Navigation	
The number of taps to achieve WHS content from the initial screen is two. (N1)	No indication about the number of taps to achieve a WHS content
The number of items in the main menu would go from four to six (N2)	No indication about the number of items in the main menu.
The content will be spread in different levels, leaving the user to explore further in each section (N5)	The content navigation should not go further in terms of screen/taps, maintaining the content in less screen possible (N4)
	Presence of a "Back" button (N8)
Design	
	When available, the buttons and other clickable items should have a visible space between them (D6)

Market-based	Literature-review-based
Content	
The content should utilise long text, usually more than two paragraphs (C1)	The content should utilise short text, avoiding vertical scrolling (C2)
No need for introductory or explanation text on the initial screen (C4)	Presence of an introductory or explanation about the App on the initial screen (C3)
	Provide action feedback, such as confirmation before downloading or deleting (C6)
	Presence of recommended tour(s)/route(s) (C9)
	Only display essential information, no more than needed (C11), reinforcing L1
	Clickable buttons should provide tactile feedback or sound (C12)
	Considering the surrounding environment, location-based information (C13)
	Providing notification of location-based information, i.e.: an alert when a POI is close by (C14)
	Use of visual clues for visited POI, optimizing the navigation (C15)
	Large font / the possibility to customise font-size of the interface (C16)
	Allowing personalisation/configuration of interface elements (C17)
Features and Media	
Providing map in GPS and static versions (F3, F4)	No recommendation found regarding the use of maps.
	Use of AR (if the App idea allows it)

Table 3.11: *Guidelines differences*

Some other elements that were not traced – or suggested – on the extracted guidelines were implemented to be compared in the prototypes, such as:

- **Content: List vs Grid content**

  "List" usually is when the options are listed in a vertical sequence. "Grid" presents the content in a "tile" format, generally in square shape. See image 4.2.

- **Map: icons**

  Displaying one map with generic "map – pin" icon, and other with personalised icons (according to content categories)

- **Map: marker information (?)**

  When tapping/clicking in a pin on a map, the information may be displayed in the bottom of the screen, or a "floating" banner. See image 4.3.
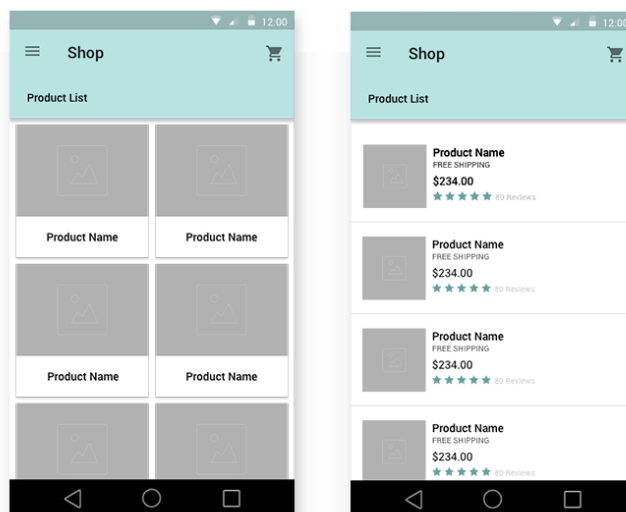
Figure 3.14: *an example of the difference between "Grid" (left) and "List" (right) formats* [30]
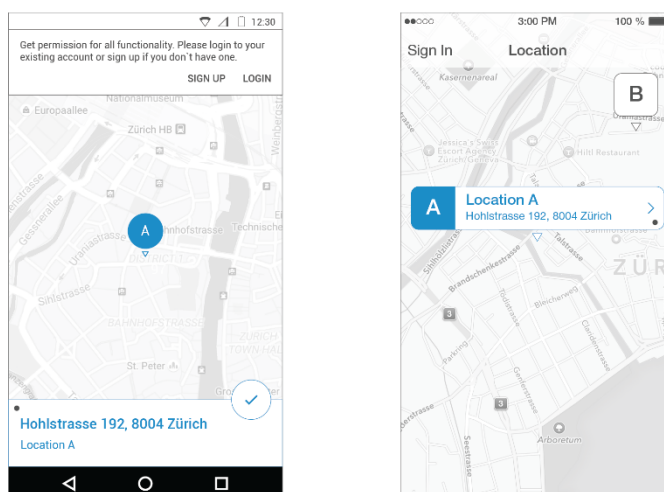

Figure 3.15: *map options of displaying marker information: bottom (left) and floating (right)* [31]

In the following table, the comparison between Market/Industry and Literature-based guidelines is provided, with common guidelines in light-green colour.

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[30] Image retrieved and modified from:

https://assets.justinmind.com/blog/wp-content/uploads/2016/04/mobile-ui-patterns-structure-grid-list-1.png

[31] Image retrieved and modified from: https://blog.lemberg.co.uk/android-vs-ios-how-create-habitual-ui

Code	Guidelines	Market-Based	Literature-Based	Common on both
	Layout			
L1	Place Content in one screen / minimising-avoiding scrolling		X	
L2	Vertical Scrolling	X		
L4	Consistency between different sections			X
L5	Orientation: provide session title		X	
L6	Providing a search bar		X	
	Navigation			
N1	Number of Taps to WHS Information	2	(up to) 3	
N2	Number of items in the main navigation (average)	6		
N3	Navigation Menu visible			X
N4	One Level Navigation Menu		X	
N5	More Navigation Levels	X		
N6	Self-explanatory menu			X
N8	Presence of the Back button		X	
	Design			
D1	Limited use of colours			X
D3	Simple design			X
D5	Use of icons			X
D6	Space between buttons or other clickable items		X	
	Content			
C1	Long text	X		
C2	Short text		X	
C3	Info at start screen		X	
C4	No info at start screen	X		
C5	Prevent information loss (when back)			X
C6	Provides action feedback (in some cases, confirmation before deleting/uploading)		X	
C9	Tours / Routes		X	
C11	Focus / Only display essential information, no more than needed		X	
C12	Use of Aesthetics graphics		X	
C13	Clickable buttons with tactile feedback or sound (for Elderly)		X	
C14	Considering the surrounding environment		X	
C15	Provide notification of location-based		X	
C16	Use of visual clues for visited POI		X	
C18	Screen font large (for Elderly) / optimal size		X	
C19	Allowing personalization / configuration		X	
	Media and Features			
F1	Photos / Aesthetic graphics			X
F3	Map GPS	X		
F4	Map Static	X		
F9	VR (if the App idea allows it)		X	

Table 3.12: *Guidelines comparison*

As seen, the guidelines were found by literature-review and usability studies, and the ones extracted from the Apps currently available in the market have enough differences to justify a comparison test. To do it, two prototypes were developed as follows.

3.7 – Transforming Guidelines into Prototypes

After having two different sets of guidelines, industry and academic-literature based, the next step was a more practical approach: creating prototypes for mobile Apps using each set of guidelines, and testing them against each other.

For this, two versions were developed:

- Prototype Red: market/industry-based

- Prototype Blue: academic-literature based

The reason of calling "Red" and "Blue", was to set a neutral impression for the users/testers, not revealing their nature (industry or literature), neither their chronological development using letters such as "A" and "B" – which could lead to the impression of "A" being the first version, and "B" a second-and-updated version. Also these colours choice, Red and Blue, took into consideration potential colour-blindness issues, in order to avoid difficulties in distinguishing the versions.

On the next chapter will be detailed the development of each prototype, content-wise and their technical specifications.

Chapter 4 – Prototypes Development

The development of two different App prototypes using the extracted interface guidelines from the market/industry and academic literature-review is the core part of the empirical approach to compare and validate the guidelines.

Prototypes are a common practice in software development, working as a feasible tool to test features that emulate a possible real application (Nielsen, 1993, p. 94). They are very important for the analysis of potential design problems (Adenauer and Petruschat, 2012). Through the prototypes, in a cost-effective way, it is possible to test concepts and functionalities before the development of a final App version (Morson, 2014, p. 69).

The prototype secures the *look and feel* of what could be a future application, where the *look* deals with the aspects of cosmetic and visual interaction. The *feel* goes on its interaction behaviour (Boll et al., 2013, p. 159), providing a real impression for the testers.

Each set of extracted guidelines generated a different prototype version, divided into:

- Red: the prototype following the guidelines from the industry/market

- Blue: the prototype following the guidelines from the academic literature-review

As said, the reason of choosing "Red / Blue" was to avoid using "A / B" which could lead to the interpretation that "A" is the first version, and "B" the second one. The set of colours (Red/Blue) was also chosen to avoid colour-blindness issues, helping to visually differentiate the prototypes for the evaluation.
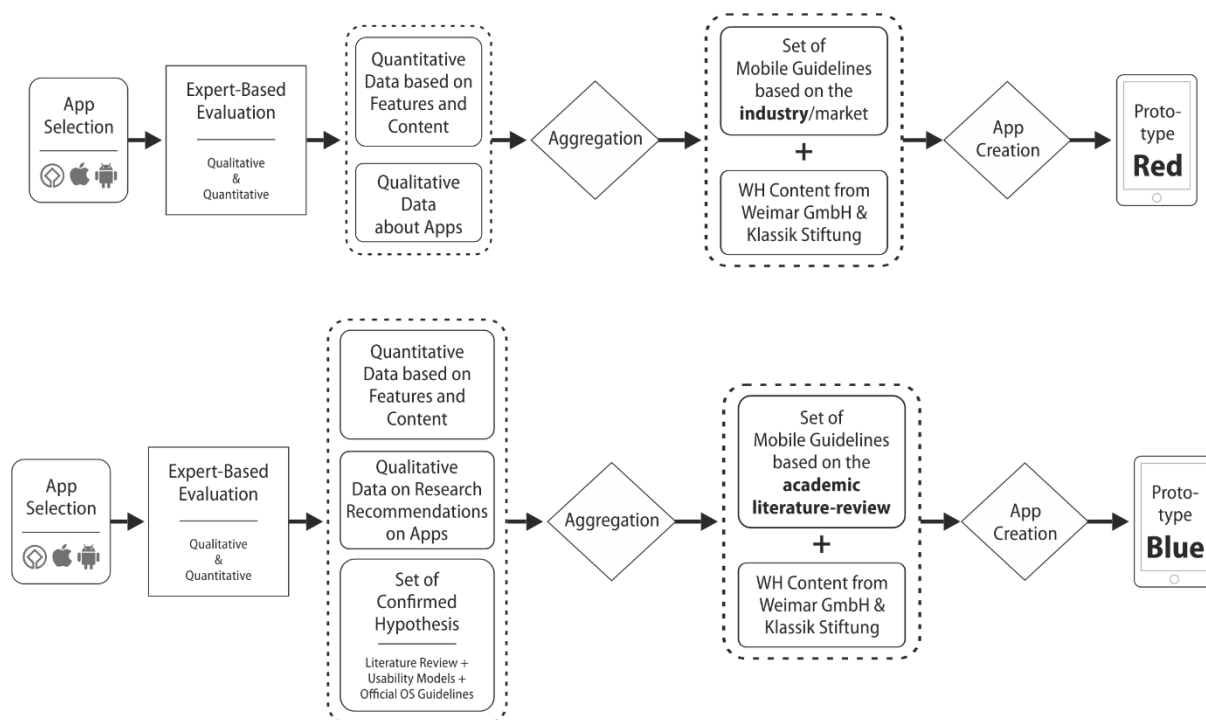
Figure 4.1: *Schematics of different prototypes creation*

4.1 – Prototype Tools

It is possible to find many non-coding prototype/wireframing tools to create App prototypes to be tested with users without long hours of programming. These tools offer an excellent opportunity to develop reliable prototypes by incorporating mobile gestures (such as swiping, pinching) and common visual elements from popular mobile OS to be added in the models (Kvalheim, 2015), creating a familiar interface to the users.

Most of these tools offer a free trial period, going afterwards for a monthly payment system plan or the software purchase possibility. Some of the most popular prototyping tools available

are: Axure[32], Balsamiq[33], InVision[34], Junstinmind[35], Marvel[36], Ptoto.io[37], and UXPin[38], to mention a few. Also, the giant software company Adobe released their own prototype tool in 2017 (after some beta testing) – the AdobeXD[39], as part of their Adobe Suite which includes other creative tools such as Photoshop and Illustrator.

There are differences in the features and capabilities each of these tools are offering, despite all of them being designated to creating App prototypes. Choosing a prototype tool is a matter of personal taste, considering the offered functionalities on each software. For this research, it was chosen the Justinmind software for the following reasons:

- The possibility to download an App directly into the mobile device (iOS and Android), giving a more real feeling to the users. It also offers the option to access the prototype via a desktop browser.

- Possibility to create an "iframe" inside the app. The "iframe" feature is common on web development, that allows an external page to be embedded in an HTML page. This feature proved to be useful in implementing tailored maps generated from GoogleMaps inside the prototype and opening external content – such as the official UNESCO's world heritage sites page inside the prototype navigation (App header and main menu). This "iframe" feature is rarely offered in the other mentioned prototype tools.

- Possibility to create fixed interface elements that do not scroll with the screen, useful for headers and main menu.

An issue on using the free-trial software is the time limitation (usually 30 days of use) and user testing (some have a restriction on the number of participants). Considering these constraints

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[32] https://www.axure.com/

[33] https://balsamiq.com/

[34] https://www.invisionapp.com/

[35] https://www.justinmind.com/

[36] https://marvelapp.com/

[37] https://proto.io/

[38] https://www.uxpin.com/prototyping

[39] https://www.adobe.com/uk/products/xd.html

and options, the Justinmind software was privately purchased for this research, facilitating a no-rush development and opening to a limitless amount of user testing participants.

4.2 – Development

Following the proposed methodology of comparing and testing two sets of guidelines through prototypes, the development took into consideration creating a standard content and visual basis for both versions and providing the interface differences of these two guidelines models, to be tested with users.

4.2.1 – Content

Both prototypes used similar content, mainly retrieved from the official touristic bureau from Weimar – Weimar GmbH [40], and some from the largest city cultural foundation – the Klassik Stifftung [41], and from the Bauhaus-University Weimar [42]. The crediting for the content was given in both prototypes, and representatives from the Weimar GmbH and Klassik Stifftung were invited to participate in the evaluation.

The chosen language for the content was English in both versions. It was more accessible for testers not familiar with the German language, although always displaying the German name and the locations' titles.

4.2.2 – Design

From the visual perspective, both prototypes used the same images and, at some extension, the same icons, with some differentiation according to the main menu sessions and map design. From a cosmetic point of view, the idea was to create similar apps, with subtle differences

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[40] https://www.weimar.de/en/tourism/

[41] https://www.klassik-stiftung.de/en/institutions/

[42] https://www.uni-weimar.de/en/university/profile/unesco-world-heritage-bauhaus/

applied from their own guidelines, to avoid a biased approach on making one version "uglier" than the other. In this way, both prototypes display the same visual appeal for the users, and the testing remain concentrated in the technicalities from the different set of guidelines.
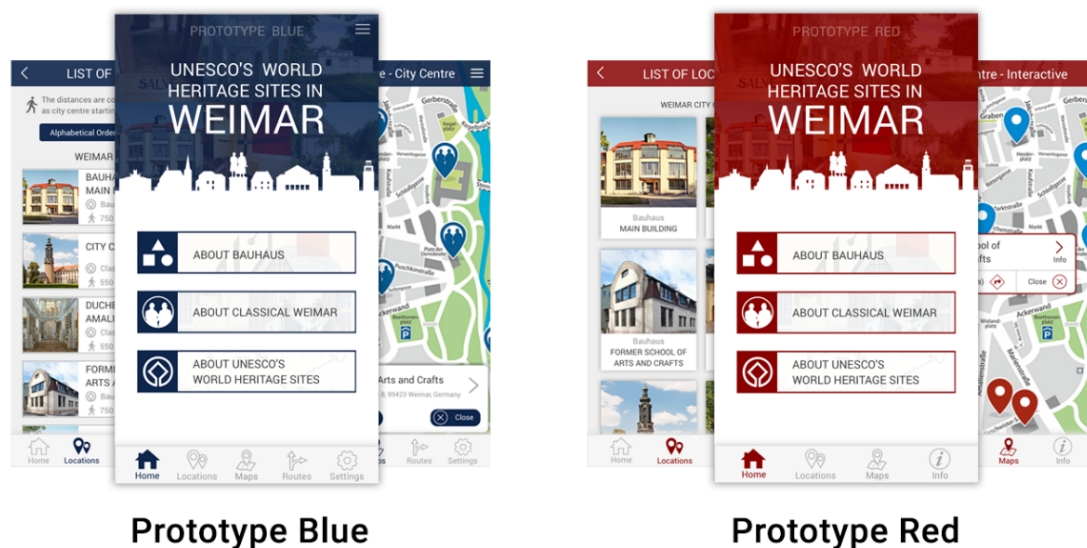
Figure 4.2: *Prototypes Blue and Red preview, with subtle differences*

4.3 – Content Structure

The content structure on both prototypes was built prioritising one-level navigation, whenever possible. The articles' content was extracted from the official tourism web portal for Weimar[43], related page from the Bauhaus University[44] and official UNESCO WHS page[45].

The Red Prototype followed the number of items at the bottom/main menu indicated by the marked-based set of guidelines.

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[43] https://www.weimar.de/en/culture/unesco-world-heritage/classical-weimar/ and
    https://www.weimar.de/en/culture/unesco-world-heritage/bauhaus-sites/

[44] https://www.uni-weimar.de/en/university/profile/unesco-world-heritage-bauhaus/

[45] https://whc.unesco.org/en/list/846/ and https://whc.unesco.org/en/list/729/
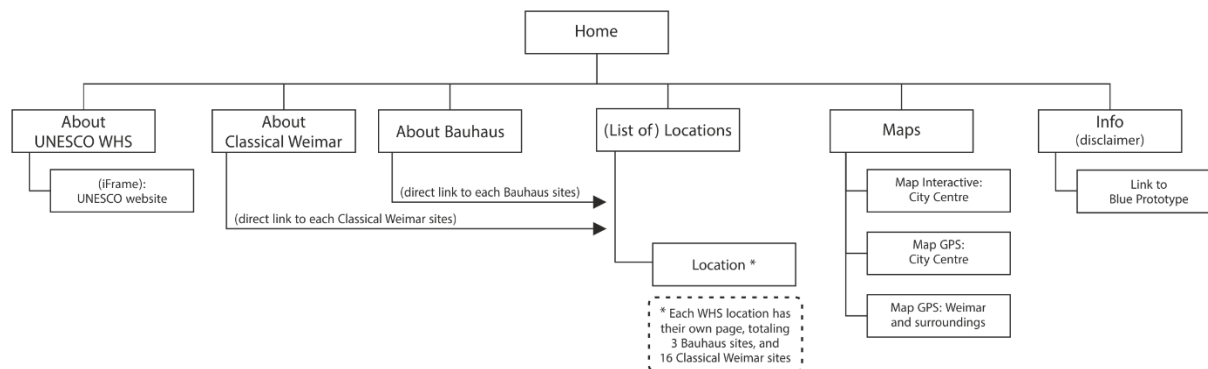
Figure 4.3: Content structure of Red Prototype

The Blue Prototype added "routes" – a guideline extracted from the academic literature -, "settings" and "(hamburger) menu". The differences between the Red and the Blue version enabled to test alternative ways for content navigation.
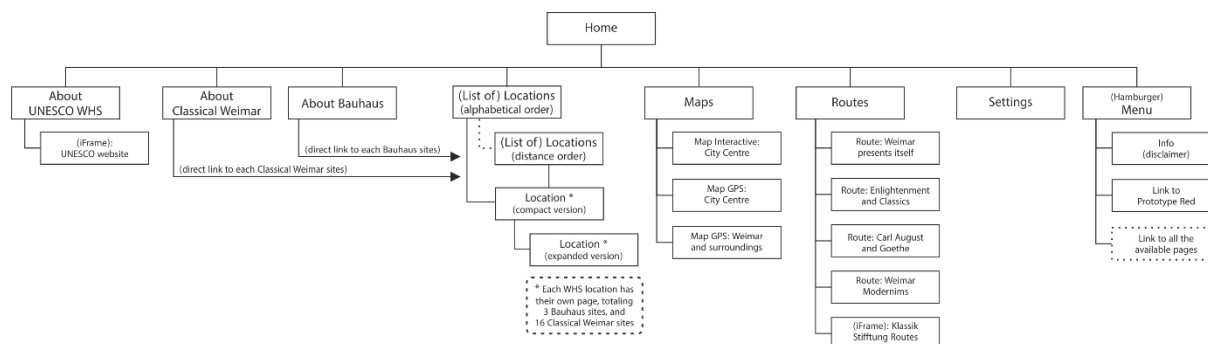
Figure 4.4: Content structure of Blue Prototype

In terms of content organisation, the Blue prototype utilises all the content from the Red prototype, but the "info" – which was substituted by "settings". Content-wise, it can be seen that the Blue prototype has more expanded options in its navigation, including:

- an extra option for "locations" with the possibility to expand the content for each POI;

- Routes, displaying five different options among *Classical Weimar* and *Bauhaus*;

- Settings, as a mock-up functionality, offering customisations on text size, articles format (expanded or contracted), GPS notifications for POI, and distance unities (miles or Km);

- The addition of a "Hamburger" menu, displaying shortcuts for all the available pages and sections in the prototype, plus a link to the "Red" prototype.

4.4 – Interface Design

As said, the chosen interface development on both prototypes aimed to test a different set of guidelines against each other. The differences vary mostly on features and formats. On the following sub-sections, the main differences between the two prototypes will be detailed in terms of interface design. The discussion uses the codes identified previously in Sections 3.5 and 3.6, allowing to see where the specific guideline has been retrieved, if from the current Apps in use or the academic literature-based. The code will appear inside brackets [ ], to demonstrate how they were compared.

The guidelines common on both methods (industry and literature) were applied in both prototypes - such as consistency between different sections [L4], navigation menu visible [N3], self-explanatory menu [N6], limited use of colours [D1], simple design [D3], and use of icons [D5]. In addition, some highlights on the differences will be illustrated to facilitate comprehension.

4.4.1 – Start screen

The main difference between the prototypes at their start screen is a pop-up explanation of the Blue prototype showing the app's main sections [C3]. On the Red prototype, the user goes directly to the main screen [C4].

Prototype Blue   **Prototype Red**
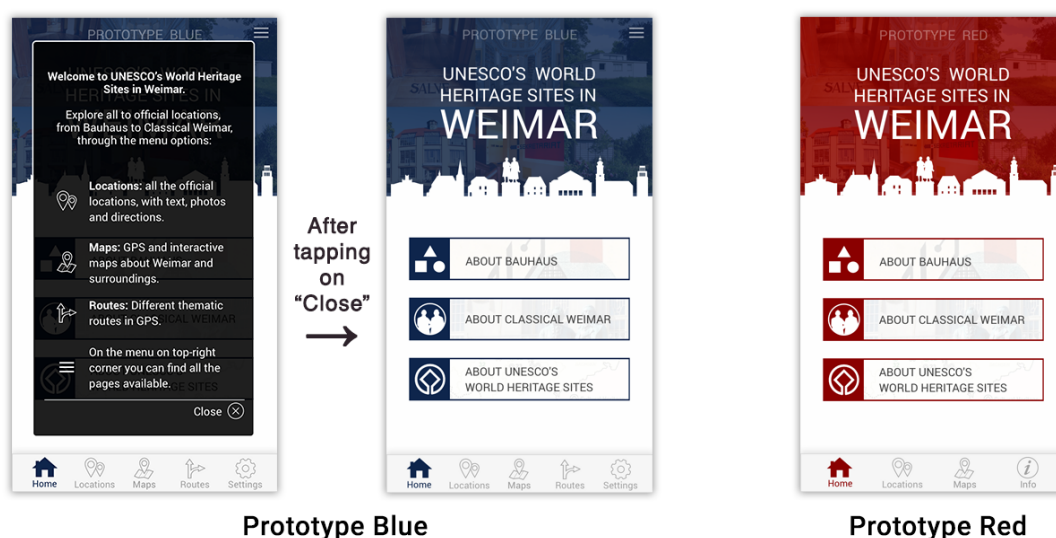
Figure 4.5: Differences in the start screen

4.4.2 – Menu

The menu reflects the content structure, displaying the Blue prototype with more options, including settings [N3, N4, N6]; and the Red prototype with fewer options (based on the industry guidelines) [N3, N6]. On both prototypes, the section icon is highlighted to identify the section where the user is [D1, D3, D5, D6] currently navigating.

The Blue version also offers the Tour feature [C9].

Figure 4.6: Differences in main/bottom menu

4.4.3 – Article Header

The prototypes also served to extrapolate the interface design elements and test different aspects that were not evident on the industry or literature guidelines, such as the presence of a photo-gallery on top of each POI. In the images below, one can see that the gallery is evidenced by navigation arrows and indicative circles, providing immediate feedback on where the user is inside the photogallery.

The Blue version provides more photos related to the POI, while the Red version just shows one picture about the location [F1].
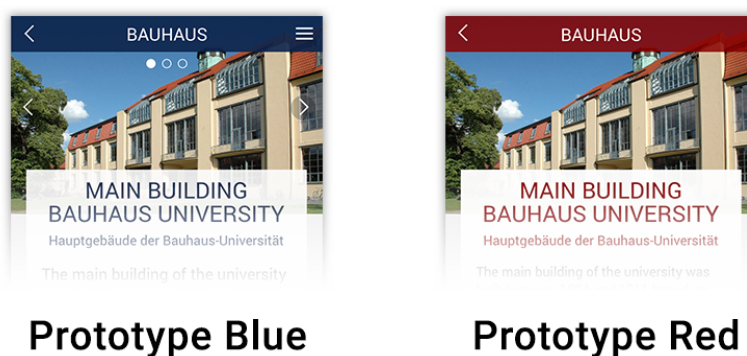

Figure 4.7: Differences in Article Header

4.4.4 – Text Length and Size

The main difference between font size between the versions was the use of bigger font size [C18] on the Blue version – based on elderly-friendly setting, in contrast with smaller one on the Red version.

Regarding the articles, the text is longer in the Red version [C1], creating a vertical scrolling [L2], in contrast with the Blue version with a short text [C2] with the possibility to expand it by offering "Show more information" feature. The second option aims to create an optimised use of the screen space.
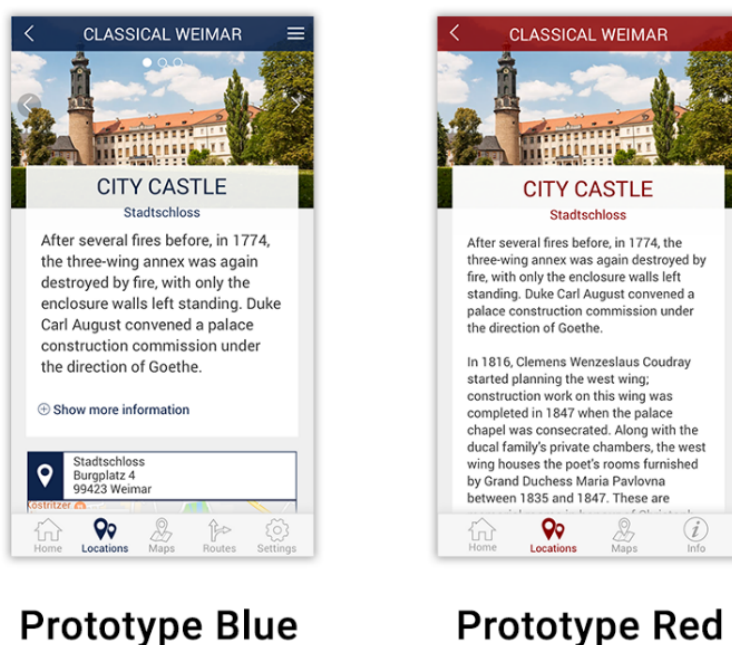
Figure 4.8: *Differences in text length and font size*

4.4.5 – Space Between Interface Elements

The Blue version follows the recommendation of having space between buttons or other clickable items [D6], being elderly-friendly.
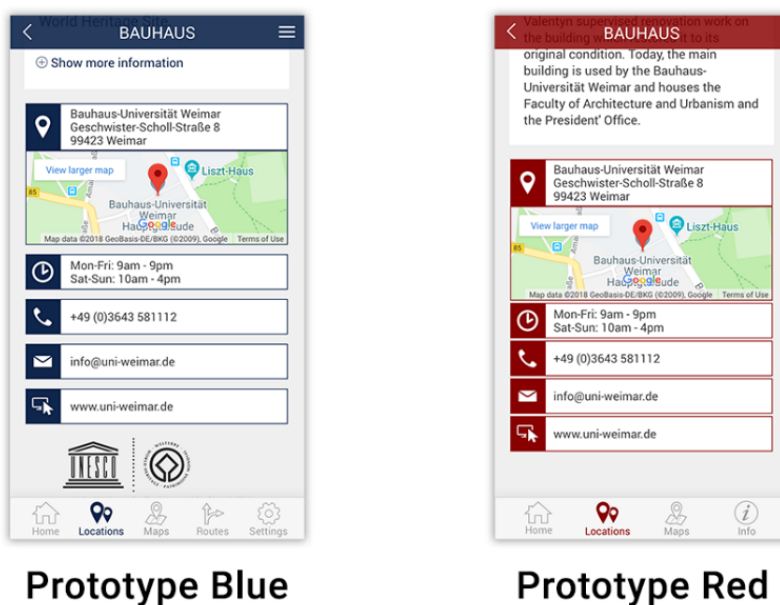
Figure 4.9: *Differences in elements spaces*

4.4.6 – POI Display List

Another implemented and tested a comparative feature that was not covered on both guidelines is the different ways to display the list of POI. The Blue version showed the distance from the user location to the attractions. In contrast, the Red version displays a bigger image without the sites' walking distance based in their current position.

The Blue version also offered the possibility to display the POI list by alphabetical order or distance order.

In terms of the number of POI displayed on the screen – both versions presented a similar choice, showing four locations without the need for scrolling.
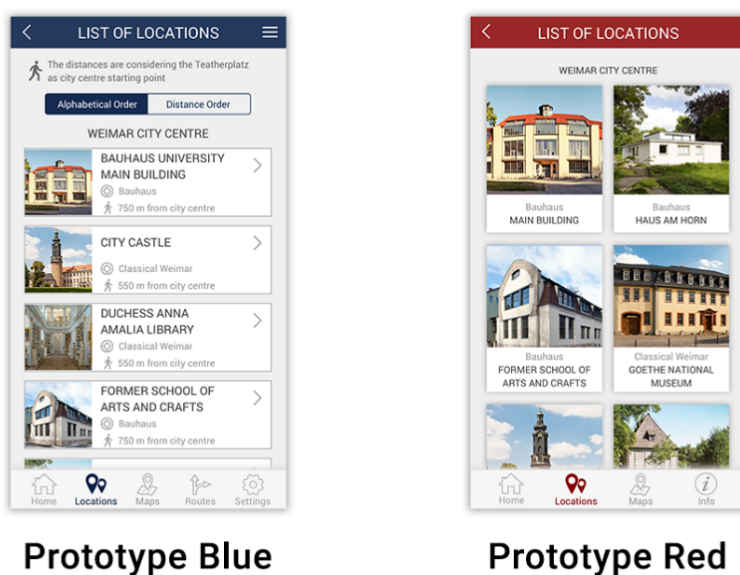
Figure 4.10: Differences in displaying the Point of Interest locations

4.4.7 – Map Icons

When testing the maps, another element was added, offering a different set of icons for the locations. The Blue version presented two different location icons, customised in relation to each WHS type (Bauhaus or Classical Weimar). The Red version used a regular location icon, only making the differentiation between both WHS by the use of colours.
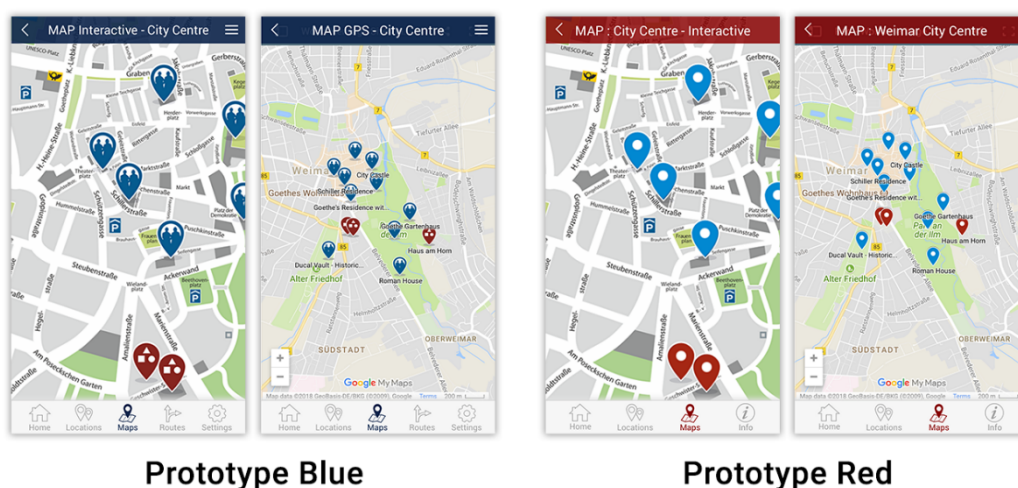

Figure 4.11: Differences in map icons

4.4.8 – Map POI Info

When the user tapped/clicked in a POI inside the map, a pop-up window with the required information appears before leading to the POI article/page. For this feature, two different types of pop-ups were created: one at the bottom of the screen for the Blue version, and another in the middle of the screen, in the Red version. This feature will test if the users prefer to continue to visualise the entire map when the pop-up appears, or if they consider the pop-up information in the centre of the view a more straightforward approach.
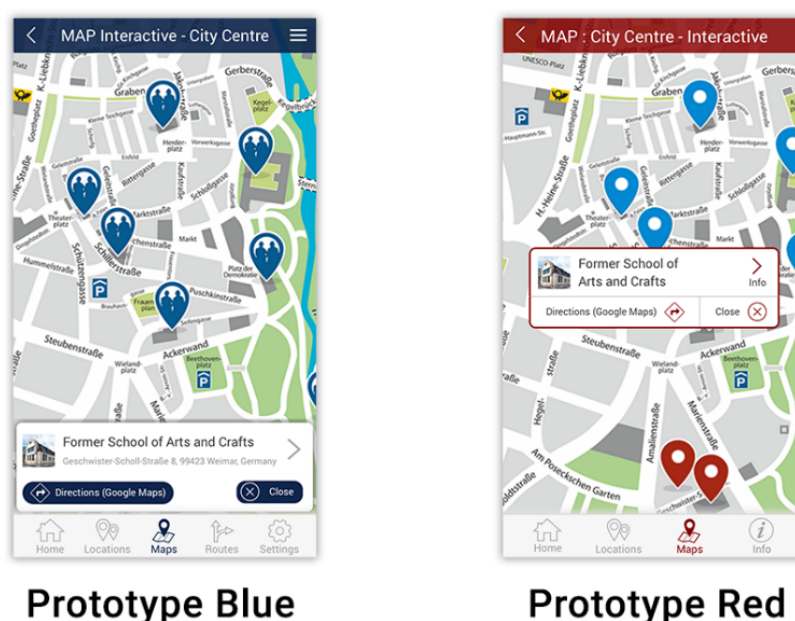
Figure 4.12: Differences in pop-up information preview

4.4.9 – Type of Maps

Each one of the prototypes offered the user two different types of maps. One is the so-called "GPS Map", based on GoogleMaps, creating a piece of slide-type information once the POI was clicked; the other is an "Interactive Map" with a pop-up intro (with different positions, bottom on Blue and middle-screen on Red).
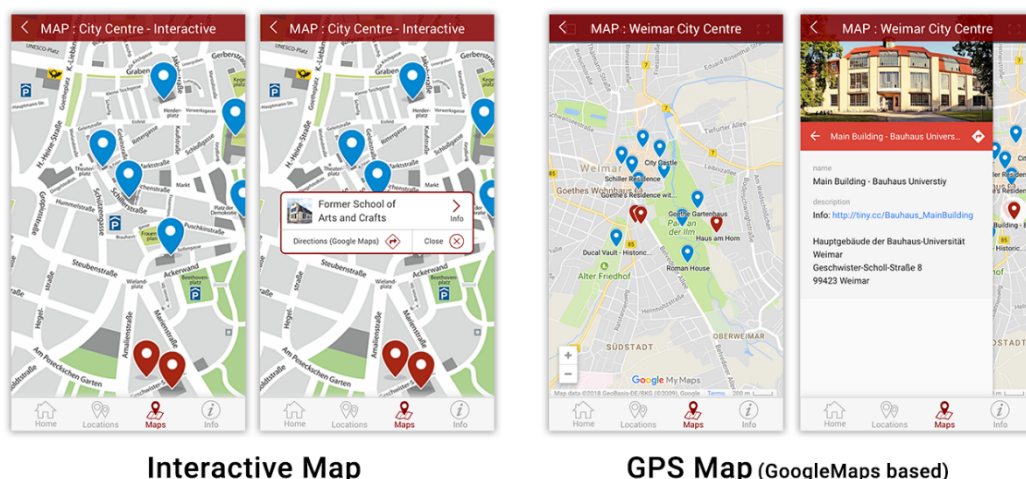
Figure 4.13: *Types of maps: Example of customisable (AKA interactive) and Google Maps*

4.4.10 – Routes

The implementation of routes was based on the academic literature-review (C9), and for that reason, it was only implemented in the Blue prototype. The routes used content provided by the *Klassik-Stifftung* page for UNESCO WHS.
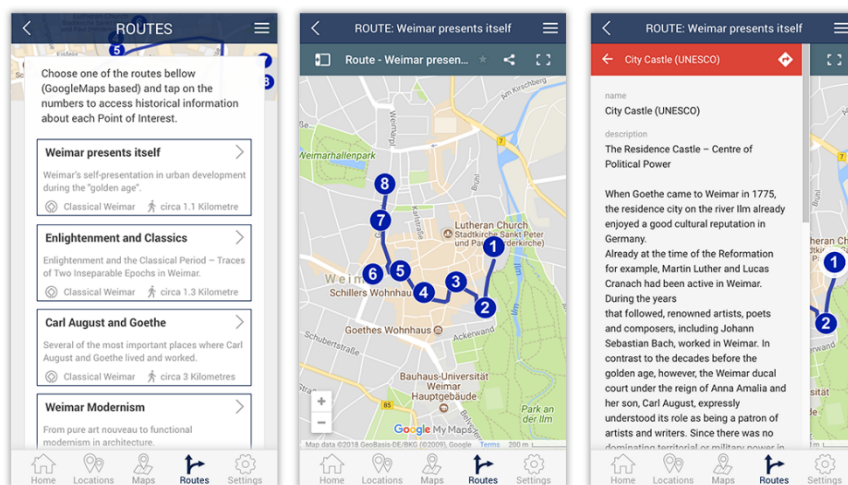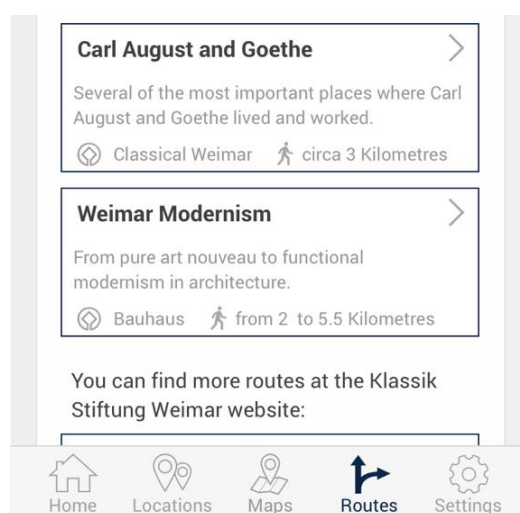

Figure 4.14: *Routes preview on Blue Prototype*

In total, four routes were offered in the prototype, being tree for Classic Weimar and one for Bauhaus. Each route presents their own title with a small description, accompanied with details

on the type of WHS (Classical Weimar or Bauhaus), and the approximately walking length in kilometres, as seen on Figure 4.15.


Figure 4.15: *Routes detail*

The routes were developed on GoogleMaps, being accessible inside the prototype App. The routes can also be accessed on:

- Weimar presents itself (Classical Weimar)
  https://www.google.com/maps/d/viewer?mid=16UFCiltWCcWFs2yeLEtV9X4II1AGSPb6

- Enlightenment and Classics (Classical Weimar)
  https://www.google.com/maps/d/viewer?mid=17YLSQUdrNnGbrmSOdusGf1EXqwBgSVhN

- Carl August and Goethe (Classical Weimar)
  https://www.google.com/maps/d/viewer?mid=1Bx0UB8SvtAplLRfMYmRmo7EgdvEhUj3P

- Weimar Modernism (Bauhaus – with the possibility to engage in a more extended version)
  https://www.google.com/maps/d/viewer?mid=1IPbDRnYOIQD2TOgghJvFduVo2TKsxmIT

4.4.11 – Interface Personalisation

This section/page was also implemented only on the Blue prototype, by following the recommendation of allowing customisation and further configuration (C19) of the App's interface. It allows changing features such as font-size (especially helpful for the elderly

group), distance units (kilometres or miles), GPS notification when near a POI (C15), and how the articles can be presented if compact (C11) or extended format.
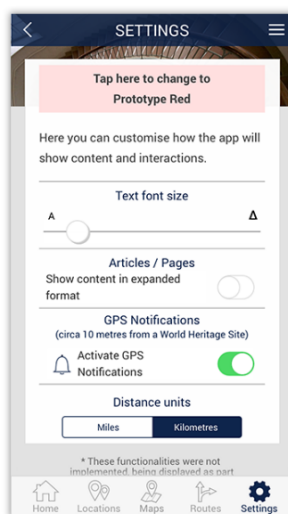
Figure 4.16: *Settings page on Blue Prototype*

4.4.12 – Menu / Site-map

Although this particular feature was not found on the academic literature-review recommendations, neither on the industry-based guidelines, it was implemented as comparative experimentation on the Blue prototype. It displays a site-map from all the content available inside the App, helping the user to visualise and access the available content. This feature aimed to enhance navigation through the App content.
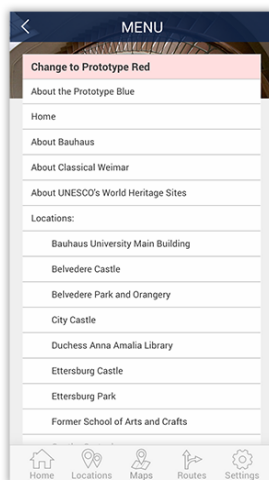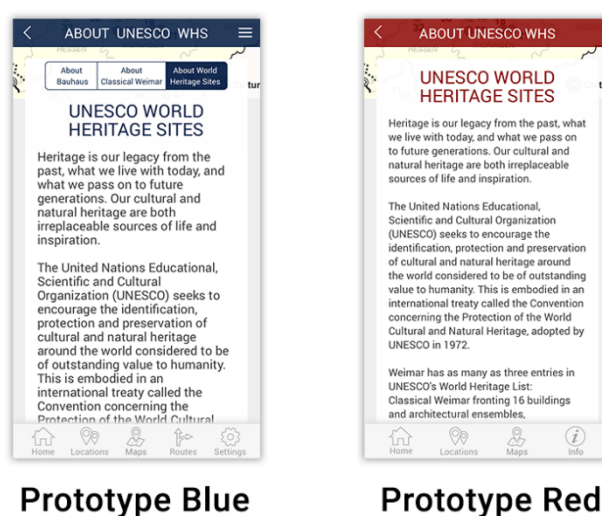

Figure 4.17: *A "site-map" available on Blue Prototype*

4.4.13 – In-tab Navigation

Another feature missing from the academic literature-review but found on the industry-based analysis is the use of in-tab navigation. This feature has the potential to enhance the navigation on sub-sections inside the same topic and was implemented on the Blue prototype to be tested in the evaluation.

It consists of clickable tabs presented at the top of the article, displaying further exploration on the current page, also providing visual feedback by highlighting where the user is inside this context (L5).

Prototype Blue   **Prototype Red**

Figure 4.18: An in-tab navigation available on Blue Prototype, in contrast with Red version

4.4.14 – Videos

Similar to the previous example, neither the literature nor industry guidelines recommended the use of video. Especially if we consider the surrounding environment (C14), displaying sounds and kinetic imagery can be challenging as the App aims to be used mostly in outdoor spaces.

With this in mind, videos were applied in the Blue prototype to check if this popular format can be useful to reinforce content, being tested during the evaluation.
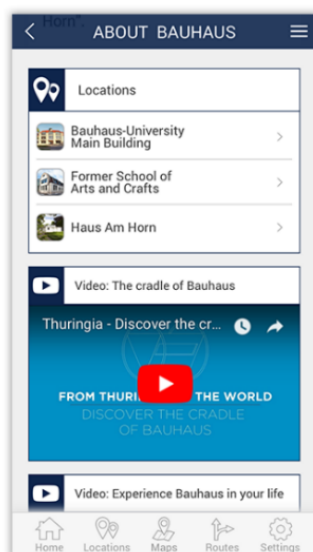
Figure 4.19: *Video availability on Blue Prototype*

4.5 – Implementation

As explained before, both prototypes were implemented using a paid version of JustInMind[46] platform, which offers the possibility to emulate a real App on mobile devices without the costs and time of programming the software itself.

Beyond the App emulator, the platform also offers a web version. This functionality comes with the fact that the mobile prototype is developed in HTML5 through the JustInMind platform, mimicking a dedicated app.

As this platform also offered the possibility to access the same App through web-browsers, this option was also available for the users, despite all the testers being asked to use the Apps in their mobile version, according to the evaluation.

4.5.1 – App Prototypes

To access the mobile prototypes, the users were instructed to download the Justinmind App – available for free on iOS and Android OS:

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[46] https://www.justinmind.com/

- iOS: https://itunes.apple.com/gb/app/justinmind/id891264087?mt=8
- Android: https://play.google.com/store/apps/details?id=com.justinmind.androidapp

After installed and opened, at the start screen, there is a login page (not needed to open the prototypes). At the bottom of the start page, there is a field that says **"Introduce Token"**.
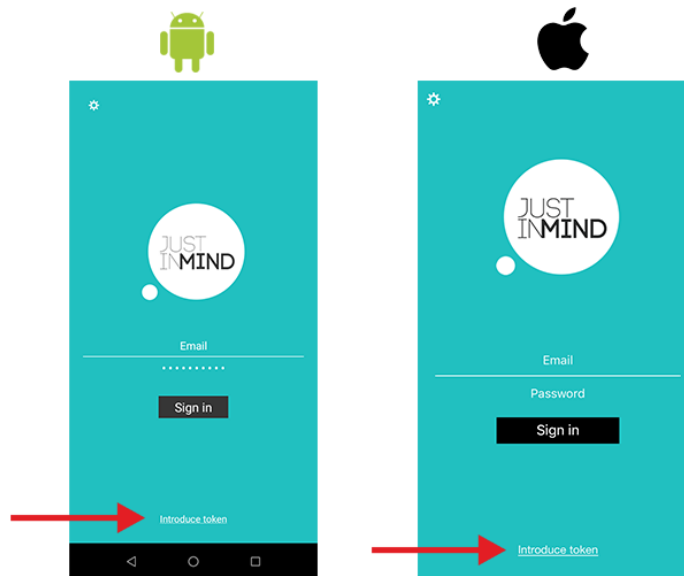
Figure 4.20: *preview on Android and iOS*

Each prototype has its own token, described at the evaluation page. The respective tokens were:

- Token for the Red Prototype: KR91DB
- Token for the Blue Prototype: GJ67TP

After these steps, the users could then experience the prototype(s) as a regular app. On the evaluation page, it was also explained the possibility to switch between the two versions without the need to type the other Token, through the paths:

- Accessing the link inside the "Info" at Red Prototype;
- Accessing the link inside the "Settings" at Blue Prototype.

4.5.2 – Web Prototypes

As mentioned before, it was also possible to open the prototypes directly in a web browser (Firefox, Chrome, Safari, Edge, etc.), without the need to use the Justinmind App and Tokens.

However, to have a proper mobile App experience, it was urged that the users stick to the Justinmind app. By using the mobile phone, they had a closer experience of a real App. The access from each web-version of the prototypes are:

- Red Prototype web version: http://tiny.cc/Prototype-Red
- Blue Prototype web version: http://tiny.cc/Prototype-Blue

In case of any unforeseen circumstance, the web version was offered as alternative access, affecting the access to the App version. Fortunately, no mobile-version access' issues were experienced from the testers.

Chapter 5 – Prototype Evaluation

In order to compare the practical application of the two set of guidelines (industry vs literature-review), a task-based test and a comparative survey were implemented to evaluate both prototypes. The idea behind it was to have different individuals performing a series of pre-defined tasks in both prototypes and answering a series of questions comparing features and formats presented in both versions.

Questionnaires are a well-known method to collect and summarizing evidence (Lazar et al., 2010; Molleri et al., 2016). They also help to collect opinions and inputs from the users in a wide range of data gathering purposes, such as usability, user satisfaction and interface design (Stanton et al., 2017, p. 30). In this case, this method was crucial to compare and analyse both sets of guidelines (industry and literature) against each other, to extract an ideal set of guidelines for Apps dealing with open-air world heritage sites, inside the context of the present research.

The questionnaire had a set of pre-defined answers to be chosen by the users, making it ideal for statistics, especially on user satisfaction (de Castro and Macías, 2016). However, it also offered open answers to provide the chance for the testers to add personalised inputs and comments to the questions.

5.1 – Evaluation Development

A questionnaire can be divided into four parts: introduction, participant information, information section and epilogue (Stanton et al., 2017). At the introduction, it is essential to give information regarding the test but without providing any information that may produce a

biased result. In this case, it was enough to illustrate that the test was meant to compare two different models of interface design. Within this context, the testers got the idea about what the test/questionnaire was about, without saying what exactly were the differences or origins of both prototypes.

As participant information, the gender identification was discarded in the analysis as it was believed its relation was irrelevant for this study. However, the data helped to check a balance in the representation of the genders among the testers. The analysis considered some other relevant information to understand the testers' profile such as: age – to build insights and with the different groups of tourists visiting Weimar every year; familiarity (or not) with the city of Weimar - showing if the results would change if a tester had previously visited the locations; and the behaviour related to the use of the Apps, especially for travel and touristic activities, and the testers previous expertise in using them.

The selection of the testers/participants targeted two different groups: people who have been in the city of Weimar before, and people who never been in the city. The age groups also had a wide range, going from the early '20s to late '40s. The differences bring different perspectives to the data analysis based on how familiar the users are with the locations, and which features may be in preference of certain age group. For this, the testers included academics, students and other professionals, from a diverse set of areas of expertise.

Regarding the number of participants, it is argued that even a modest number of five participants is enough to perform a reliable usability test (Nielsen, 2012; Sauro, 2010) getting the necessary feedback to find usability problems when compared with a setting using a more massive amount of testers. Considering the intention of testing guidelines, this number was largely extrapolated. In this case, 35 participants confirmed the interest in performing in-depth evaluation, and 33 started filling the evaluation questionnaire, with two testers not completing it. In the end, the complete attendance totalised 30 participants, six times more than the literature suggests.

5.2 – Evaluation Implementation

After designing the evaluation questions and flow, it was chosen as an unmonitored/unmoderated setting for the evaluation's user tasks and online application. The

unmonitored setting for assessments is not new on computer sciences (Reips, 2002), and it is commonly applied for online surveys and questionnaires. Unmoderated tests can be perfectly applied for testing prototypes (Nielsen Norman Group, 2014). They bring a series of advantages by increasing the measurement precision (Feenstra et al., 2017); no restriction of time (Barak and English, 2002; Caine et al., 2012); and simultaneous participation (Reips, 2002).

Unmonitored tests have a set of advantages in comparison to the monitored ones, which may be intrusive to the task performance, time-consuming in terms of one tester per time in the observational setting (Stanton et al., 2017, p. 44). In addition, in this case, it offered a simulation closer to the reality, in normal circumstances, the users will be dealing with the App independently and will have to figure out how to use the software all by themselves.

The testers were asked to perform a set of activities in each one of the prototypes – as will be detailed in the upcoming sections – and, in the end, to answer a digital questionnaire. The questionnaire was implemented using Google Forms[47], as it is a free tool and covering all the needs relating to the type of questions. The Google Forms also offers the possibility to export the collected data making it easier to generate different data sets and graphics for the analysis.

Regarding its structure, the questionnaire used different types of questions, changing according to the type of data to be collected. Most of the questions were multi-choice options, added with the opportunity for the user to add their own answer.

5.2.1 – Type of Questions

Surveys commonly present two types of questions: open-ended or close-ended. Usually, open-ended questions give more freedom to the participants in answering without any influence. However, they are time-consuming in both ends: for the participants to create their own answer and for the researcher, to summarise the content. They demand more energy for the

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[47] https://docs.google.com/forms/

interpretation from collected data (Reja et al., 2003). Close-ended questions are more suitable for quantitative usability data (Farrell, 2016).

As the questionnaire has 69 questions in total, an open-ended approach could be discouraging for the testers and reduce the participation rate until the end. With this in mind, the survey was developed using close-ended questions, but space for the testers to add open-ended answers if desired. In this way, the participant could always give (or not) his/her own input without overwhelming them. Most of the questions had a screenshot from the applications to help as they work as a guide to facilitate the memory retrieve from the user's experience. Examples of the screenshots used in the evaluation are available in Section 4.5.

5.2.2 – Questionnaire Application

As said, the evaluation questionnaire was developed and applied using Google Forms. The testers received an introductory explanation with instructions and links, available at http://www.joatan.com/app/. In this page, every participant could find information such as:

- "How to proceed" – giving instructions on how to access the prototypes.

- "Download the JustInMind App" – offering links to iOS and Android devices.

- "Open the prototypes" – explaining how to use the Tokens after installing the JustInMind App, in order to access each one of the prototypes. This section also mentions how to access the web versions, if necessary

- "Perform the tasks" – For each prototype, a series of pre-determined tasks was created in order to make the users navigate through different pages. The Red Prototype tasks were related to *Classical Weimar*, and the ones for the Blue Prototype were associated with *Bauhaus*. The order of using the prototypes and respective tasks to be performed by the participants was open to their own choice.

- "Fill out the evaluation" – this section explained how long it would take to fill the form and how to proceed to take part in a draw of a 50€ voucher from Amazon (privately paid by the researcher), as a participation reward. After finishing the evaluation form, the participants had the chance to visualise the available set of results, including their own contribution and the anonymous contribution of other respondents.

In this page, the users would find the link for the evaluation, initially available at http://tiny.cc/Evaluation-Prototypes (now closed). Regarding about which version/tasks the participants started their testing, after the evaluation, it was asked to all participants which version they began their task performance, having 26.6% (8 participants) answering "Blue", 20% (6 participamts) answering "Red" and the majority of 53.2% (16 participants) did not recall which version they started using. Unfortunately, this question was not placed in the original questionnaire, being asked later by email. However, the given answers show somehow a balance on the starting prototype version used to perform the assigned tasks, at least for those who remembered which version they used first.

As the original evaluation is now closed and is impossible to access it online, a copy was made available at http://www.joatan.com.br/app/original_questionnaire.html, also available in the Appendix (A.5) Section. In both sources, it is possible to read all the questions asked to the testers (apart from what path each user did) with the screenshots to help the comparison during respective questions.

The results can be seen from a page generated from GoogleForms itself, available at http://tiny.cc/Evaluation-Result. The results are also detailed in Section 5.4 (Evaluation Results).

5.2.2.1 – Assigned tasks

After introducing the users to the guidance on how to install the JustInMind App, and how to download the prototypes, the users were ready to perform the tasks and evaluation.

The task's idea was to collect the users' opinion on a series of features, design, and analyse the differences in the content presented in both prototypes. As seen in the Implementation section, both prototypes showed subtle changes between them. Both have similar content and the same locations.

The tasks aimed to mimic someone who is visiting Weimar and wants to discover the sightseeing of the city related to world heritage sites of UNESCO. Each version had a task related to a different UNESCO WHS in Weimar:
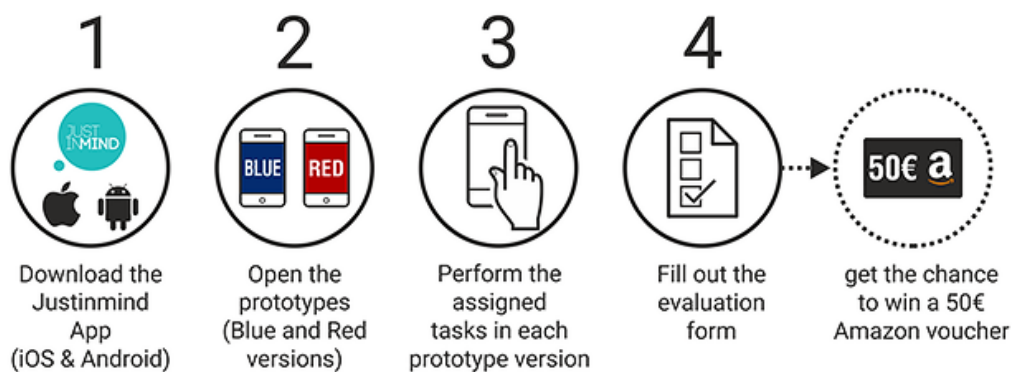
- Red Prototype:
    - Find a location related to the "Classical Weimar", in any way you want.
    - Find a location related to the "Classical Weimar", by using the maps (here you can try different map versions).

- Blue Prototype:
    - Find a location related to the "Bauhaus", in any way you want.
    - Find a location related to the "Bauhaus", by using the maps (here you can try different map versions).

It was also suggested to the users, to access all the sessions of each version, exploring all the available content. Some questions of the evaluation form inquired about this experience.

5.2.2.2 – Participation reward

As an incentive, all the participants could opt to take part in a draw of a 50€ voucher from Amazon, as explained at the introductory web page with the instructions.

Figure 5.1: The main steps from the evaluation process explained to the users on the initial page.

5.3 – Structure

The evaluation was divided into seven sections: About you, About the attractions, About the Red Prototype, About the Blue Prototype, Comparing the two versions (Red/Blue), About Weimar, and Final opinion.

The "About You" section was designed to collect the demographics from the participants, such as age, gender and occupation. It also collected information regarding their behaviour on using Apps for travel purposes.

The "About the attractions" was designed to check if the participants could recognise the UNESCO's WHS logo after using the prototypes, confirming if they acquired this knowledge by using the prototypes or if they already knew the information.

"About the Red Prototype" and "About the Blue Prototype" investigated the impressions on the interface elements and features from each version, with the "About the Blue Prototype" also inquiring about exclusive features/pages, such as Routes, Settings and Right-Top-Menu.

After collecting the information regarding each prototype, the next section "Comparing the two versions (Red/Blue)", created a direct comparison between the prototypes, asking the participants choose between one or another according to different characteristics, and justifying their choices.

The "About Weimar" section was designed to separate the testers in two different groups: the ones who have previously visited Weimar, and the ones who have never been in the city, to see if an existent relation of physical familiarity with the locations could affect the answers. As will be discussed in the evaluation results, this differentiation did not affect the results, not showing relevant differences in the testers' evaluation regarding content and features. The only part that was affected by the physical familiarity with the city was in the question in which testers have been asked if the Apps could be an incentive for them to travel to Weimar.

At the end of the evaluation, the testers were offered the possibility to add any comment or suggestions, optional participation, and checking how easy it was to fill the questionnaire.

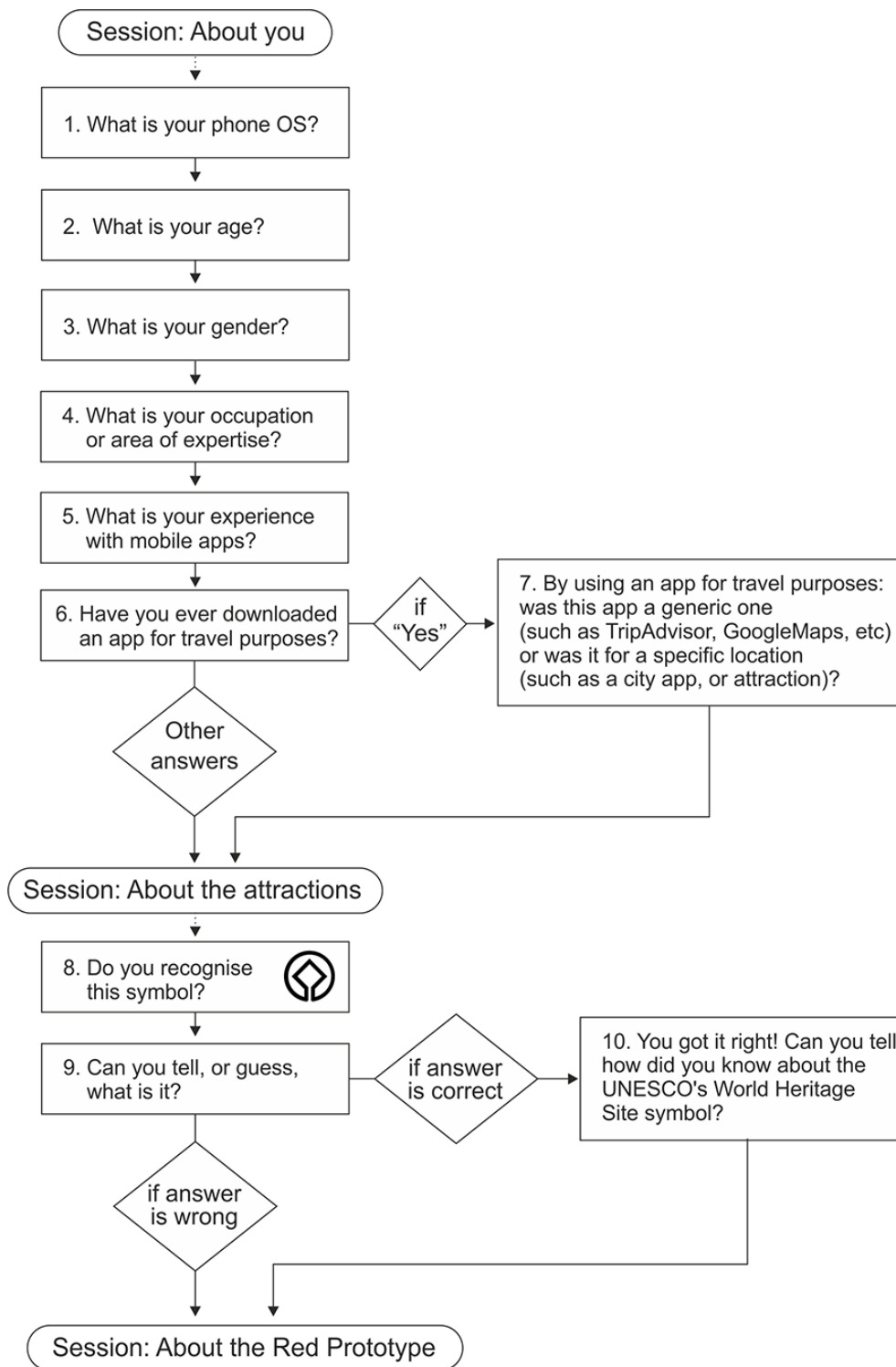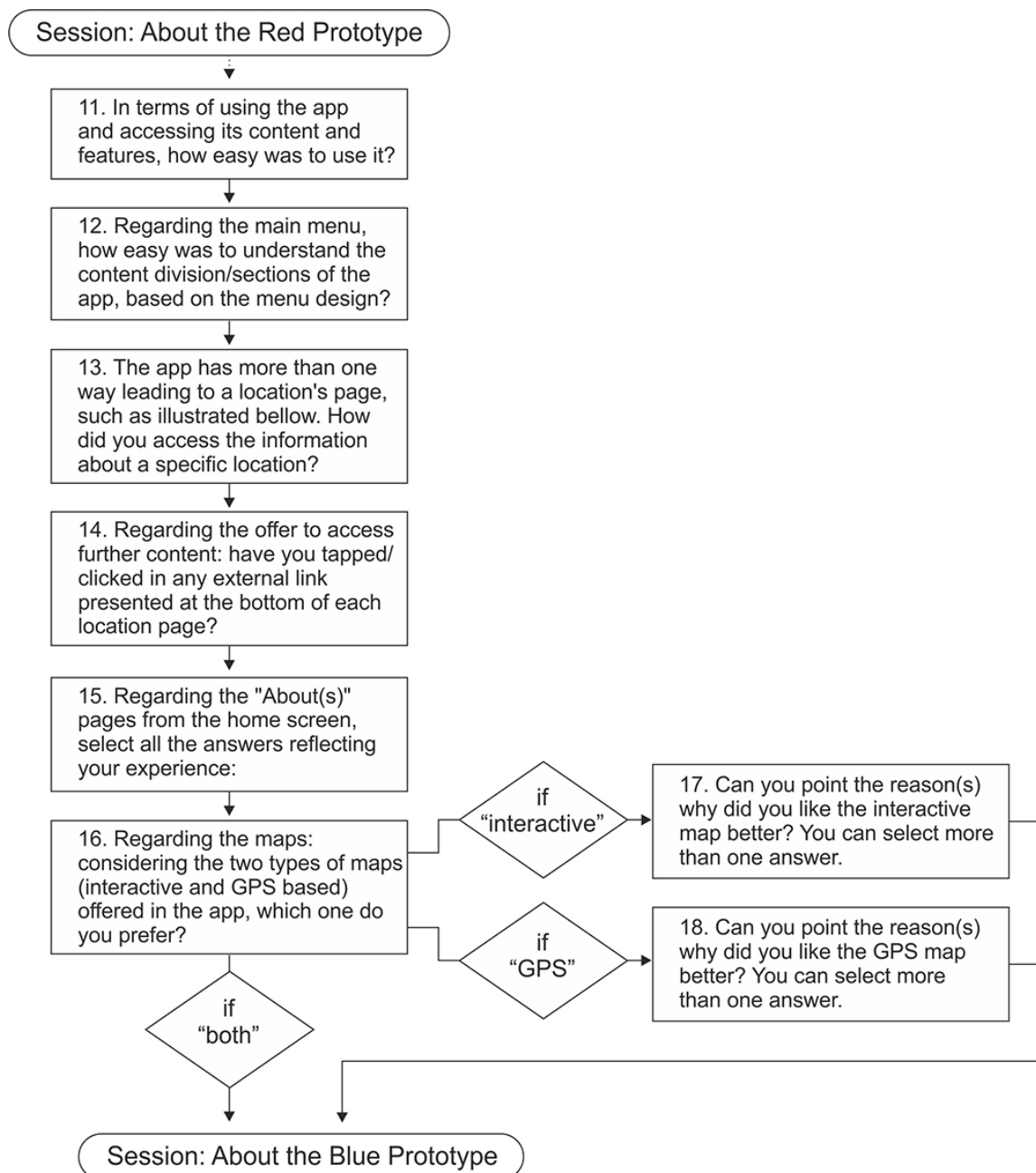The structure of the questions was organised as it follows on the next pages:

Figure 5.2: *Questionnaire structure 1 of 6.*

Figure 5.3: *Questionnaire structure 2 of 6.*

It is important to stress that the questionnaire always displayed the respective mentioned screenshots for most of the questions, in case the participants forgot about a specific UI feature.
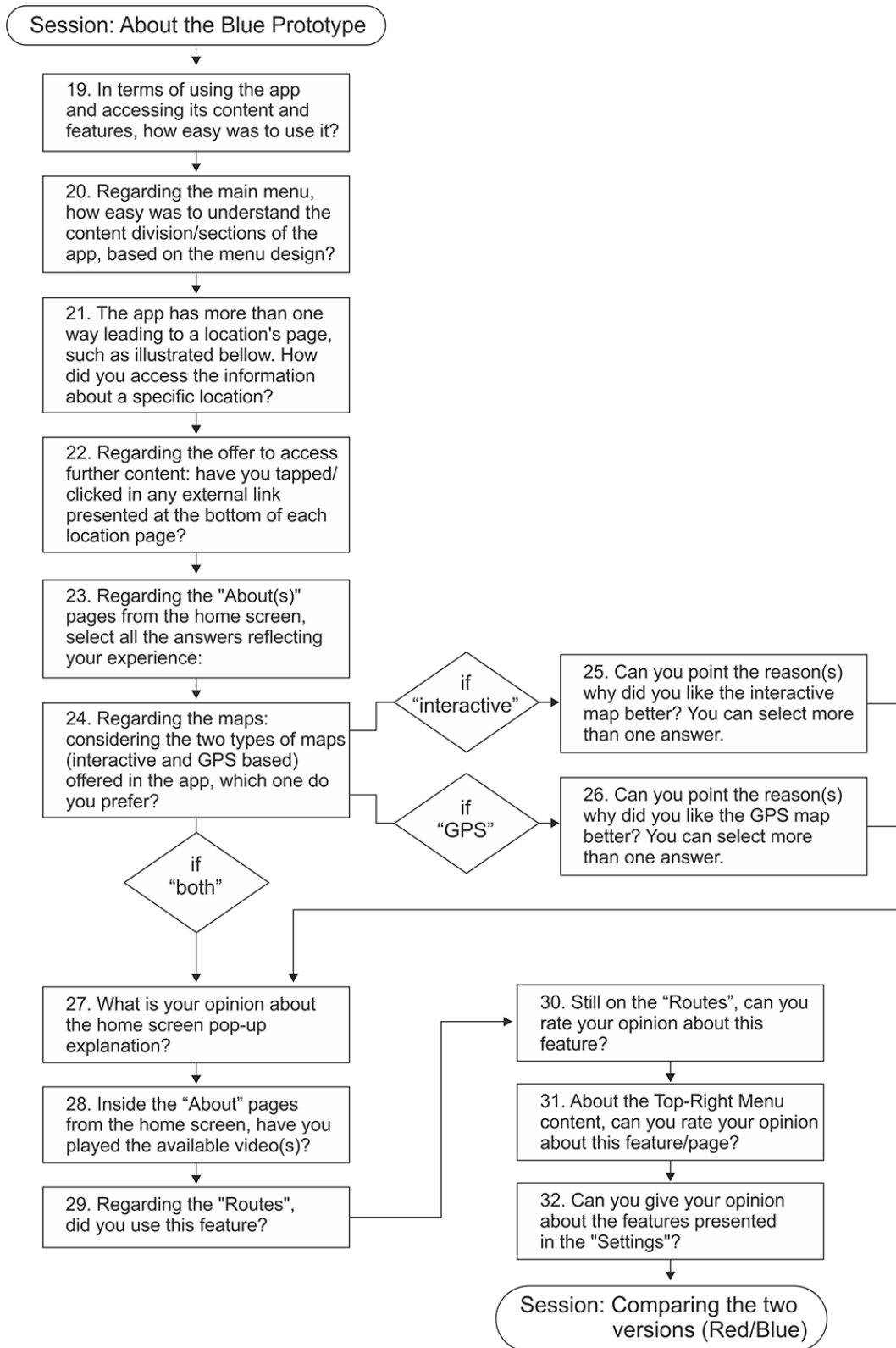
Session: About the Blue Prototype

19. In terms of using the app and accessing its content and features, how easy was to use it?

20. Regarding the main menu, how easy was to understand the content division/sections of the app, based on the menu design?

21. The app has more than one way leading to a location's page, such as illustrated bellow. How did you access the information about a specific location?

22. Regarding the offer to access further content: have you tapped/clicked in any external link presented at the bottom of each location page?

23. Regarding the "About(s)" pages from the home screen, select all the answers reflecting your experience:

24. Regarding the maps: considering the two types of maps (interactive and GPS based) offered in the app, which one do you prefer?

if "interactive"

25. Can you point the reason(s) why did you like the interactive map better? You can select more than one answer.

if "GPS"

26. Can you point the reason(s) why did you like the GPS map better? You can select more than one answer.

if "both"

27. What is your opinion about the home screen pop-up explanation?

28. Inside the "About" pages from the home screen, have you played the available video(s)?

29. Regarding the "Routes", did you use this feature?

30. Still on the "Routes", can you rate your opinion about this feature?

31. About the Top-Right Menu content, can you rate your opinion about this feature/page?

32. Can you give your opinion about the features presented in the "Settings"?

Session: Comparing the two versions (Red/Blue)

Figure 5.4: *Questionnaire structure 3 of 6.*
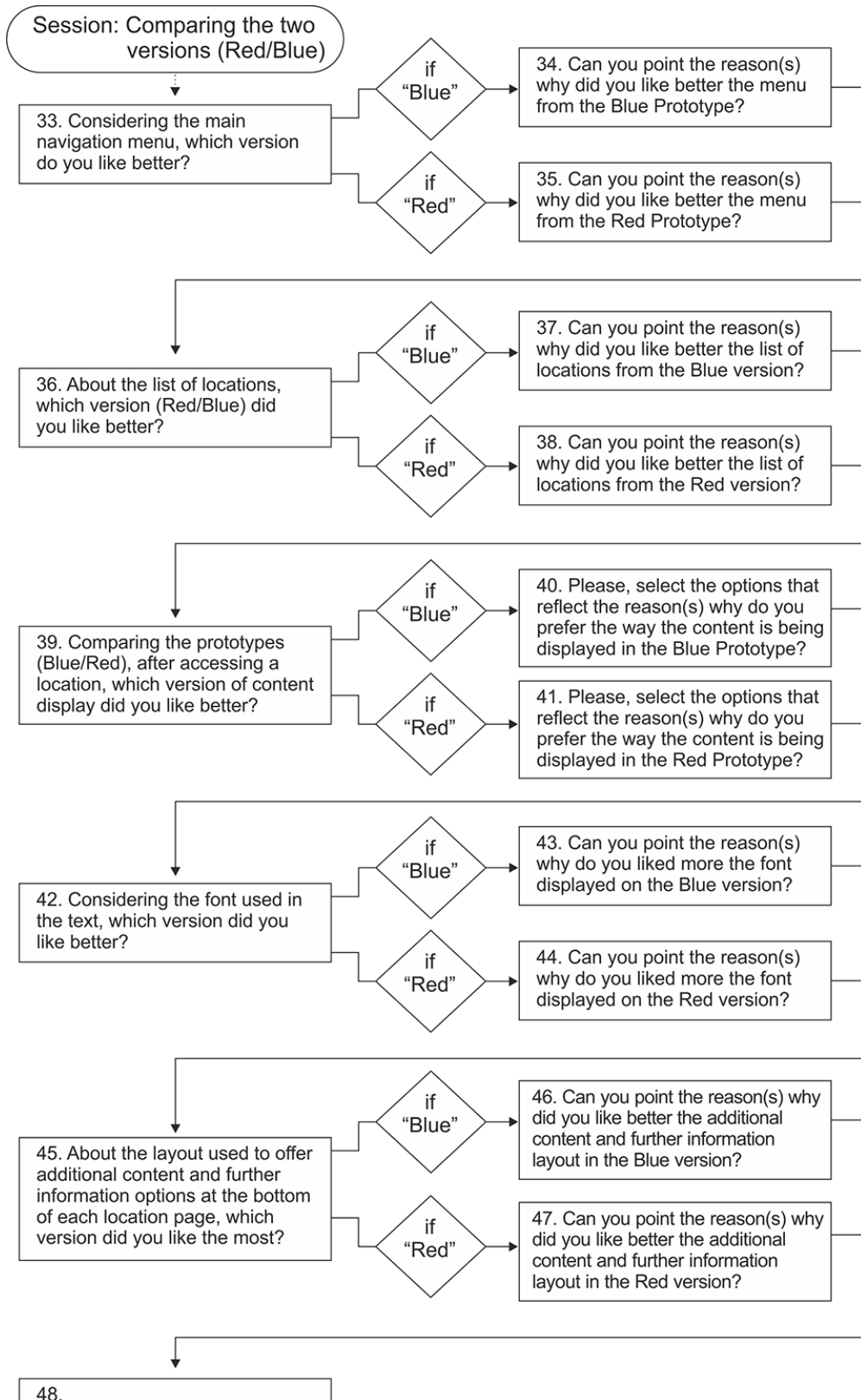
Figure 5.5: *Questionnaire structure 4 of 6.*

Session: Comparing the two versions (Red/Blue)

48. From the home screen, when you accessed an "About" page (Bauhaus, Classical Weimar, UNESCO's World Heritage Sites), which is your preference between the two models?

if "Blue"

49. Can you point the reason(s) do why did you like better the "About" pages from the Blue version?

if "Red"

50. Can you point the reason(s) do why did you like better the "About" pages from the Red version?

51. Considering the different ways of presenting and exploring the photo/image at the head of the attraction's description page, which version did you like the most?

if "Blue"

52. Can you point the reason(s) why did you like better the way the image is presented at the Blue version?

if "Red"

53. Can you point the reason(s) why did you like better the way the image is presented at the Red version?

if "both are the same"

54. Considering the way the locations are presented inside the maps (Blue/Red), which one did you like better?

if "Blue"

55. Can you provide the reason(s) why did you like better the maps from the Blue version?

if "Red"

56. Can you provide the reason(s) why did you like better the maps from the Red version?

57. Considering only the Interactive Map on both prototypes, after you tapped/clicked in a location, which version do you like the most?

if "Blue"

58. Can you tell the reason(s) why did you like better the interactive map from the Blue version?

if "Red"

59. Can you tell the reason(s) why did you like better the interactive map from the Red version?

60.

Figure 5.6: *Questionnaire structure 5 of 6.*

Figure 5.7: *Questionnaire structure 6 of 6.*

This structure of questions aimed to cover all the needed parts to have an overview and comparison between the developed prototypes.

5.4 – Evaluation Results

After the data collection using questionnaires, the next step was to perform data analysis to evaluate the testing phase results. As explained, users were asked to fill their opinions about both App prototypes during the data collection phase. Thus, a large set of data was available for comparison and further analysis. The primary data set collected from testers included their views on features, design, and their opinions on the differences between how the content was presented in both prototypes. As noted in section 5.1 (Implementation section), each prototype followed one specific set of guidelines, allowing to test the users' views on different aspects.

As said, 30 testers completed all the evaluation steps. As a consequence, the percentage rate used in the result is one vote equal 3.33%. Also, in the answers provided to the open-ended questions, the testers wrote their impressions using their own words. Only minor spelling and typos were corrected in the analysis, and the responses preserved their original wording.

The following sub-sections will provide the statistical results and graphics expressing the answers to the questionnaire. For the graphics, if the answers were not visually clear, a text will be placed below, with grey background – to distinguish from the paragraphs.

Overall, the evaluation revealed a preference for the guidelines extracted from the academic literature over the ones from the Apps available in the market. The outcomes that will be discussed in details in Chapter 6 provide a solid set of guidelines for App developments to be used in open-air cultural spaces, emphasizing WHS. The original questionnaire, alongside with the screenshots presented to the participants, is available in A.5 – Evaluation Questionnaire with Screenshots, in a version adapted to Microsoft Word.

5.4.1 – About the Testers

The first section of the evaluation was to trace the testers' profile, with questions regarding age, gender, and OS.
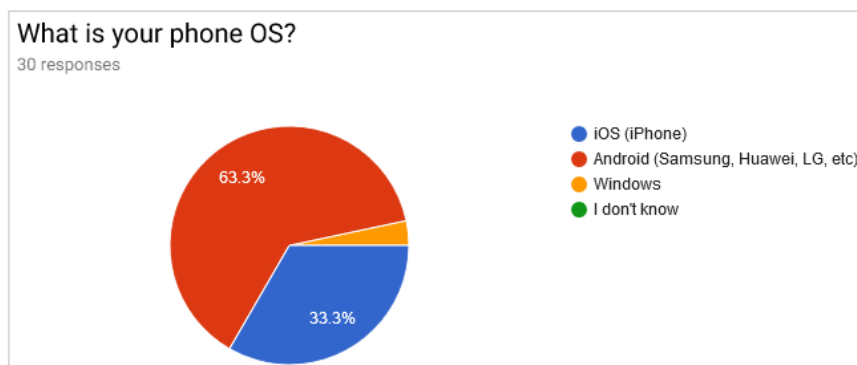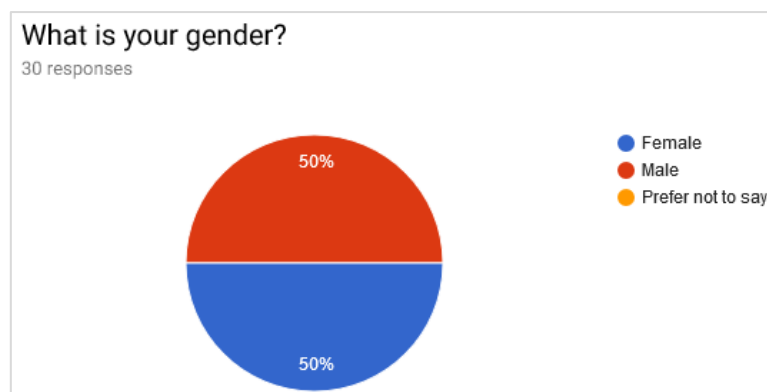
Figure 5.8: *Question 01 result.*

As seen on Figure 5.8, the proportion of iOS and Android users, was fairly similar to the usage of mobile OS for Europe in 2018, of 68.5% Android and 28.5% iOS ("Market share of leading mobile operating systems 2010-2019," 2020), which makes up to a fair representation of the European OS market share for the evaluation. As previously discussed, the popularity of both operational systems was decisive during the process of creating the prototypes for the Apps dealing with the open-air historical places associated with the UNESCO World Heritage Site (WHS).

Regarding age, the range of participants broadened from 24 to 49 years old (Figure 5.9). Again, it can be considered a fair representation, being divided into: 24 (1 participant); 25 (2); 28 (2); 29 (3); 30 (2); 31 (2); 32 (3); 34 (1); 35 (4); 37 (4); 38 (1); 39 (1); 40 (1); 49 (1). Age was an important demographic for this evaluation as the prototypes aim to contemplate different target audiences. For instance, font-size influenced the participants' decision on the prototype they preferred. The older testers preferred the Blue version because it provided a bigger font size. The Blue version also offered short texts with the possibility to expand it by offering the "Show more information" feature, optimizing the space used on the screen.
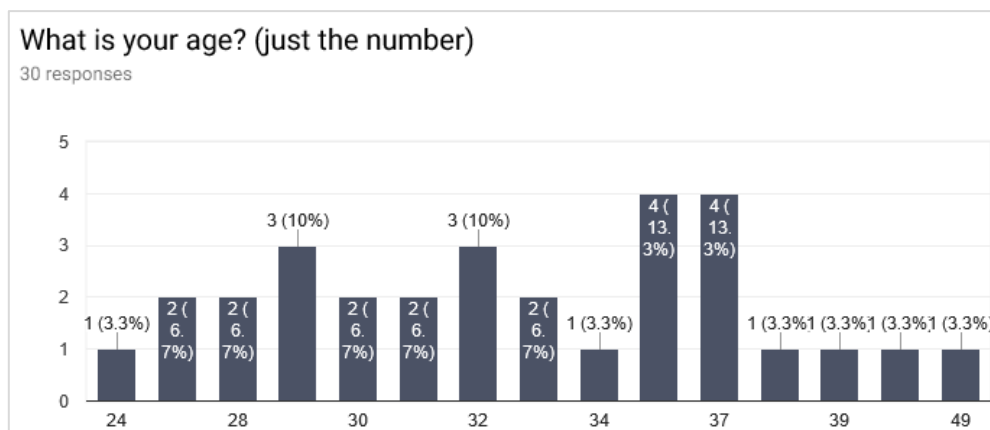
Figure 5.9: Question 02 result.

The gender division among the testers was well balanced, being equally distributed into female and male participants, from 50% to each gender. The equal distribution between males and females was important to ensure a fair representation but, in this case, the analysis did not show any relevant influence in the preferences or in the way testers made decisions while testing the prototypes.

Figure 5.10: Question 03 result.

Another analysis reflects the professional demographics of the testers. Experts from different fields were involved and were asked to provide their views concerning the prototypes. Despite using slightly different ways to describe themselves (Figure 5.11), the result shows a wide range of professions that could be aggregated as Architect/Urbanist (6); Researcher (5); Computer Scientist (4); UX Designer (3), Communication (3); Designer (2); Game Designer (2); Civil Engineer (1), Marketing (1); Physicist (1); Project Manager (1) and Unemployed (1). It also enhances the evaluation trustworthiness, as most of the testers have expertise directly

related to the subject area, being it a strong familiarity of technology, design, communication, and architecture, a crucial aspect of both WHS explored by the prototypes.
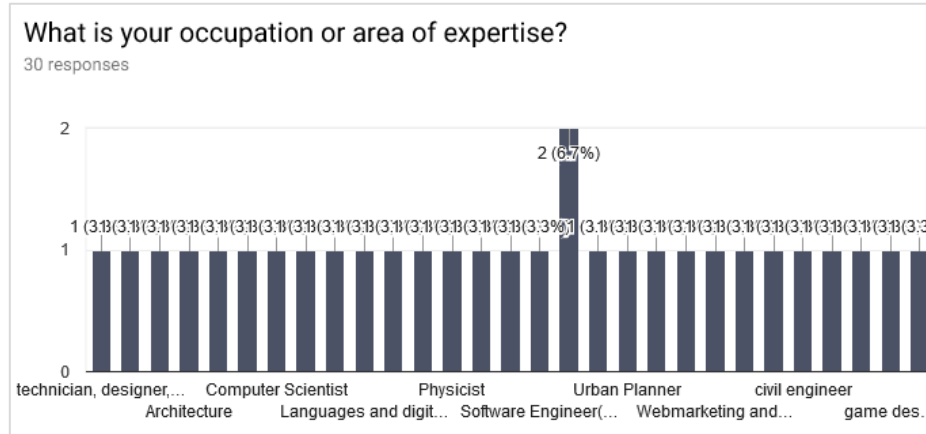
Figure 5.11: Question 04 result

From their experiences in using mobile Apps (Figure 5.12), just one participant (equivalent to 3.3%) showed little experience in using Apps. The majority (24 people) of the participants claimed to have significant experience in using Apps daily, followed by people (5) with some experience, mostly on emails, maps and messaging. The experience they have gained in the industry made them view both prototypes more broadly and give appropriate guidance on what they felt was important.
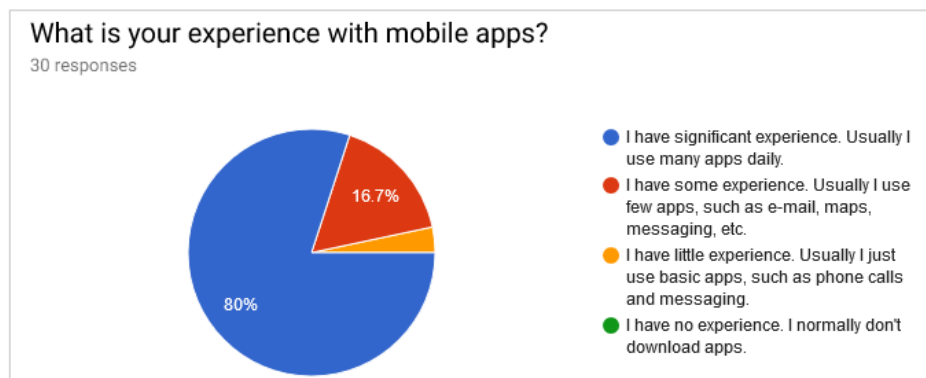
Figure 5.12: Question 05 result.

When asked if they ever downloaded an App for travel purposes (Figure 5.13), 90% answered positively, with two testers saying no, and one answering "I don't remember". This question was essential to check the familiarity of the testers with Apps that are somehow similar to the

proposed prototypes. The previous experiences enhanced the testers' understanding of available features, such as maps, routes and POI information.
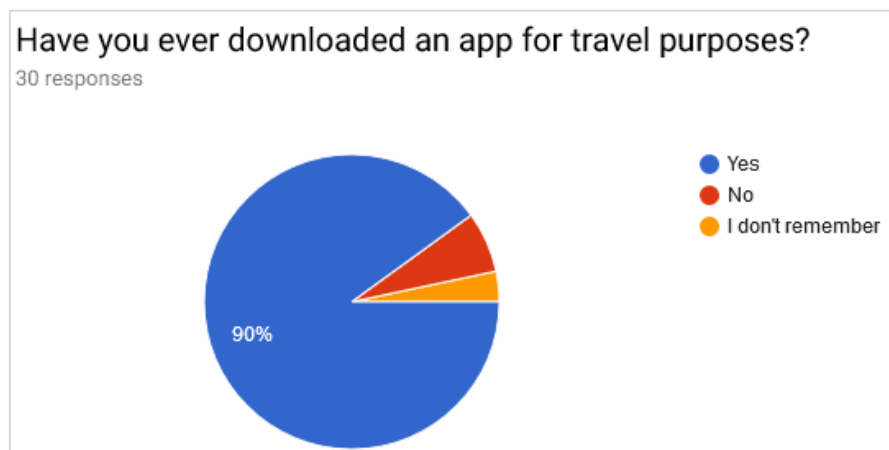
Figure 5.12: Question 06 result.

For those who answered positively regarding previous experience of downloading an App for a planned journey (Figure 5.13), they were redirected to another question, to explore more about what kind of App they usually install in travel occasions. The primary purpose of this question was to find out if they have used a so-called "generic" App, which offers information about the places and POIs, such as TripAdvisor. Or if they downloaded a "dedicated" App, tailored for a location or city – demonstrating a more engaged approach to the travel destination. From this question (Fig. 5.14), 70% (19 votes) claimed using both types of Apps (generic and dedicated), followed by a generic touristic App with 18.5% (5 votes), and 14.8% (4 votes) for "dedicated" App only.

This result also emphasises the quality of the testers based on their previous experiences, as the majority has experience with both generic and dedicated Apps. It provided solid know-how and a strong knowledge base to compare the prototypes starting with an understanding of the subject from the users' point of view.

By using an app for travel purposes: was this app a generic one (such as TripAdvisor, GoogleMaps, etc) or was it ...on (such as a city app, or attraction)?
27 responses

It was a generic touristic app — 5 (18.5%)
It was a specific app for a city/locati... — 4 (14.8%)
Both, generic and specific apps — 19 (70.4%)
I don't remember — 0 (0%)
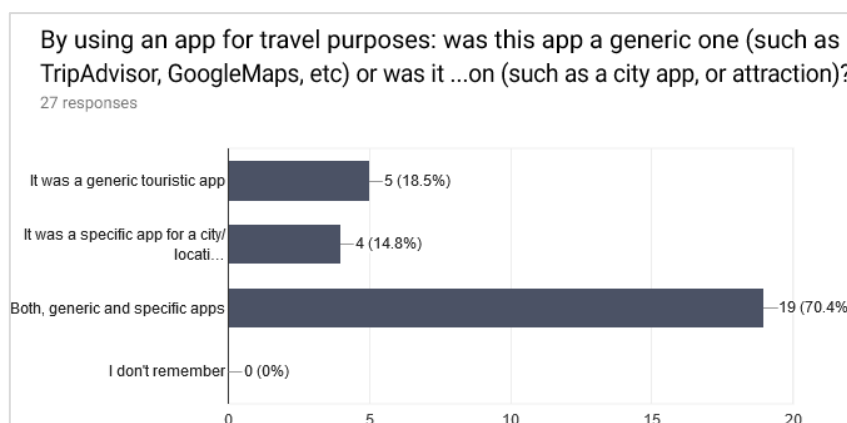
Figure 5.14: Question 07 result; after choosing "yes" in Question 06.

In general, the users had a profile including a balanced gender and age groups rage, with people with previous experiences in the use of Apps for travel purposes.

5.4.2 – About Attractions

Weimar is internationally known for the Goethe and Schiller's legacy, and for being the birthplace of the Bauhaus movement. Many times, one can assume that tourists visit the city strictly in reason of its attractions, without knowing its double recognition as a WHS. So, a set of questions aimed to analyse if a dedicated App could bring awareness of the WHS status.

The awareness of the WHS symbol is usually low from the visitors (King and Halpenny, 2014). Considering also the profile of the tourist who visits Weimar, described at Section 2.3 of this study, only 35% of the visitors answered that the status of a "UNESCO World Heritage Sites" was a reason to visit the city, in contrast with 94% answering "sightseeing", and 65% pointing "museums and exhibitions" as the main reason to visit Weimar (Dietrich, 2014).

Following this idea, during the prototype evaluation, the logo of WHS was shown to the testers without the description around it, with the question "Do you recognise this symbol?" (Figure 5.15), with a positive answer of 70% among the participants.
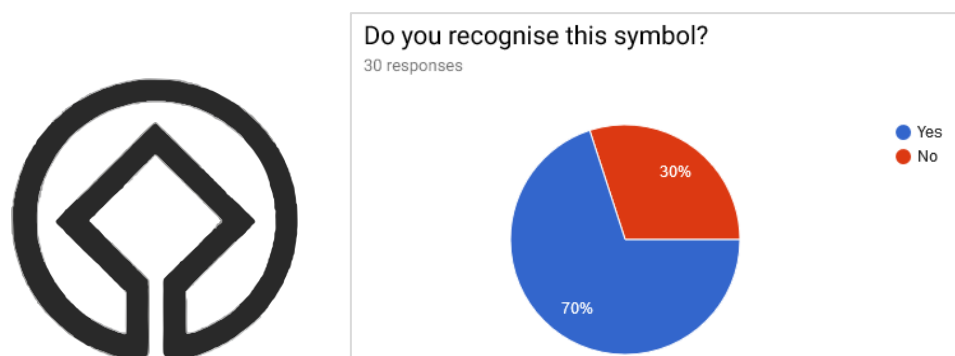
Figure 5.15: Question 08 result, along with the shown WHS symbol.

Another question checked if after using the prototypes the testers would know or recognise the WHS logo. Despite the positive outcome, another question was made offering a multiple-choice to the tester identify the meaning of the symbol including the answers "Weimar symbol", "Monument symbol", "UNESCO symbol", "UNESCO WHS symbol" and "Sorry, no idea". The majority, 76%, answered it correctly (Figure 5.16).
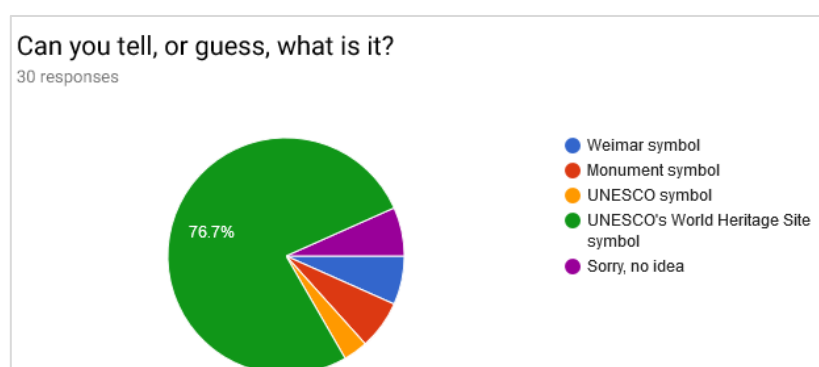
Figure 5.16: Question 09 result.

To check if the correctness of answer regarding the UNESCO WHS logo was based on their experience using the App or if it was a lucky guess, the ones who answered the previous question correctly were led to another question inquiring if the answer was based on "I learned from the prototypes," "I knew this symbol before" and "I just guessed it" (Figure 5.17). The majority, 59.1% (13 votes), answered they learned it from the Apps, in contrast with 36.4% (8 votes) stating they knew the symbol before, with just one vote (4.5%) claiming it was guessed. This result confirms the importance of having a dedicated WHS App to enhance brand awareness.
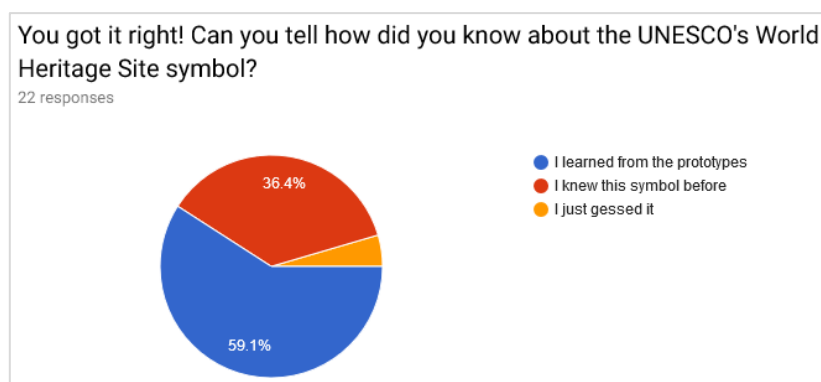
Figure 5.17: *Question 10 result; after choosing the right answer in Question 09.*

5.4.3 – About the Red Prototype

After gathering information on the testes' profile and their knowledge regarding the WHS, the evaluation covered the prototypes individually, starting with the Red version. The questions went from more general questions about usability to details on features and experiences.

In this section of the questionnaire, the questions were illustrated with the specific prototype(s) screenshot(s)[48] related to the topic, working to refresh the testers' memory and/or to facilitate the comparisons when necessary. Different formats of questions were used: single or multiple-choice, or 5 degrees scale (Likert scale), and so on. Some examples:

- "Mark only one" (answer), in a 5-scale choice from "Very hard" (1) to "Very easy" (5), or from "Not useful" (1) to "Very useful" (5).
- "Mark only one" (answer), in a list of choices, with "Other" option, where the participant could write their own open-ended answers.
- "Mark only one", with no possibility to write their own answers, for more direct questions.
- "Tick all that apply" (in case of multiple choice), with "Other" option, where the participant could write their own open-ended answers.

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[48] The questionnaire, with the options and prototype screenshots can be accessed at the Appendix from Chapter 5, and online at http://www.joatan.com.br/app/original_questionnaire.html.

It is important to clarify that the idea behind both prototypes was not to make one version "better" than the other, but strictly doing them using the guidelines retrieved from two different sources (industry and academic – as previously detailed), with the changes only addressing the recommendations. In other words, the prototypes could be considered two versions of the same product, in this case, an App for WHS in Weimar, with two versions slightly different, but using similar established features.

5.4.3.1 – Usability

The Red Prototype's first questions were how easy it was to access the available content and features. On the Likert scale of 1 being "very hard," and five being "very easy," 46% voted for 5, and 40% on 4, bringing a majority of 86,7% voting between 4 and 5 (Figure 5.18). In general, most people found it easy to access the Red Prototype's basic contents and features.
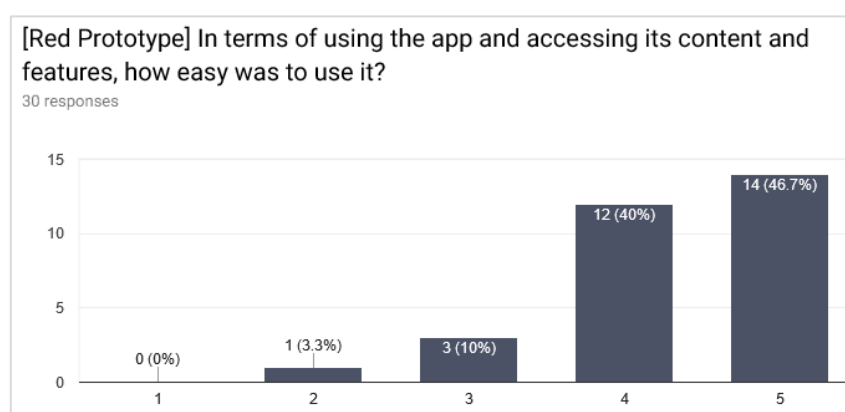
Figure 5.18: Question 11 result.

5.4.3.2 – Main Menu

When questioned about how easy it was to understand the main menu, placed at the bottom of the prototype, the prototype achieved an even better result (Figure 5.19), with 63% voting on 5 and 36.7 in 4, with no votes on other scales. Therefore, it is possible to say that the Red Prototype provided a simple panel where users could easily navigate and access additional content and features within the application.
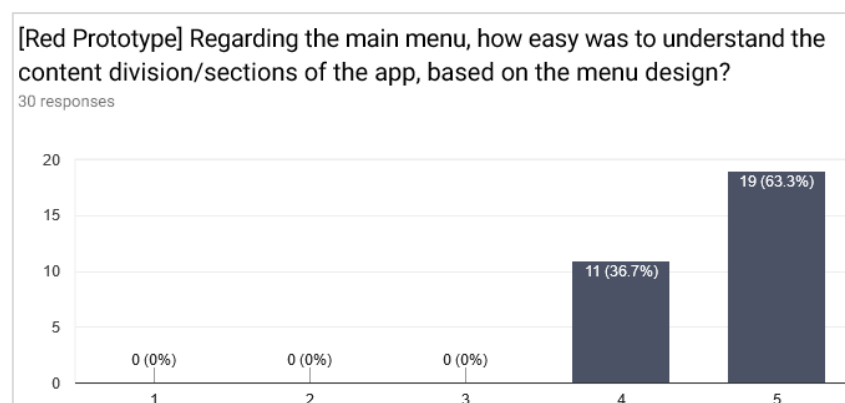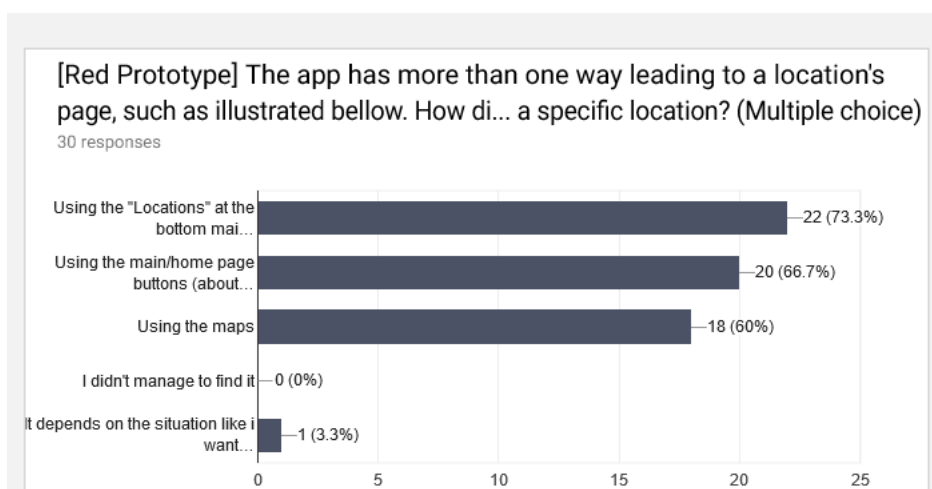
Figure 5.19: Question 12 result.

5.4.3.3 – Accessing Content

The App allowed users to access the same content through different paths. In order to find out which way as used (or which one would be the most popular choice), a question with all possible paths was placed (Figure 5.20), with the possibility for multiple-choice between the available options.
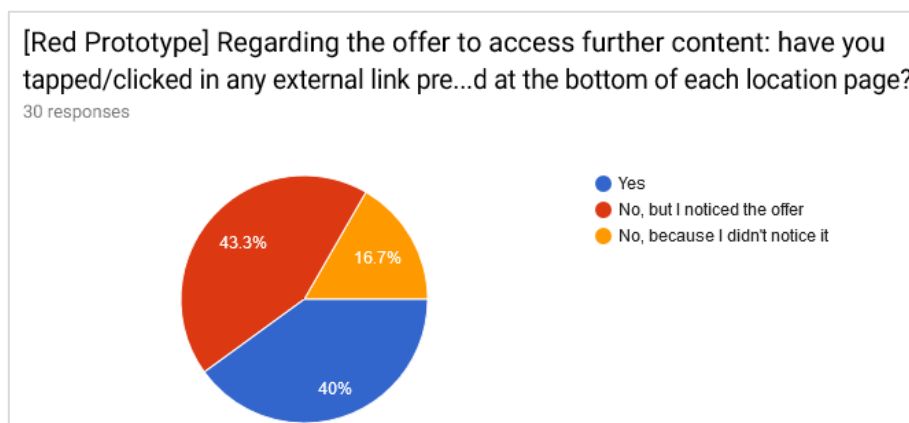

Question 13:
- *(22 votes) Using the "Locations" at the bottom main menu*
- *(20 votes) Using the main/home page buttons (about Bauhaus, about Classical Weimar)*
- *(18 votes) Using the maps*
- *(0 votes) I didn't manage to find it*
- *Other (open answer – one comment)*
  - *It depends on the situation like I want to visit city castle, then I directly opened the locations at the bottom menu, but for other unknown locations definitely I clicked on the main menu buttons like which sites are under unesco world heritage.*

Figure 5.20: Question 13 result.

Just to clarify, when the user opened the App, the main screen will display the options: "about Bauhaus," "about Classical Weimar," with access to the respective locations inside. However, the same content was also offered in the "Locations" option at the main menu. From the results, the majority preferred to access the locations through the main menu (73%), with the "About …" pages appearing as a second preferred reason among the given option (66%), and via maps as a third preferred option (60%). This result leads to the conclusion that the main navigation menu is the preferred option for users to access the content, so it should be designed to concentrate on the App's main features.

5.4.3.4 – Further Information

The next question (14th) verified how the users interact with extra content, such as official links, opening time, map, and telephone number related to the location. As seen in Figure 5.21, 83,3% of people noticed it, but just 40% opted to use/tap it. 16.7% of people did not even see it. This result allows one to reflect on the problem of over-populating the screen with information that people might not use, despite the importance of showing information that might be relevant to their touristic plans, such as opening time and ticket costs.

Figure 5.21: Question 14 result.

The test showed that the main menu is the preferred way to access the information available inside the app. However, as an alternative, the prototype also offered direct links at the opening screen regarding the main content "groups", such as Bauhaus, Classical Weimar and WHS. The next questions checked on how the users interact with these contents, offering the following options and results (Figure 5.22).

The suggested task for the Red Prototype was related to the Classical Weimar. It is possible to see by the numbers of people who accessed "About Classical Weimar" (63.3%), in contrast with those who accessed "About Bauhaus" (56.7%) and "About WHS" (50%). In this case, the given task influenced the testers' behaviour inside this prototype. Despite the preference on "About Classical Weimar" having slightly more accesses, it is relevant to point that 50% of the testers found the presented information useful (without considering the "other" option, who also led to the same result, with other comments). 50% accessed a page regarding the World Heritage Sites. It can lead to the idea that offering information regarding the WHS itself, beyond the one attached to the locations, works efficiently.

Question 15:
- (3 votes) I didn't access them
- (12 votes) I accessed them to find the locations, as part of the assigned task
- (15 votes) I found the information useful
- (19 votes) I accessed "About Classical Weimar"
- (17 votes) I accessed "About Bauhaus"
- (15 votes) I accessed "About UNESCO World Heritage Sites"
- Other (1 open answer:)
  - *I found the information useful, I accessed "About Classical Weimar", I accessed "About Bauhaus", I accessed "About UNESCO World Heritage Sites", I accessed to find the information about the city 'Weimar'*

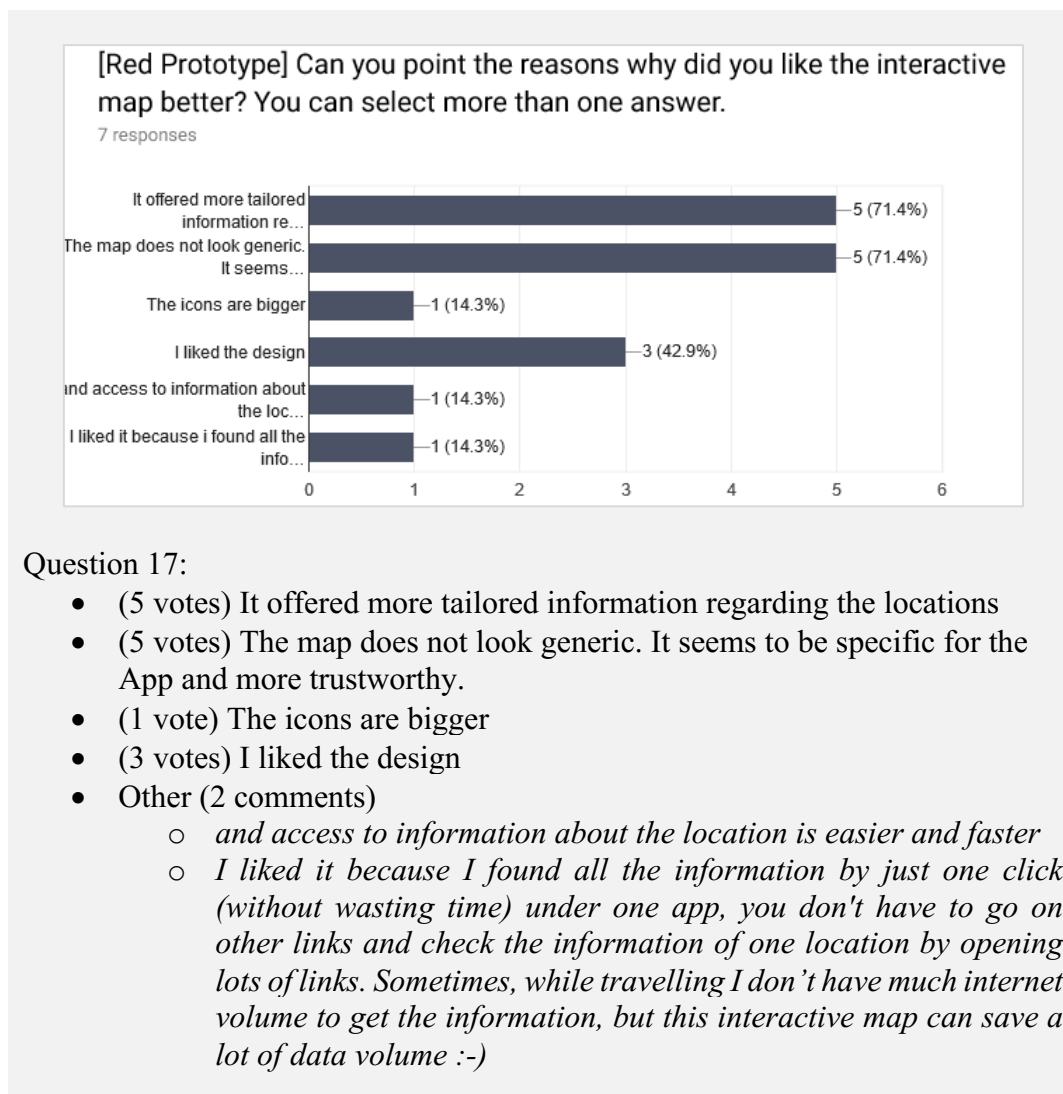***Figure 5.22:*** *Question 15 result.*

5.4.3.5 – About the Maps

When asked about what kind of map, being able to choose between standard GPS styles (made on GoogleMaps) and an interactive (tailored) maps (Figure 5.23), a majority of 53.3% opted for the GPS version, with 23.3% choosing "both", and other 23.3% voting for the interactive option. Adding up all the favourable votes for the GPS version - counting the votes on "GPS" and "both" – it totalised a 76.6% for the GPS standard format for maps.
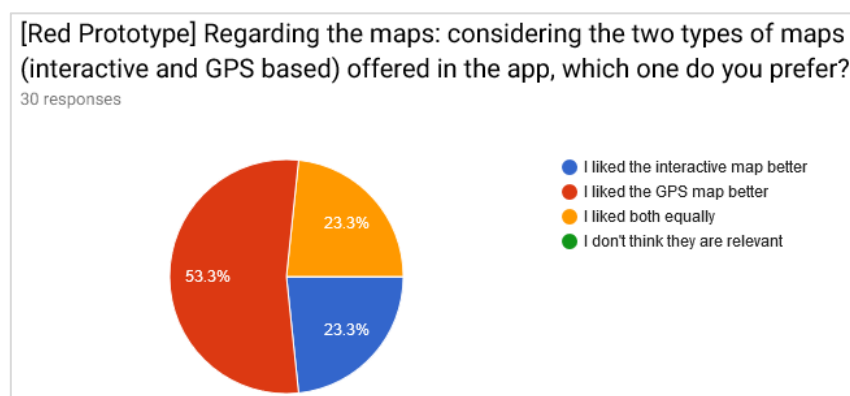
Figure 5.23: Question 16 result.

It is clear that the familiarity with GoogleMaps services and its navigation influenced this result, as it is a very popular tool in both, web and Apps, due to the facility to be implemented without any programming requirements (Sin et al., 2012). This preference was also noted in other questions.

Question 17:
- (5 votes) It offered more tailored information regarding the locations
- (5 votes) The map does not look generic. It seems to be specific for the App and more trustworthy.
- (1 vote) The icons are bigger
- (3 votes) I liked the design
- Other (2 comments)
  - *and access to information about the location is easier and faster*
  - *I liked it because I found all the information by just one click (without wasting time) under one app, you don't have to go on other links and check the information of one location by opening lots of links. Sometimes, while travelling I don't have much internet volume to get the information, but this interactive map can save a lot of data volume :-)*

Figure 5.24: *Question 17 result; after choosing "interactive" on Question 16.*

The reasons behind the preference for the so-called "interactive" map (Figure 5.24) ranged from it looked more tailored and offered more options, with five votes in each option. Still, when compared to why they preferred the GPS version (Figure 5.25), a majority of 14 of 16 pointed the familiarity with GoogleMaps as the main reason for their choice. This comparison leads to the conclusion that a customised GoogleMaps style should be the first option for implementing a map inside a touristic App.

Question 18:
- (9 votes) The GPS helps to find where I am in relation to the location
- (14 votes) I am more familiar with the GoogleMaps format
- (6 votes) The icons are smaller
- (5 votes) I liked the design
- Other (one commentary)
  - *I prefer the design of the interactive one, but it helps that the GPS has the names of the locations right below the pin.*
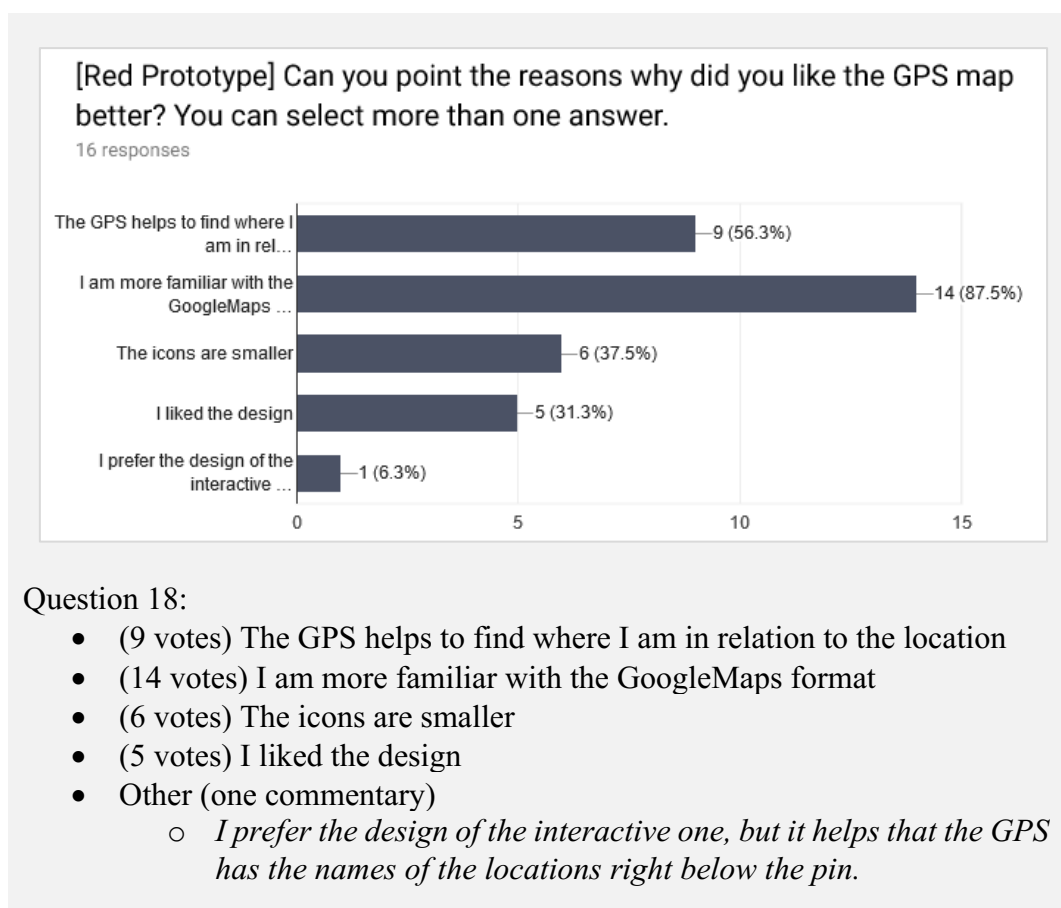
Figure 5.25: *Question 18 result; after choosing "GPS" in Question 16.*

5.4.4 – About the Blue Prototype

After the set of questions exclusively related to the Red Prototype, the next section of the questionnaire covered the features related to the Blue Prototype, following similar questions, but adding specific ones related to features only present in this version, such as the Pop-Up Explanation, Videos, Routes, Hamburger Menu and Settings.

5.4.4.1 – Usability

When the participants were asked about how easy the find using the App and accessing its content and features, on a scale of 0 to 5, with 0 indicating hard while five indicating easy, 93.3% of the participants rated App access and its usage to lie between 4 and 5 (Figure 5.26). This indicated that it was as easy to use the Blue prototype as it was to use the Red prototype.
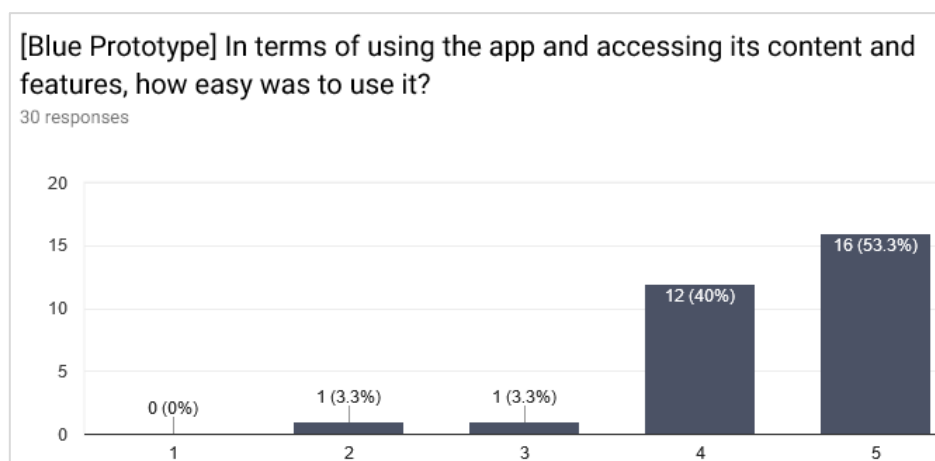
Figure 5.26: *Question 19 result.*

5.4.4.2 – Main Menu

Further, when the testers were asked how easy it was for them to understand the App's content division based on menu design, 100% of the participants rated the prototype between 4 and 5 (Figure 5.27), showing that menu navigation was reliable and straightforward.
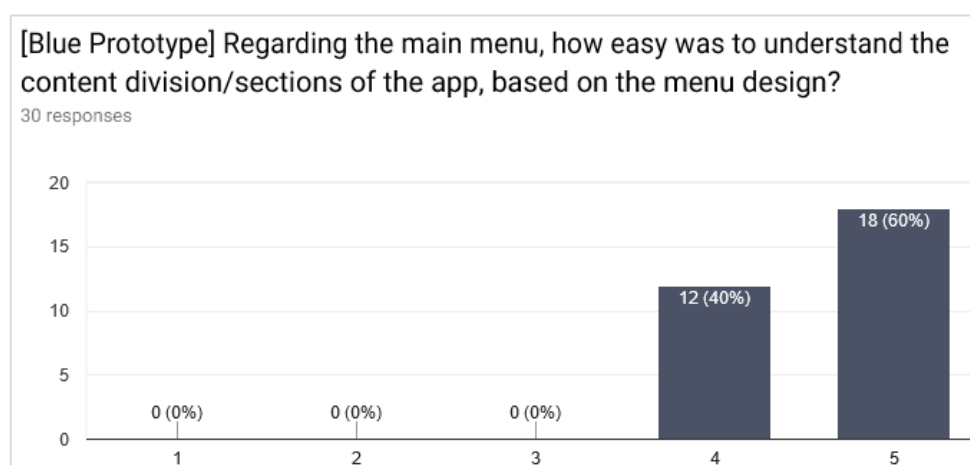
Figure 5.27: *Question 20 result.*

5.4.4.3 – Accessing Content

As similar as happened in relation to the Red Prototype, the participants relied on the Main Menu to access the locations. The Blue Prototype presented more access options than the Red one, such as the "Hamburger Menu". The results reinforce the importance of using the Main Menu as the primary navigation feature of an App.

Question 21: The App has more than one way leading to a location's page, such as illustrated below. How did you access the information about a specific location? (Multiple choice)
- (26 votes) Using the "Locations" at the bottom main menu
- (24 votes) Using the main/home page buttons (about Bauhaus, about Classical Weimar)
- (13 votes) Using the maps
- (5 votes) Using the top-right "hamburger" menu
- Other (one comment)
  - *routes*

Figure 5.28: *Question 21 result.*

5.4.4.4 – Further Information

Curiously, when compared to a similar question asking in regards of the Red Prototype, the participants noticed better the "further content" offer present in the Blue Prototype (Figure 5.29), with 6.7% fewer participants claiming they did not see it. The fact that the Blue Prototype offered more space between the elements and also included an official WHS logo might be the cause of people scrolling further.
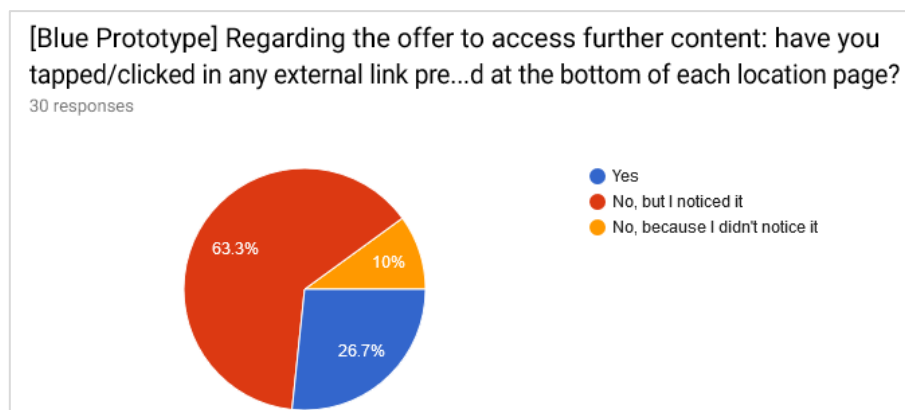
Figure 5.29: Question 22 result.

When asked regarding the access of the "About…" pages, the Blue prototype had a similar performance seen in the Red Prototype. These results show the importance of offering further information related to WHS, beyond using only the POIs.
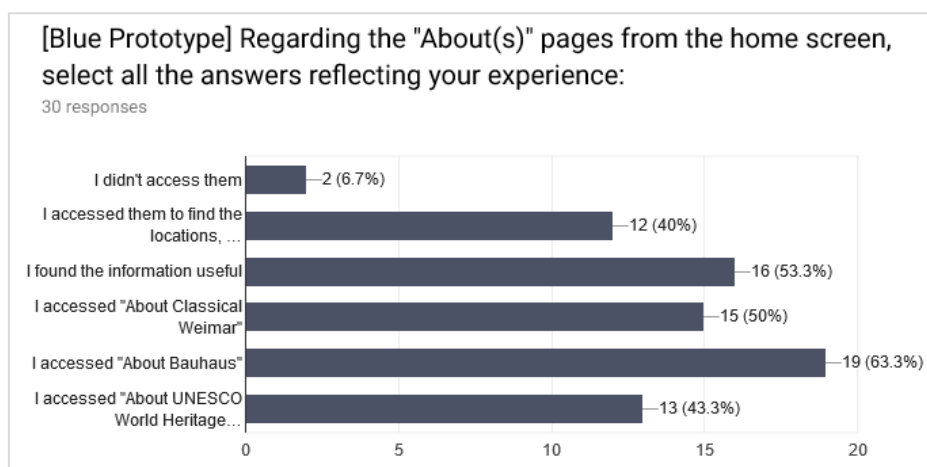
Figure 5.30: Question 23 result.

5.4.4.5 – About the Maps

Even with the Blue prototype offering a more tailored version of the "interactive" map, with personalised icons related to the WHS locations (Bauhaus and Classical Weimar), the vast majority (Figure 5.31) preferred the map resembling the GoogleMaps style, with 70% of the votes (when considering the 53.3% of those who chose the GPS version, with the 16.7% who preferred both versions).
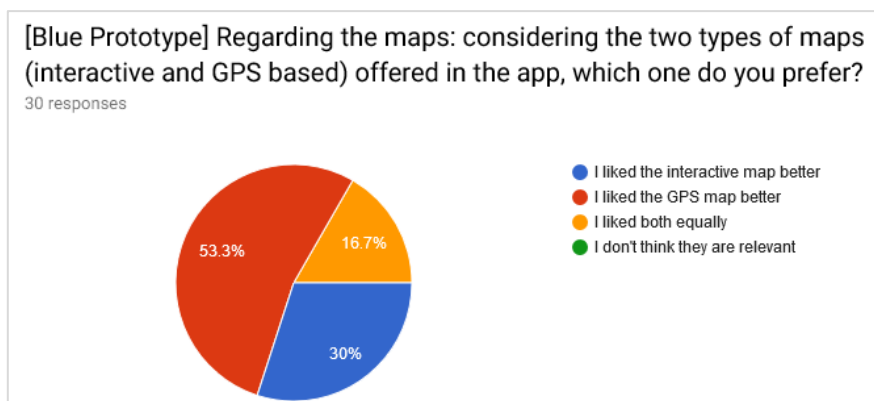
Figure 5.31: Question 24 result.

When asked why they preferred an interactive map (Figure 5.31), the main reasons included "It offered more tailored information", "The map does not look generic" and "The design of the interactive map was attractive".
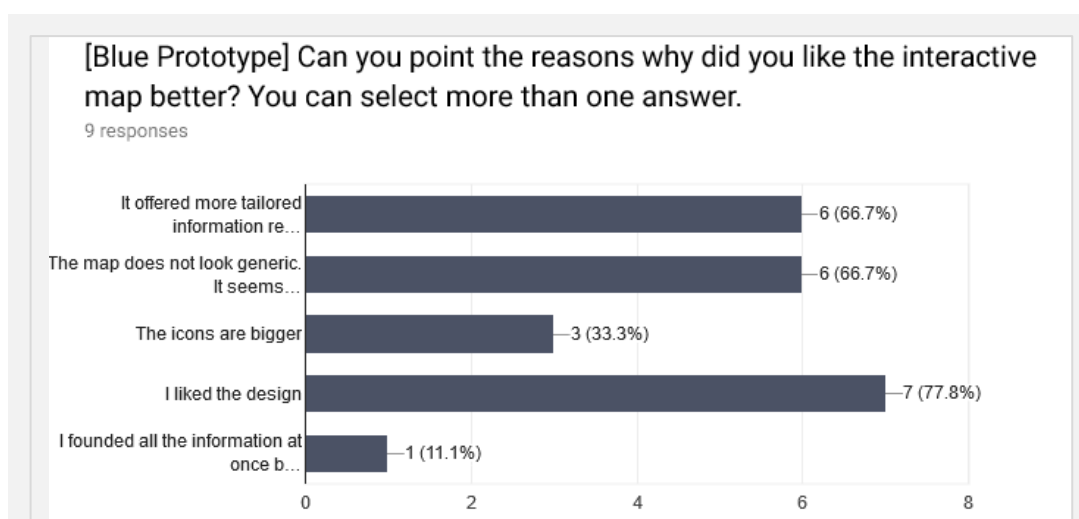
Question 25: Can you point the reasons why did you like the interactive map better? You can select more than one answer.
- (6 votes) It offered more tailored information regarding the locations
- (6 votes) The map does not look generic. It seems to be specific for the App and more trustworthy.
- (3 votes) The icons are bigger
- (7 votes) I liked the design
- Other (one comment):
    - *I found all the information at once by just one click, saved time and mobile data volume.*

Figure 5.31: Question 25 result; after choosing "interactive" in Question 24.

It is important to clarify that the interactive map from the Blue version, received nine votes from the participants, while the Red one got seven. The reason can be that the interactive map from the Blue version offered a more tailored design, related to the POIs' icons/markers.

When participants were asked why they chose the GPS Map version, 87.5% of them said, "I am more familiar with the GoogleMaps format". Again, as seen in a similar question regarding the Red version, can be justified based on the popularity of GoogleMaps as a tool widely used in different aspects of our lives.

Question 26: Can you point the reasons why did you like the GPS map better? You can select more than one answer.
- (8 votes) The GPS helps to find where I am in relation to the location
- (14 votes) I am more familiar with the GoogleMaps format
- (6 votes) The icons are smaller
- (5 votes) I liked the design
- Other (one comment):
  - *Same as with the Red (and I prefer the icon design for the Blue Interactive Map). For me having the location's names underneath the pin helped me find the places.*

Figure 5.33: *Question 26 result; after choosing "GPS" in Question 24.*

5.4.4.6 – Pop-up explanation

When opening an App for the first time, it is not rare that the user will see a pop-up window with guidance, describing the main features and navigation of the App. This feature was extracted from the academic-literature guidelines. When asked to evaluate it (Figure 5.34), 70% of the participants liked the home screen pop-up explanation because it clarified the menu

and navigation, and they would appreciate having similar explanations in other touristic Apps. It also means that, despite the need for intuitive navigation, the developers cannot assume that all the users will have the same level of experience or familiarity with the technology. A heads-up on how to use the App can prevent frustration and make the experience more enjoyable.
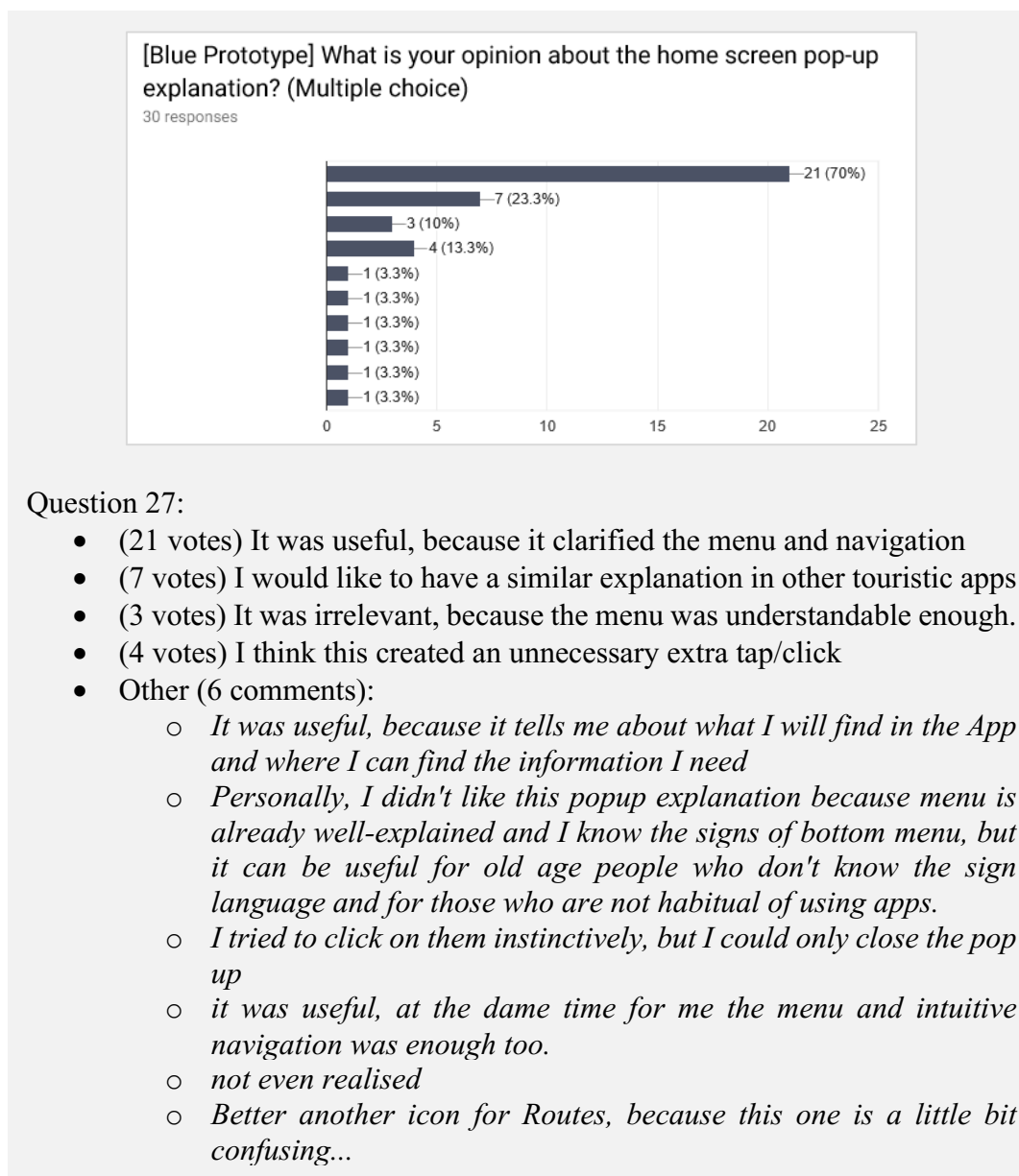
Figure 5.34: *Question 27 result.*

Question 27:
- (21 votes) It was useful, because it clarified the menu and navigation
- (7 votes) I would like to have a similar explanation in other touristic apps
- (3 votes) It was irrelevant, because the menu was understandable enough.
- (4 votes) I think this created an unnecessary extra tap/click
- Other (6 comments):
  - *It was useful, because it tells me about what I will find in the App and where I can find the information I need*
  - *Personally, I didn't like this popup explanation because menu is already well-explained and I know the signs of bottom menu, but it can be useful for old age people who don't know the sign language and for those who are not habitual of using apps.*
  - *I tried to click on them instinctively, but I could only close the pop up*
  - *it was useful, at the dame time for me the menu and intuitive navigation was enough too.*
  - *not even realised*
  - *Better another icon for Routes, because this one is a little bit confusing...*

5.4.4.7 – Videos

When testers were asked whether they had played the available video(s) on the "About" pages (Figure 5.35) of the Blue prototype, 43.3% of the participants claimed not to have seen the

video. However, they believe that it was an interesting option. This reveals that most users do not tend to play videos within a touristic application. However, such videos should be present as an option to guide novice users on how to use the App.

Question 28:
- (5 votes) Yes, the video was helpful.
- (1 vote) Yes, but I don't think it is necessary
- (13 votes) No, but I think it is an interesting option
- (4 votes) No, I don't think video is helpful in this kind of app.
- (3 votes) I didn't access the "About" pages.
- (2 votes) I didn't notice any video there.
- Other (2 comments):
  - *Video increases interest about the sites to visit by getting information.*
  - *No, but i think it is interesting. I didn't play it because you're waiting for my feedback and it is 31 evening. I will test them, i like the option.*

Figure 5.35: Question 28 result.

5.4.4.8 – Routes

Routes is a feature that received a very positive reaction. Regarding the use of "Routes" feature existing within the Blue prototype (Figure 5.36), 66.7% of the participants used the feature and liked it. This feature was also mentioned positively in the open-ended answer option in the questionnaire.

Question 29:
- (20 votes) Yes, and I like them
- (1 vote) Yes, but I didn't like them.
- (1 vote) No, I didn't open the routes' page.
- (7 votes) I opened the routes' page, but I didn't use them
- Other (2 comments):
  - *It was a white screen with a small map to the top, kind of error*
  - *Because you can visit and access the historical information in a route. you cannot miss any important site.*
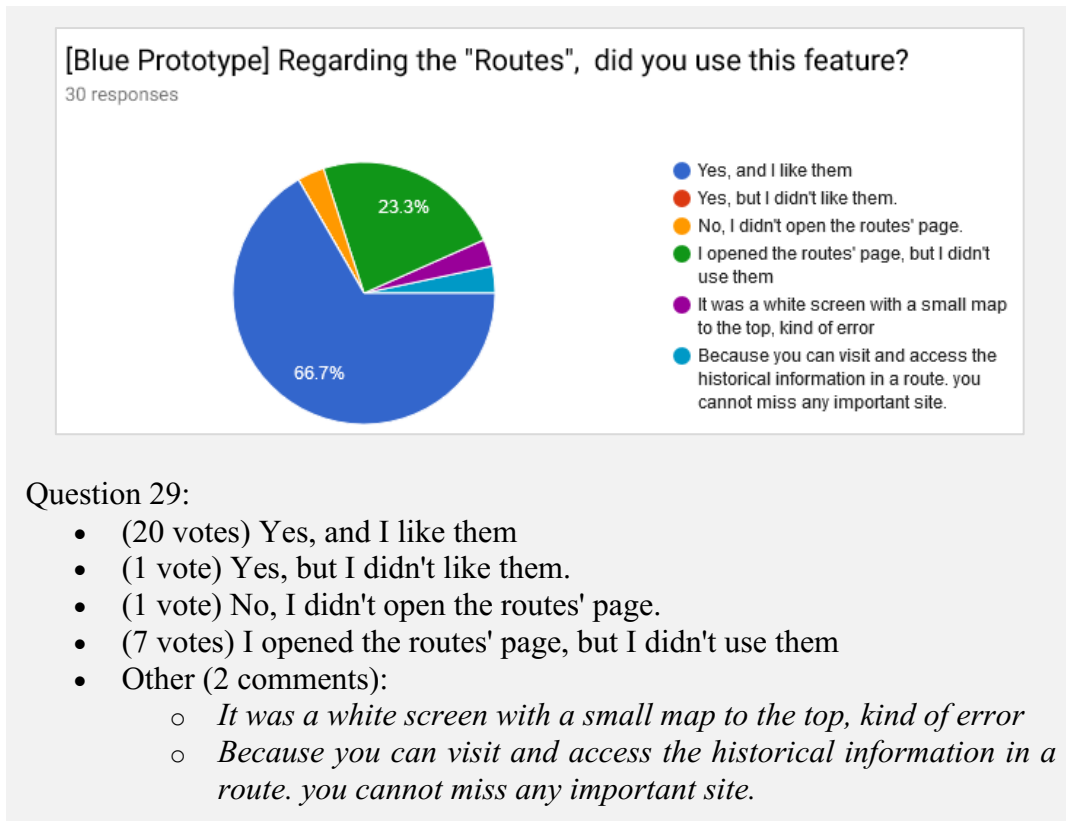
Figure 5.36: Question 29 result.

The acceptance of having a "Routes" option was reinforced by the following question (Figure 5.37) regarding its usefulness, where 66.7% of the participants agreed it was very useful in a scale of 5 (max), and the other 23.3% in a scale of 4.
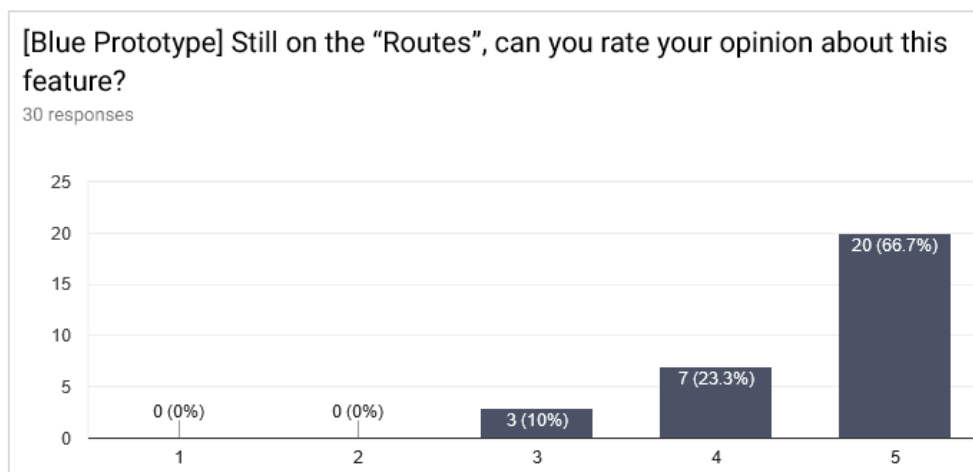
Figure 5.37: Question 30 result.

5.4.4.9 – Top-right "Hamburger" menu

The so-called "Hamburger Menu", customarily situated on top-right or top-left of the Apps, was positively received by the testers, with the majority of the votes (76.7%) located between 3 and 4, from "Not useful" as 1, to "Very useful" as 5 (Figure 5.38).
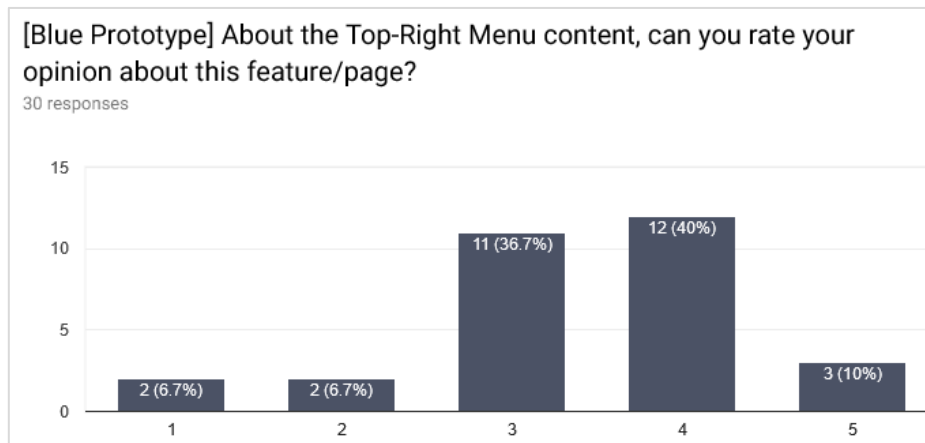
Figure 5.38: Question 31 result.

5.4.4.10 – Settings' options

Having available "settings", in order to customise some features of the App, was seen as a positive tool by the participants. When their opinion was asked in regards to the different features in the prototype, GPS notifications and Distance Units (between Kilometres and Miles) were the favourite of the participants (Figure 5.39).
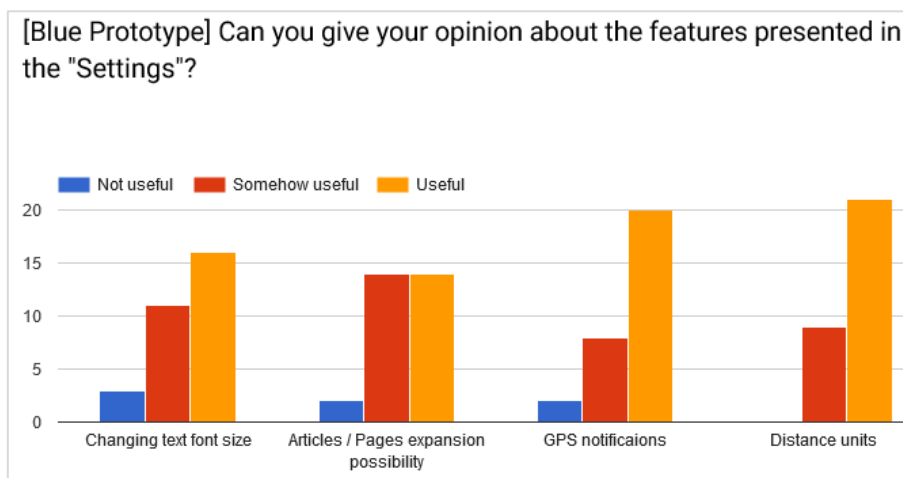
Figure 5.39: Question 32 result.

5.4.5 – Comparing the Two Prototypes (Red/Blue)

After the questions regarding each one of the prototypes, a new set of questions were presented to closely compare features between both prototypes, allowing a direct comparison.

5.4.5.1 – Main menu

The main menu of the Blue prototype (Figures 5.40 and 5.41) was preferred by the testers because it had more content options. For them, it was easy to understand and it was more appealing for touristic activities.
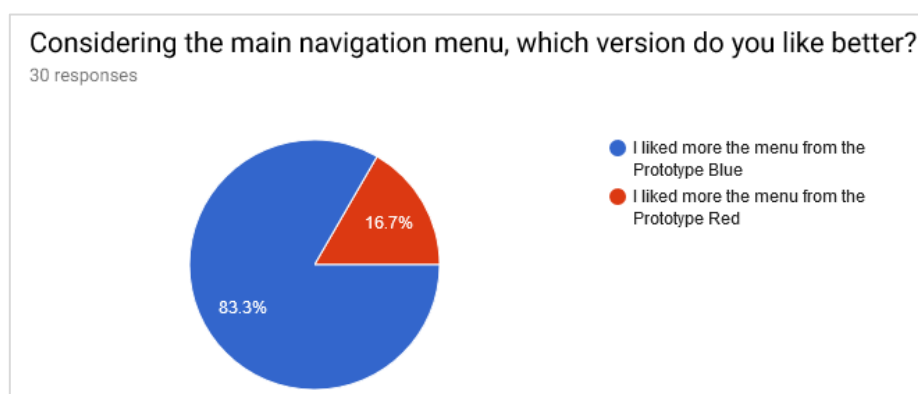
Figure 5.40: Question 33 result.

For the 25 participants (83.3%) who chose the main menu from the Blue prototype in compared to the one offered in the Red prototype, the reasons of their choice were mostly on "It has more options" (72%) and "I liked the Routes" (72%), reinforcing the importance of using routes for touristic Apps.

Can you point the reasons why did you like better the menu from the Blue Prototype? (Multiple choice)

25 responses

- 18 (72%)
- 5 (20%)
- 12 (48%)
- 2 (8%)
- 18 (72%)
- 8 (32%)
- 1 (4%)
- 1 (4%)

Question 34:
- (18 votes) It has more content options
- (5 votes) It was easy to understand
- (12 votes) It was more appealing for touristic activities
- (2 votes) I liked the icons.
- (18 votes) I liked the "Routes"
- (8 votes) I liked the "Settings"
- Other
  - *it has more information with many options. One can directly jump into 'what he/she wants to know?'*
  - *the Blue design is more appealing for the App purpose*

Figure 5.41: *Question 34 result; after choosing "Blue" in Question 33.*

For the five participants who chose the main menu from the Red prototype version as their favourite, the reason of their choice was "It was easy to understand" (80%) and "It was less complicated" (60%), probably in reason of fewer options displayed on it.

Question 35:
- (2 votes) It has less options
- (4 votes) It was easy to understand
- (1 vote) It was more appealing for touristic activities
- (0 votes) I liked the icons
- (3 votes) It was less complicated
- (1 vote) I liked the "Info"
- Other (1 comment):
  - *I did not understand what Routes icon means. Looks like audio navigator icon*
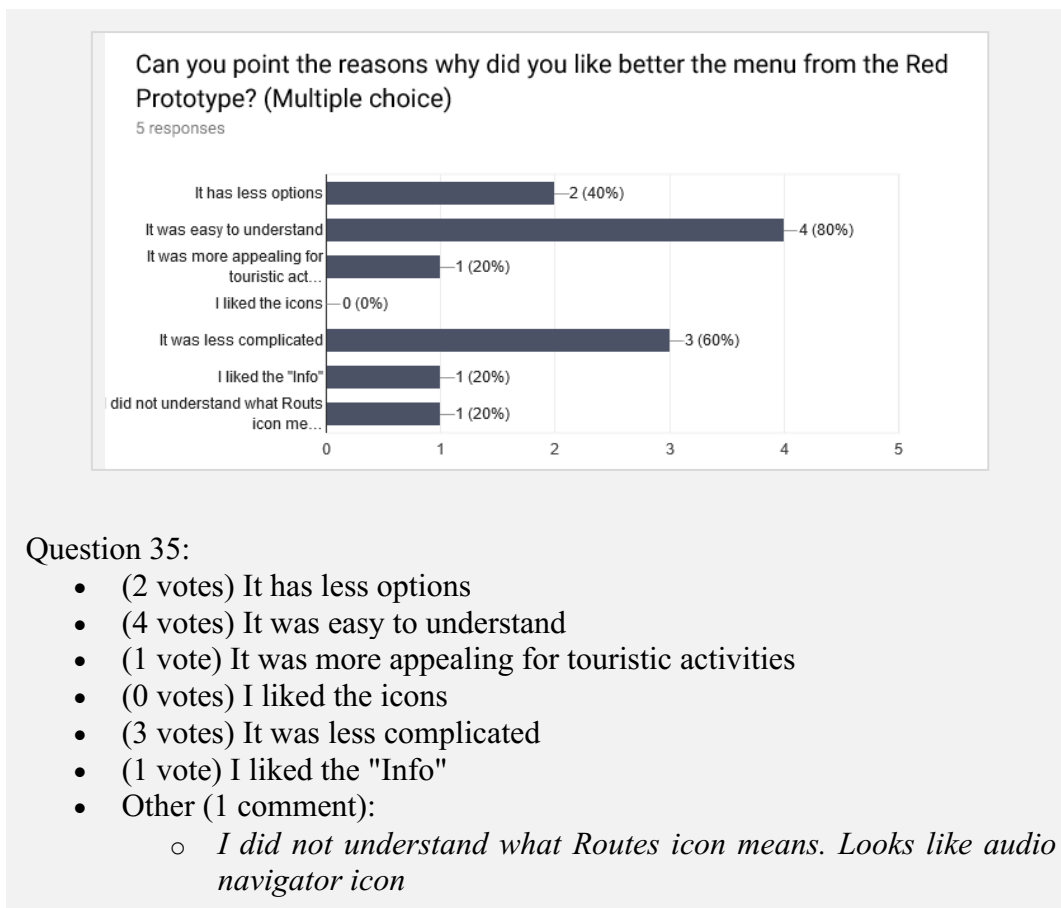
Figure 5.42: Question 35 result; after choosing "Red" in Question 33.

5.4.5.2 – Locations

Regarding how the locations (POIs) were displayed, the Blue prototype covered it in a more convenient and attractive way when compared to the Red version (Figure 5.43).
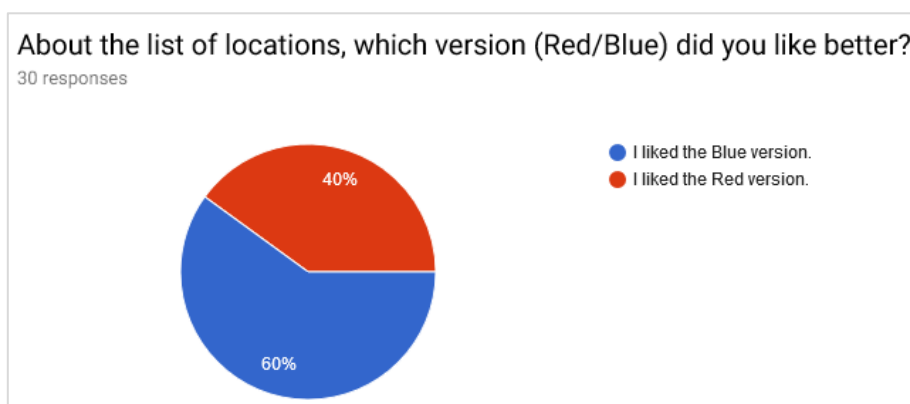
Figure 5.43: Question 36 result.

For the 18 participants (60%) who chose the content display for locations in the Blue version as the most attractive, the reasons mentioned were: the list format showed more information per screen space, the distance to the locations is available, and the App provided an alphabetical and distance order. It helped to make tourists find strategic sites to visit conveniently from virtually anywhere.

Question 37 (18 responses):
- (9 votes) I like more the "list" format
- (11 votes) The "list" format shows more information per screen space
- (14 votes) The distance to the locations is available
- (10 votes) Every location is identified as Bauhaus or Classical Weimar sites
- (13 votes) It offered Alphabetical and Distance order
- Other (2 comments):
    - *both are good, the list is slightly more ergonomic for me, but the Red is good for big pics*
    - *I liked it because of two different options, it is easy to see where can i go and how much distance it needs to reach at the location. As a suggestion give view option i.e, 'list' or 'grid' view.*

Figure 5.44: Question 37 result; after choosing "Blue" in Question 36.

The 12 participants (40%) who chose the content display for the Red version as the most attractive mentioned the following reasons (Figure 5.45): the grid format of display allowed many pictures to be displayed on the screen at once, the version showed bigger pictures, and the centred on visuals with less text attracted 6 participants.

Question 38 (12 responses):
- (8 votes) I like more the "grid" format
- (10 votes) It shows bigger pictures
- (2 votes) It shows more options on the screen at the same time
- (4 votes) Every location is identified as Bauhaus or Classical Weimar sites
- (6 votes) I like the design centred on visuals and with less text
- (0 votes) Other
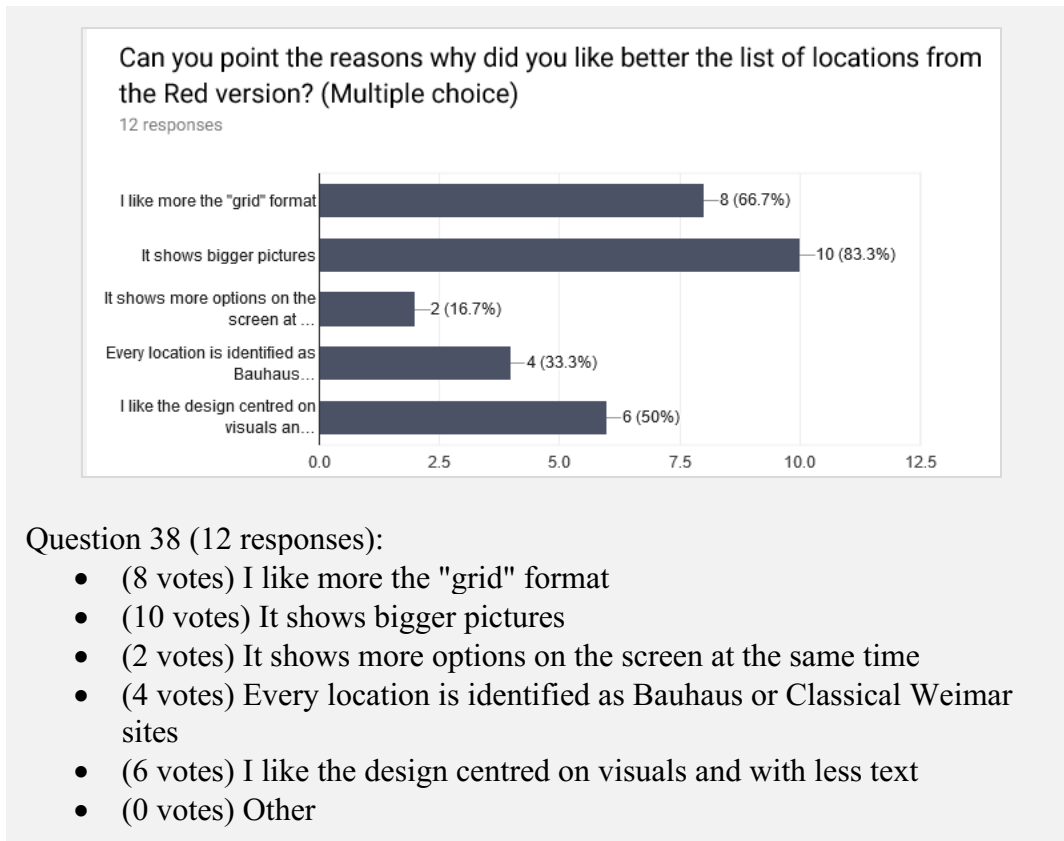
Figure 5.45: Question 38 result; after choosing "Red" in Question 36.

5.4.5.3 – Content

After accessing each POI, the participants were asked about which version of content display they liked most (Figure 5.46), with 73.3% choosing the Blue version. This includes every offered element, such as imagery, font-size, text-length and further information regarding the POI.
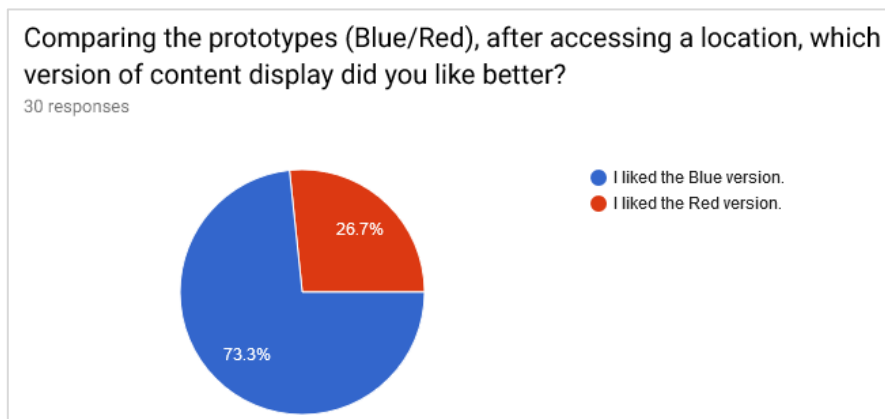
Figure 5.46: Question 39 result.

The 22 participants (73.3%) who chose the Blue version in the previous questions, 90.9% of the participants highlighted that the version offered the "show more information", in case the user wanted to read more. Also, 81.8% of the participants liked the fact that the Blue version displayed shorter texts which were considered straight to the point.

Question 40 (22 responses):
- (18 votes) The text was shorter, going directly to the point
- (20 votes) It offered the "show more information", in case I wanted to read more
- (10 votes) I liked the photo-gallery on the top
- (1 vote) I liked more this font type
- (0 votes) I liked more this font size
- Other (one comment)
  - *I can access the logistic information faster*
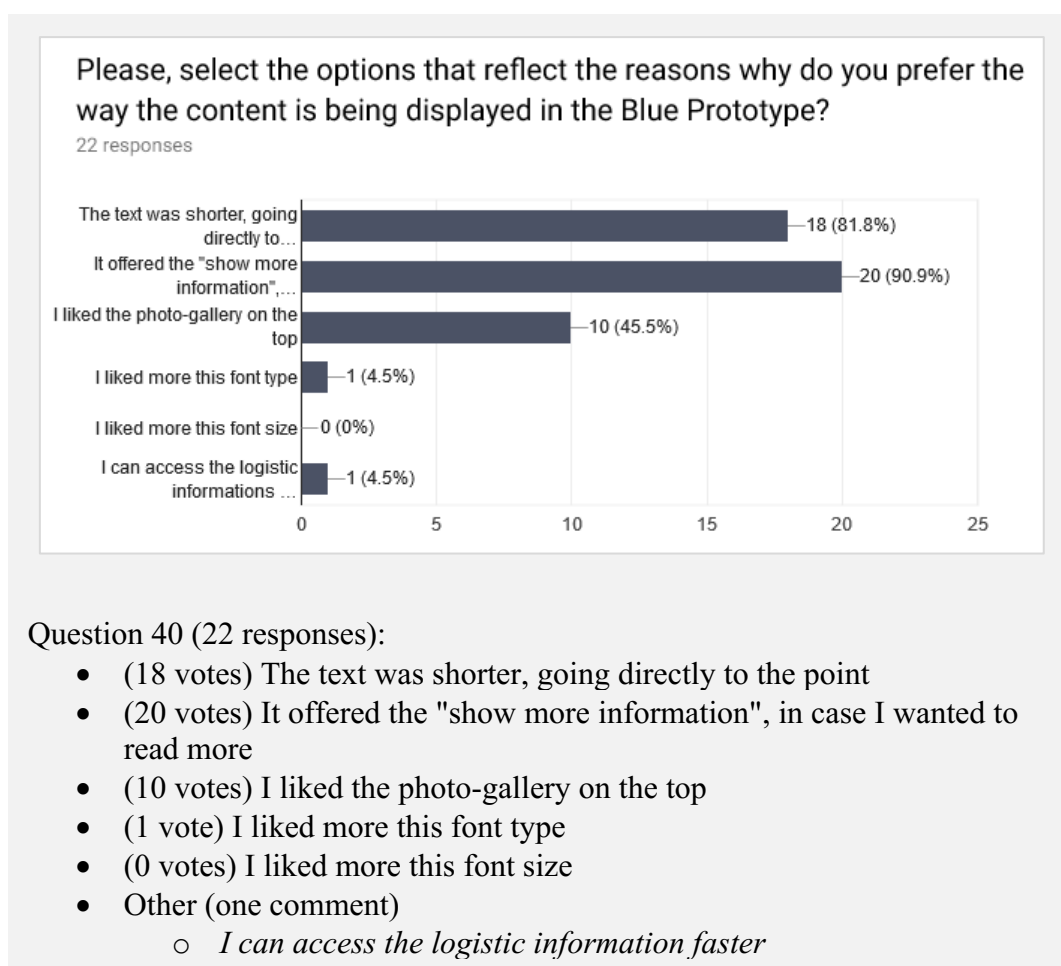
Figure 5.47: Question 40 result; after choosing "Blue" in Question 39.

When participants' opinions were asked about the reasons why they preferred the content displayed in the Red prototype (Figure 5.48), 50% claimed that the content display showed more content about the location. Also, 50% claimed that there was no "show more information" option making it more direct, with one less tap/click to access all the information.

Question 41 (8 responses):
- (4 votes) It shows more content about the location
- (4 votes) There was no "show more information" option, making one less tap/click to access all the information
- (1 vote) I liked the picture on the top
- (1 vote) I liked more this font type
- (0 votes) I liked more this font size
- Other (one comment):
  - *I like Red color*
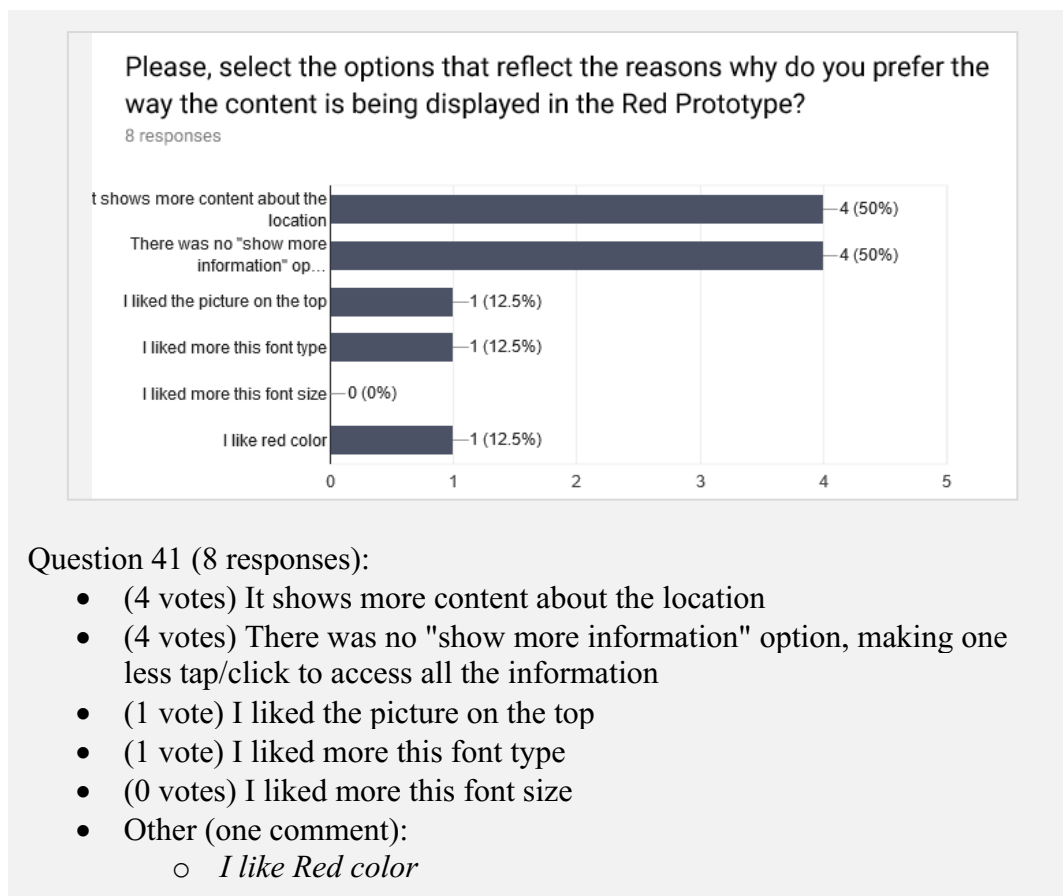
Figure 5.48: Question 41 result; after choosing "Red" in Question 39.

The font style used to display the Blue prototype's content was preferred by 83.3% of the participants, while 16.7% preferred the font style used in the Red version. The Blue prototype had a larger font style making it easier to read in outside spaces and even facilitating older adults (more often visually impaired) to use it.
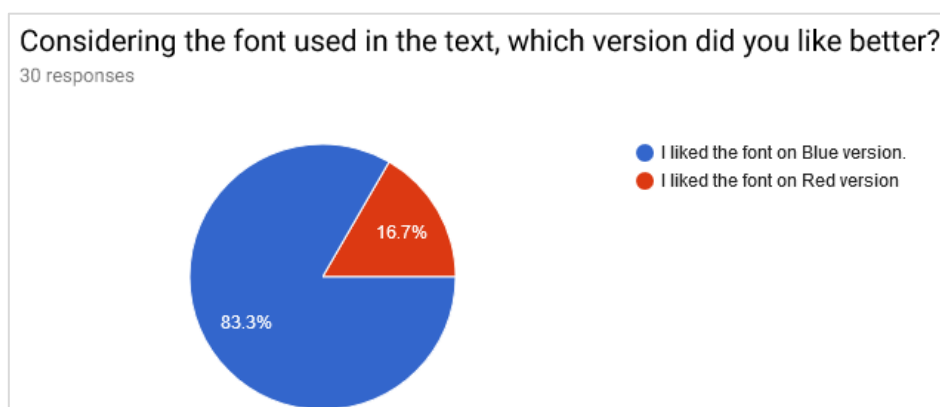
Figure 5.49: Question 42 result.

The reasons why most people preferred the content display of Blue prototype included, bigger texts, the texts were easy to read, and the line spacing was bigger.

Question 43 (25 responses):
- (10 votes) It was bigger
- (21 votes) It was easier to read
- (5 votes) I liked more this font style
- Other (4 comments):
  - *the line spacing is bigger*
  - *I have not noticed there was a difference until now*
  - *This font shows neatness not a mess.*
  - *its easier to read if you are walking*
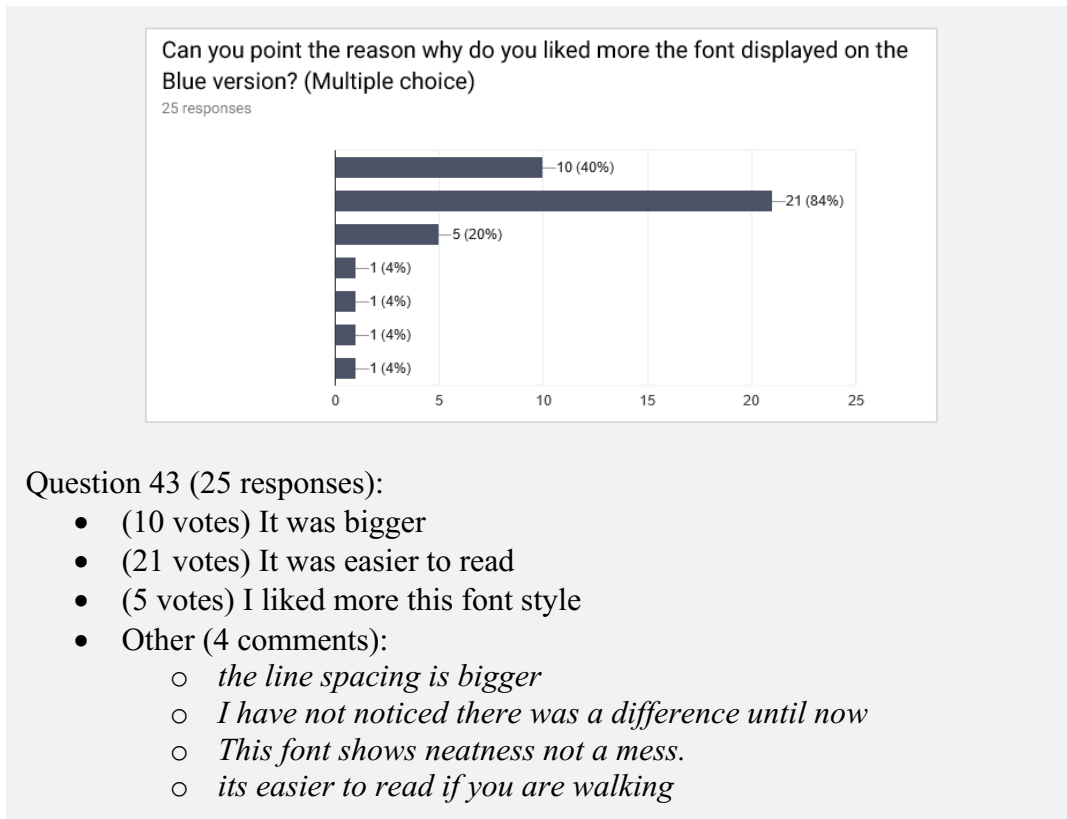
Figure 5.50: Question 43 result; after choosing "Blue" in Question 42.

Among the five participants who chose the Red Prototype's font style (Figure 5.51), 80% pointed out that "It is smaller, showing more content before scrolling the page" as the main reason for their choice.
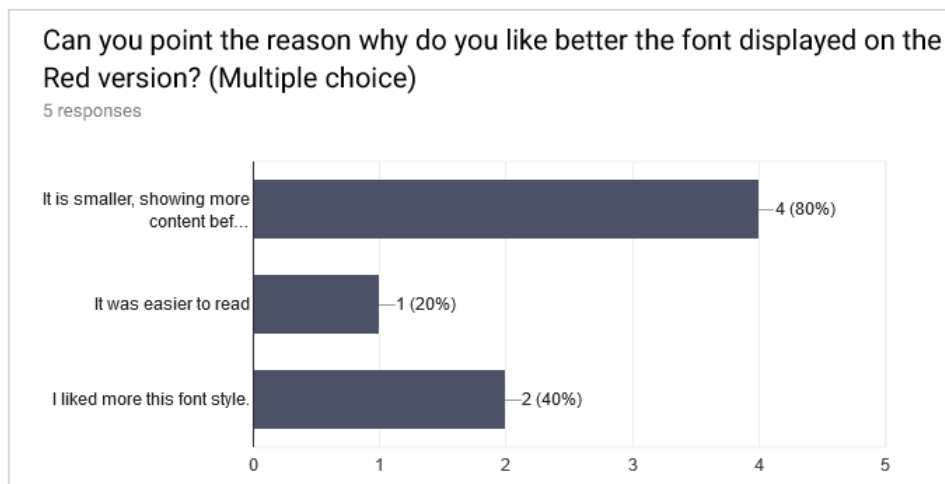
Figure 5.51: Question 44 result; after choosing "Red" in Question 42.

When comparing how the additional content and further information was displayed in both versions (Figure 5.52), the vast majority of 66.7% opted for the Blue version. The reasons for this choice are explored in the sequence.
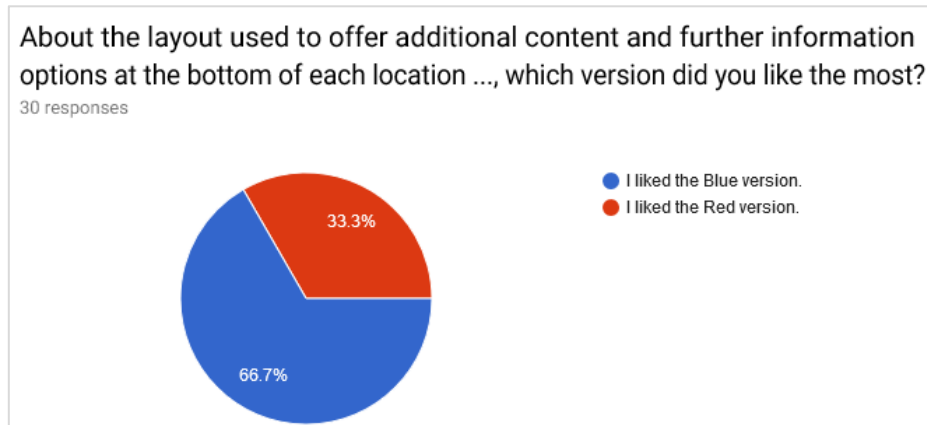
Figure 5.52: Question 45 result.

60% of the users (20 participants) who chose the Blue Prototype (Figure 5.53) in the previous question, claimed that the main reasons they preferred it was that the layout offered additional content and further information. In addition, they mentioned the fact that the version displayed more space between the content. Therefore, it was easy to tap into the content.

Can you point the reasons why did you like better the additional content and further information layout in the Blue version? (Multiple choice)

20 responses

12 (60%)

10 (50%)

2 (10%)

5 (25%)

1 (5%)

1 (5%)

1 (5%)

0   5   10   15

Question 46 (20 responses):
- (12 votes) It shows more space between the content
- (10 votes) It is easier to tap/click in the content
- (2 votes) I just liked this one more, no special reason
- (5 votes) It shows the UNESCO's World Heritage Sites logo
- Other (3 comments):
    o *More options below*
    o *no difference noted*
    o *the two UNESCO logos are unnecessary*

Figure 5.53: *Question 46 result; after choosing "Blue" in Question 45.*

For the other 10 participants who preferred the Red Prototype regarding the same characteristics, 70% of them (Figure 5.53) claimed to enjoy the compactness and simplicity of the version thus preferring the additional content and further information as displayed in the layout of the Red version.

Question 47 (10 responses):
- (7 votes)It is more compact, using less screen space
- (3 votes) It is easier to see all the options.
- (2 votes) I just liked this one more, no special reason
- (5 votes) It was simpler than the Blue one, without extra images on the bottom
- Other (one comment):
  - *Liked the Red color more*
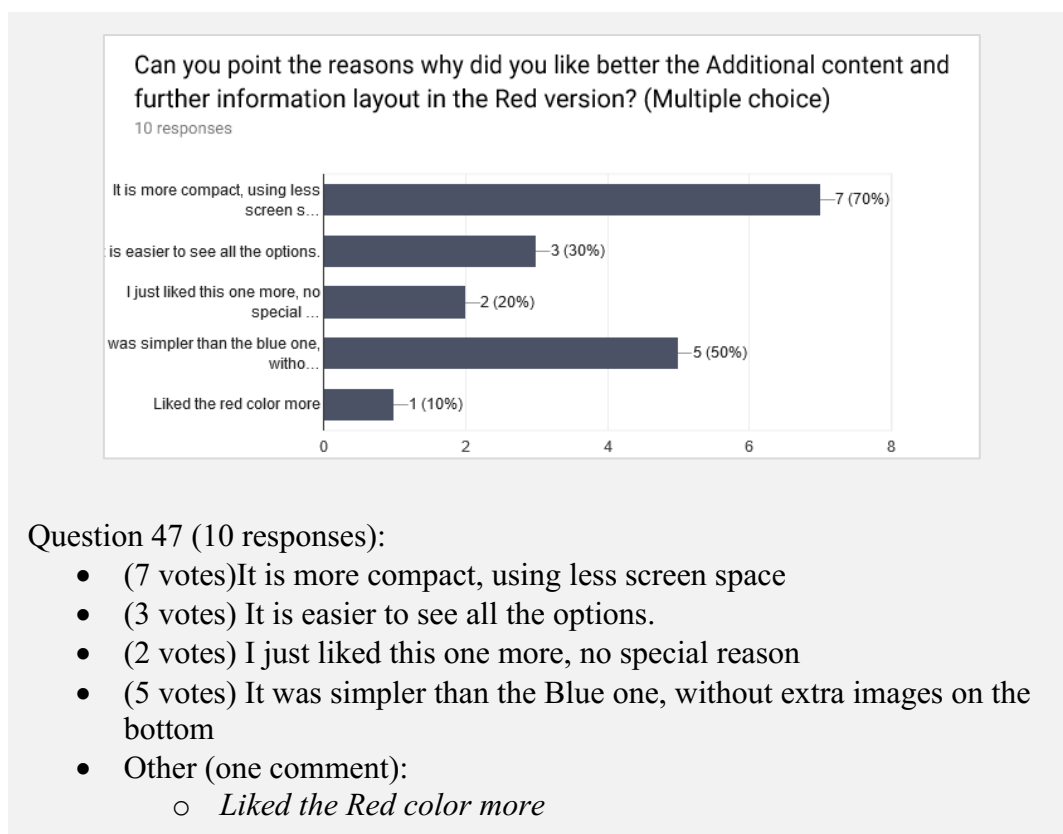
Figure 5.54: *Question 47 result; after choosing "Red" in Question 45.*

5.4.5.4 – Further information

From the home screen, when the users accessed the "About" page (Bauhaus Classical Weimar, UNESCO World Heritage), 86.7% liked more the Blue version while 13.3% liked the Red version.
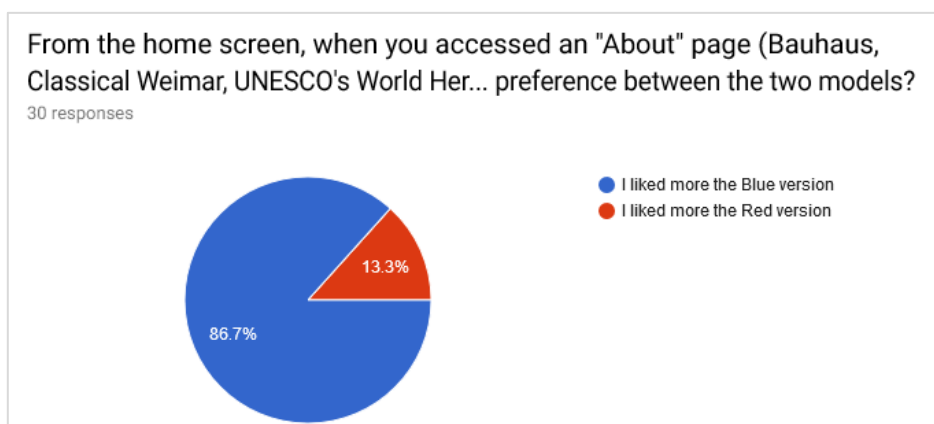
Figure 5.55: *Question 48 result.*

Some of the primary reasons why most people choose the Blue version was its font style, top navigation bar and the locations the elements were placed in the screen (Figure 5.56).

Can you point the reasons do why did you like better the "About" pages from the Blue version? (you can choose more than one answer)
26 responses

I liked the font style	3 (11.5%)
iked the top navigation between the ...	24 (92.3%)
liked the way the locations were plac...	0 (0%)
does look better in general, the lay...	6 (23.1%)

Question 49 (26 responses):
- (3 votes) I liked the font style
- (24 votes) I liked the top navigation between the pages
- (0 votes) I liked the way the locations were placed
- (6 votes) It does look better in general, the layout is more appealing.

Figure 5.56: Question 49 result; after choosing "Blue" in Question 48.

The most important result from this question refers to accepting the existence of an "in-tab navigation". This feature allows an extra-navigation option without using the "back" option to return for the content options in the previous screen.

Overall, the reason why some user preferred the "About" pages from the Red version was the font style and the compactness displayed in the Red prototype version (Figure 5.57).

Question 50 (4 responses):
- (0 votes) I liked the font style
- (2 votes) It is more compact
- (0 votes) I liked the way the locations were placed
- (2 votes) It does look better in general, the layout is more appealing.
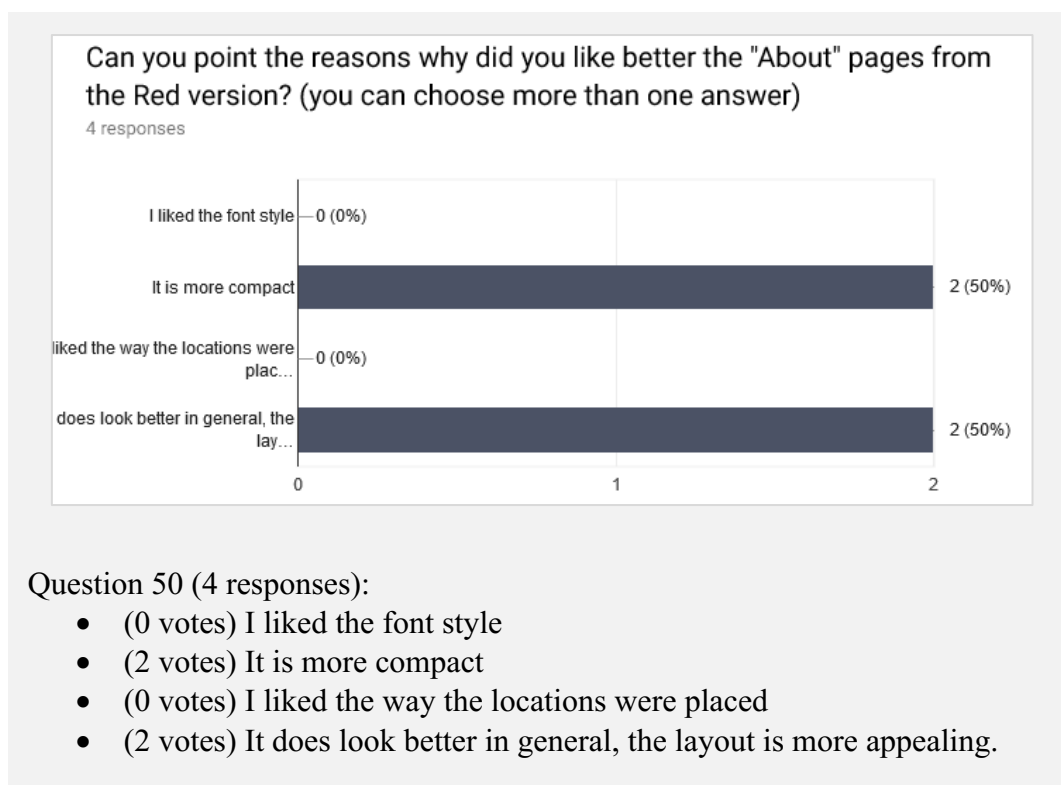
Figure 5.57: Question 50 result; after choosing "Red" in Question 48.

5.4.5.5 – Type of Imagery
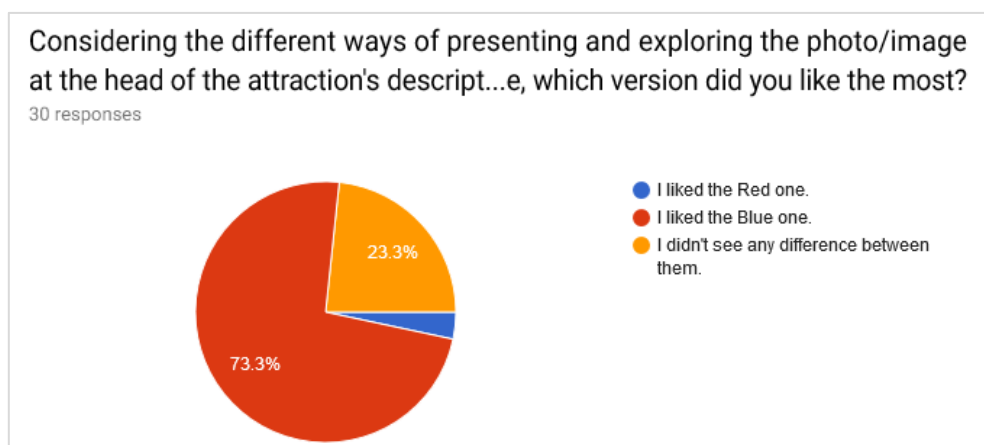
Figure 5.58: Question 51 result.

For the question 51, regarding the header of the articles along with a static image (Red version) or photo-gallery (Blue version), 22 people (73.3%) opted for the Blue version, 7 (23.3%) chose the Red version, and one person (3.3%) went for the option "I didn't see any difference between them). Reasons for why some people would prefer the Red or Blue versions are discussed in the sequence.

63.6% of the people who liked the Blue version claimed that the photo-gallery was helpful in giving a preview of the location and the photo-gallery was more attractive than a single static image. In Figure 5.59 it is possible to see this result in details.

Question 52 (22 responses):
- (10 votes) The image gives a better preview about what I am looking for
- (14 votes) The photo-gallery was helpful in giving a preview of the location
- (14 votes) I like more the photo-gallery than the static image
- (0 votes) I don't think the image is necessary
- Other (one comment):
  - *It gives more attraction by seeing more than one photo.*
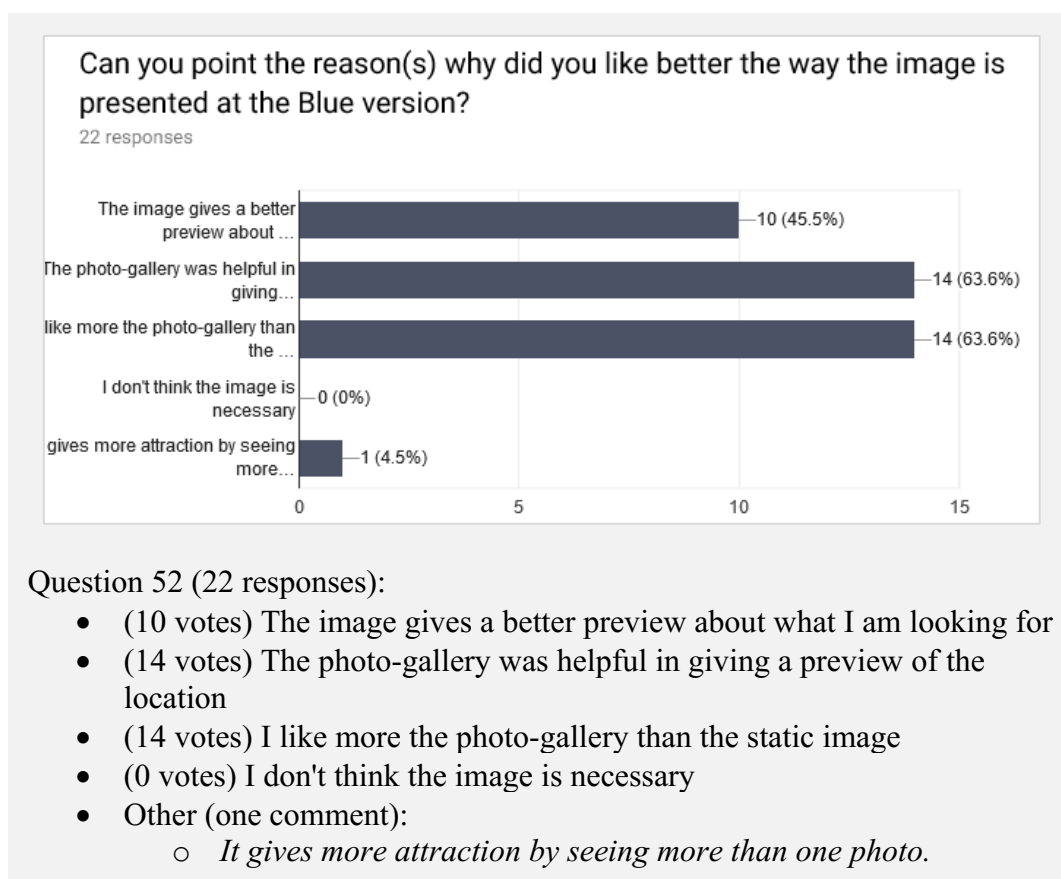
Figure 5.59: Question 52 result; after choosing "Blue" in Question 51.

Regarding the Question 53 (Figure 5.60), just one tester chose this option, pointing "Just one image is enough to have an idea about the location" and "I don't like photo-gallery, such as presented in the Blue version" as reasons for choosing a static image to represent the location(s).
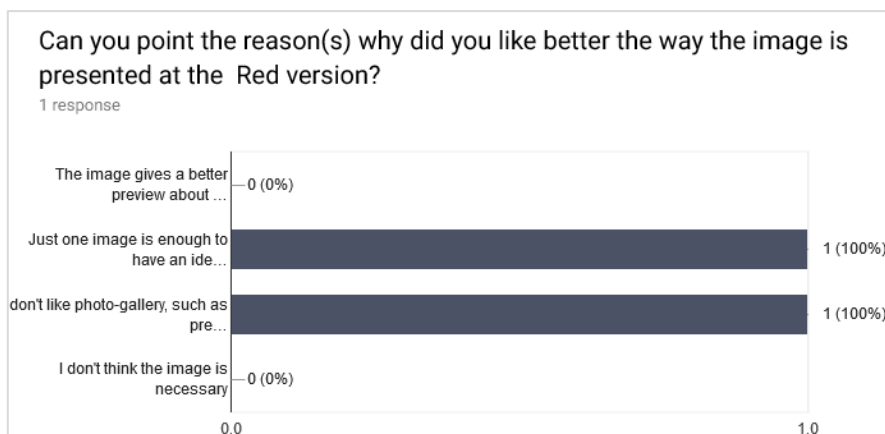
Figure 5.60: Question 53 result; after choosing "Red" in Question 51.

5.4.5.6 - Maps

Considering how the locations were presented inside the maps, 63.3% of the users preferred the Blue version, while 36.7% of the users liked the Red version more.
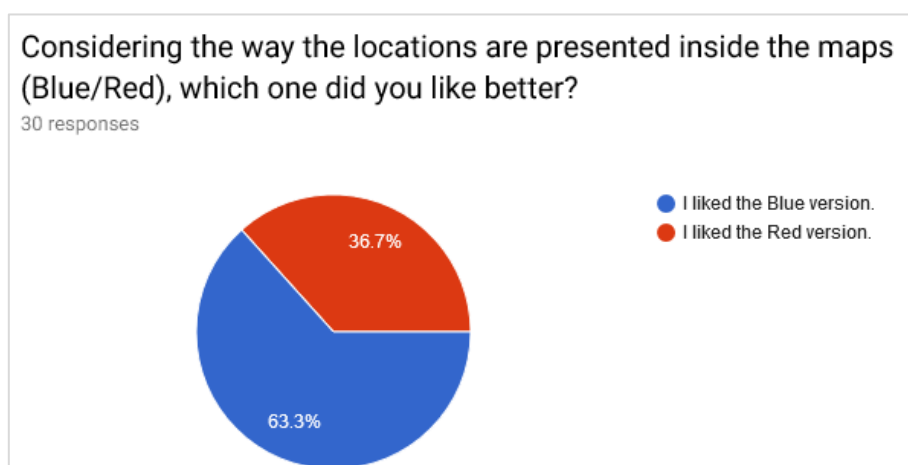
Figure 5.61: Question 54 result.

84.2% of the Blue version voters (Figure 5.62) liked more the way the Blue prototype presented the maps because icons were customised, and thus, it was easier to distinguish the locations. Secondly, the colours were helpful to distinguish one location from another.

Question 55 (19 responses):
- (16 votes) The icons are better and make it easier to distinguish the locations
- (10 votes) The colours were helpful to distinguish the locations
- (7 votes) I recognised the icons from the home screen
- (0 votes) I didn't understand the differences in colours and icons
- (4 votes) I recognised the colour scheme from the main-screen of the maps' page
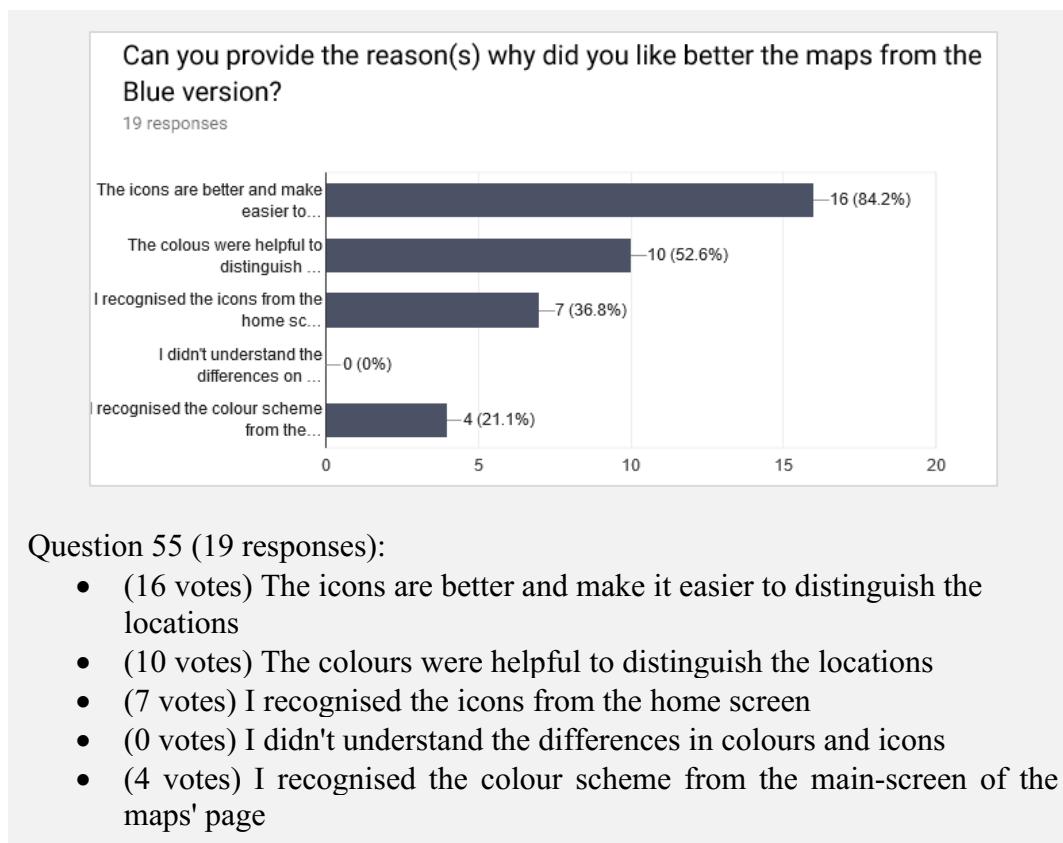
Figure 5.62: Question 55 result; after choosing "Blue" in Question 54.

Regarding the Red prototype, 72.7% of the testers who preferred it regarding this criterion (Figure 5.56), liked the standard google-maps icons over the customised ones. Also, the colours were helpful to distinguish the locations. This result is referring to the maps in both, GPS and Interactive formats, presented in both prototypes.

Can you provide the reasons why did you like better the maps from the Red version?

11 responses

It is more likely to standard google-ma...	8 (72.7%)
The colous were helpful to distinguish ...	4 (36.4%)
I didn't understand the differences on ...	1 (9.1%)
recognised the colours from the main-...	2 (18.2%)
It would be nicer if it uses the icons ...	0 (0%)
e white circle inside the marker is s...	1 (9.1%)

Question 56 (11 responses):
- (8 votes) It is more likely to standard google-maps icons
- (4 votes) The colours were helpful to distinguish the locations
- (1 vote) I didn't understand the differences on colours and icons
- (2 votes) I recognised the colours from the main-screen of the maps' page
- (0 votes) It would be nicer if it uses the icons presented at the home page (on "About" pages)
- Other (one comment)
  - *the white circle inside the marker is simpler than the other rather complicated shape*

Figure 5.63: *Question 56 result; after choosing "Red" in Question 54.*

Considering only the interactive map on both prototypes, 60% of the participants liked the Red version over 40% that liked the Blue version after a specific location was clicked. The comparative Question 57, about how the POI information is displayed after tapping in an icon on the map, was one of the few moments in which the Red version surpassed the Blue one in the testers' preference.
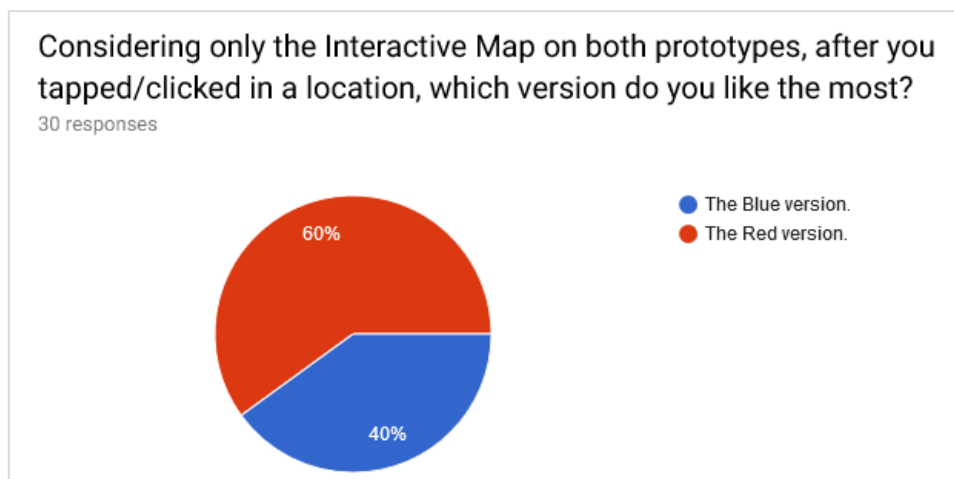
Figure 5.64: Question 57 result.

The main reason some users chose the interactive map from the Blue version over the Red was because they preferred to see the information about the location displayed at the bottom of the screen.

Question 58 (12 responses):
- (11 votes) I prefer when the information about the location is displayed at the bottom of the screen
- (0 votes) It shows more information about the location, such as the address.
- Other (one comment):
  - *It is clear and better organised. In Red prototype it looks a bit old styled*
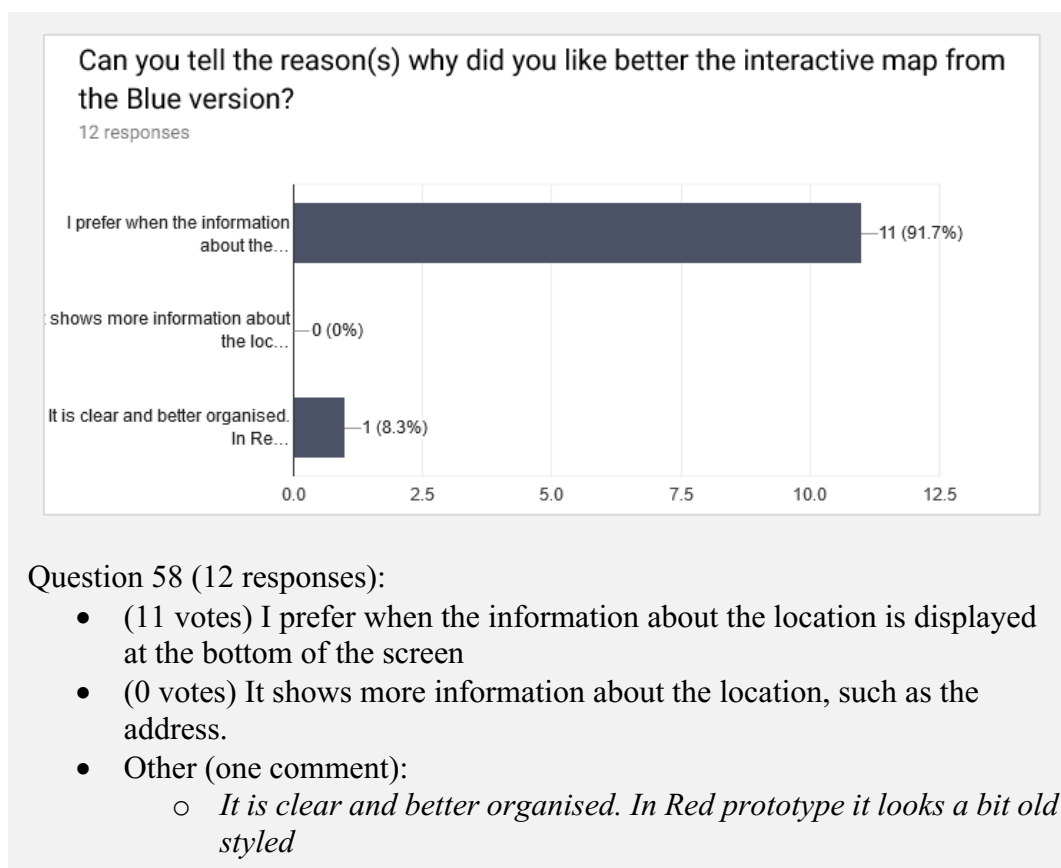
Figure 5.65: Question 58 result; after choosing "Blue" in Question 57.

77.8% of the Red version users have liked the interactive map because of the floating-centred information box above it. Also, the coloured border creates a better contrast in relation to the map.

Question 59 (18 responses):
- (14 votes) I like the floating-centred information box
- (7 votes) the coloured border creates a better contrast in relation to the map
- Other (4 comments):
    - *the "info" text under the arrow makes it more clear*
    - *the simpler it is better!*
    - *Design-wise, it is much better than the Blue one.*
    - *the center floating info box is more straight forward*
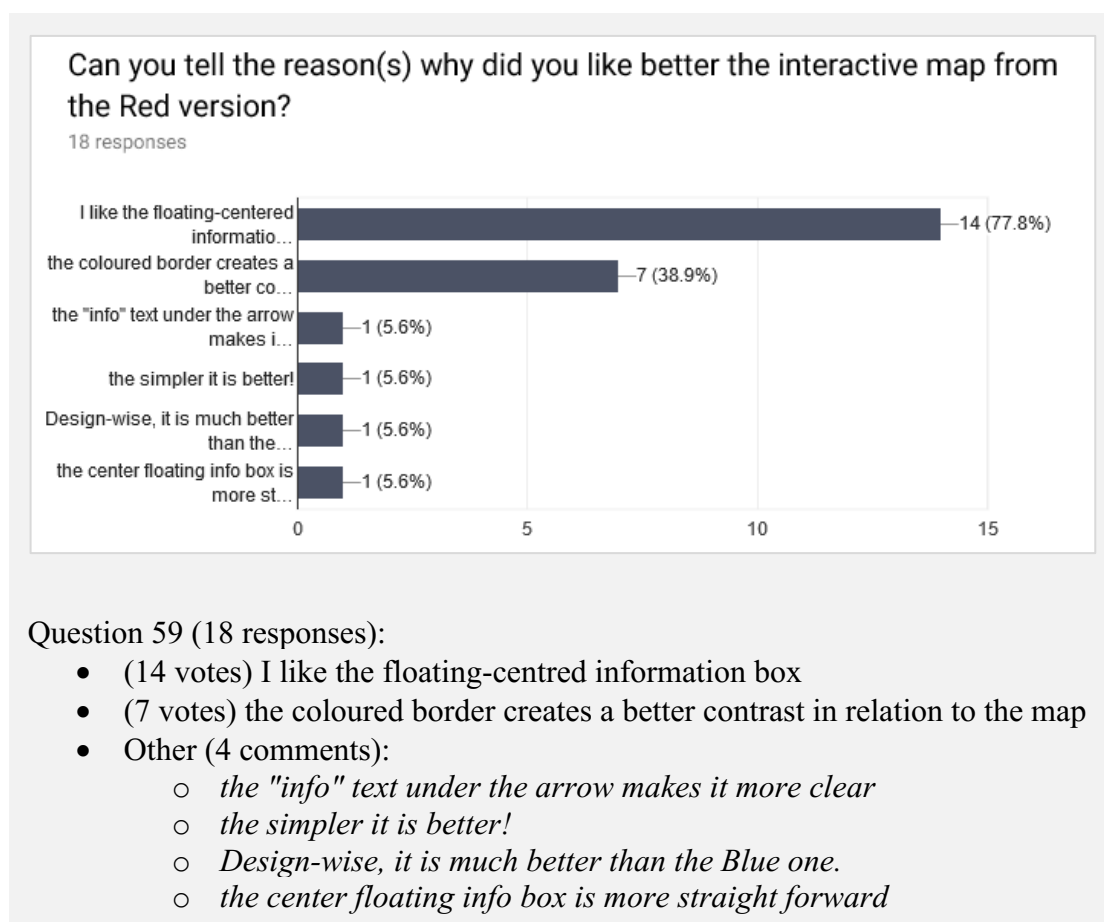
Figure 5.66: Question 59 result; after choosing "Red" in Question 57.

5.4.5.7 - About the Prototypes

In general, when asked about the overall preference between one of the prototypes, 83.3% of the participants preferred the Blue version, while 16.7% preferred the Red version. Further clarification on why some users chose Red while others chose Blue will be discussed in the sequence.
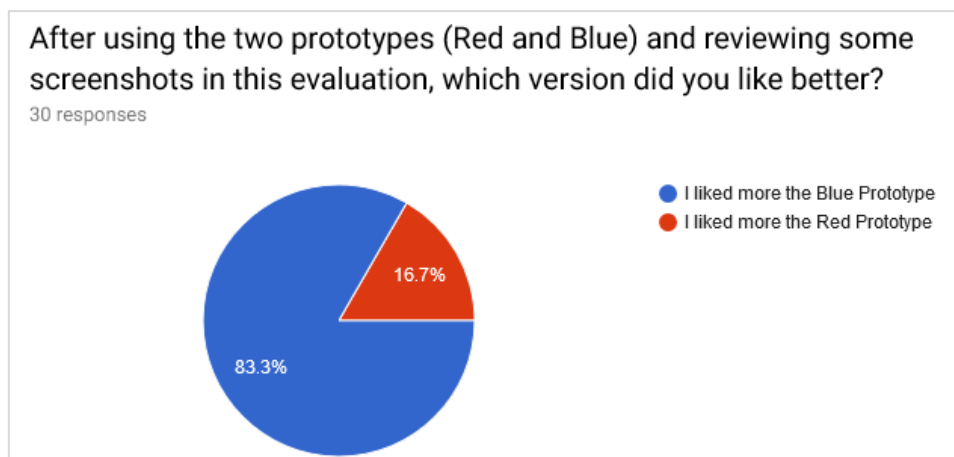
Figure 5.67: Question 60 result.

76% of the participants liked the Blue version over the Red (Figure 5.68) because it offered more options on the menu. 44% of the participants also claimed to like the colour Blue better than the Red one, thus influencing their choice on the prototype they preferred.

This questions also offered an open-ended answer option, being the most used in the entire questionnaire, with the following comments:

- *I liked the design in general, Iconography and layout are better placed and interaction flows smoother*
- *It looked more extensive and detailed*
- *Better to navigate in Blue prototype but I did not even see burger-menu at the top right (usually it is on the left or without this menu at all). I do not like the icon routes – I did not understand what is it from the first moment. All other parts look good and they are understandable from the first moment*
- *Red colour more beautiful but Blue one is more practical*
- *Blue prototype seems to be more practical and easier to use than Red one. Due to functionality, accessibility , design, understanding, perception and robust. Colour contrast is more appealing and soothing to eyes than the Red colour. Reader's view is very neat and clean. Blue prototype looks more professional not by it's design also by it's functionality.*
- *I really liked the Routes option seemed a little more ergonomic to me*

Can you point the reason(s) why did you like better the Blue Prototype? (Multiple choice)

25 responses

Question 61 (25 responses):
- (11 votes) I like the Blue colour better than the Red one
- (19 votes) It offered more options on the menu
- (8 votes) The menu on top-corner was helpful to find information
- (10 votes) It looked more professional than the Red version.
- (12 votes) I liked the design in general
- Other (7 comments, displayed in the page before)

Figure 5.68: Question 61 result; after choosing "Blue" in Question 60.

The participants who chose the Red prototype (Figure 5.69) claimed that they liked the Red colour more than the Blue one, the content structure was more direct, and therefore, there was no need to search for any content. Lastly, 60% of the participants who preferred the Red prototype liked more its design compared to the Blue one. No one provided comment on this question, differently from the previous one.
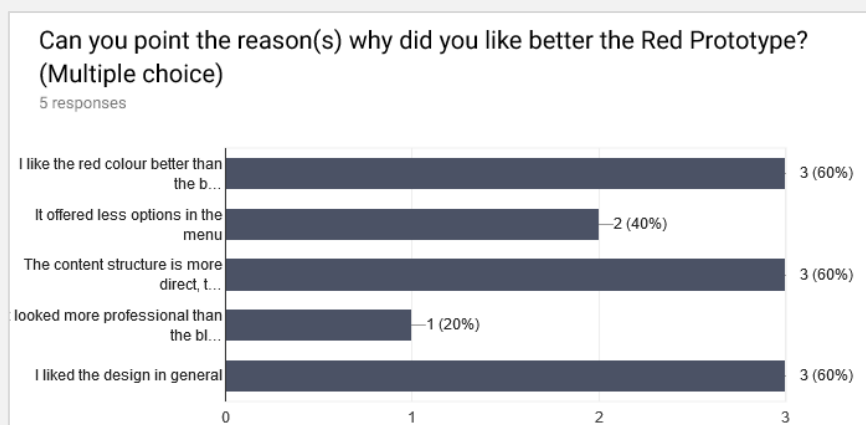
Question 62 (5 responses):
- (3 votes) I like the Red colour better than the Blue one.
- (2 votes) It offered less options in the menu
- (3 votes) The content structure is more direct, there is no need to search for the content
- (1 vote) It looked more professional than the Blue version.
- (3 votes) I liked the design in general
- Other (0 comments)

Figure 5.69: Question 62 result; after choosing "Red" in Question 60.

Regarding the Question 63, asking if the participants would consider using a similar App presented by the prototypes in a future journey to another destination, 21 participants (70%) voted for "yes", with nine voted on "maybe". It is possible to say that there was no rejection of the idea of a similar App, so the commercial development of it is highly recommended.
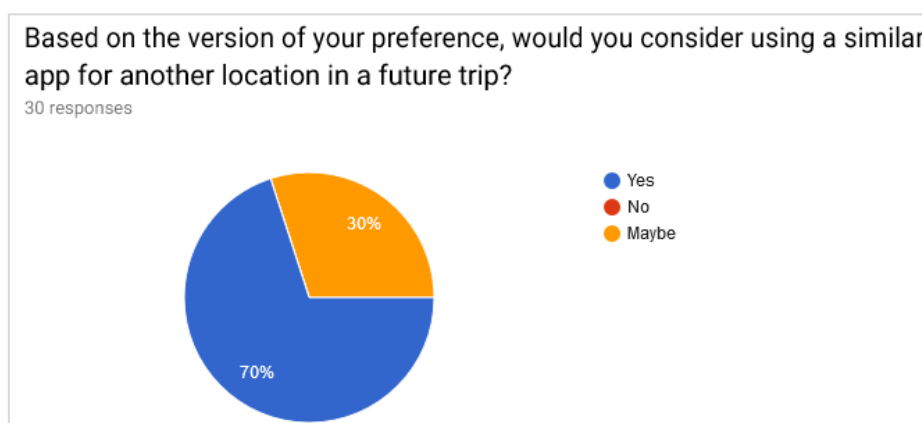
Figure 5.70: Question 63 result.

As previously explained, the prototypes were available via an App (Justinmind) and web (HTML5) formats. All the participants accessed the prototypes via Justinmind App, with two confirming they also accessed the web version. Considering that, it is possible to say that the tests were developed in similar conditions to the ones the user will find if having a codded application. In addition, considering the constraints of the official markets to display the Apps, the alternative offered no prejudice to the testing process.
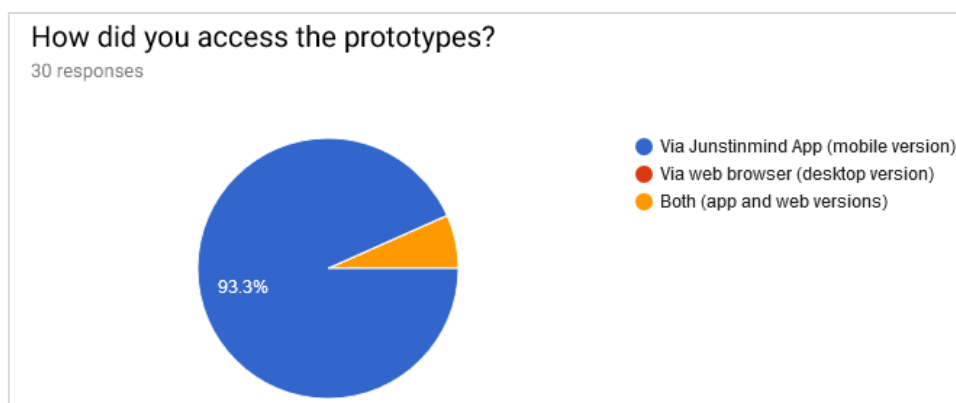
Figure 5.71: Question 64 result.

5.4.5.8 – About Weimar

The final round of questions aimed to find out if the prototypes helped to clarify the Weimar's WHS for those who never been to the city, and if the POIs were well represented for those who had previously visited the city.

60% of the participants (18 users) claimed they have been to the city before using the App, while other 40% (12 participants) answered negatively to the question (Figure 5.72).
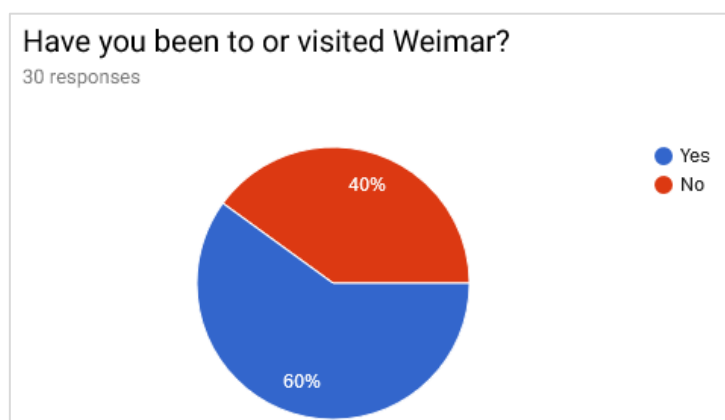
Figure 5.72: Question 65 result.

Among the 18 participants who already knew Weimar (Figure 5.73), 8 (44.4%) chose the Blue Prototype as their favourite; and 10 (55.6%) chose both versions (Blue and Red) when asked which one of them covered better the information about the POIs in Weimar. This result leaves the impression that the Red Prototype was only the favourite in this question among the testers who have never been in the city before.
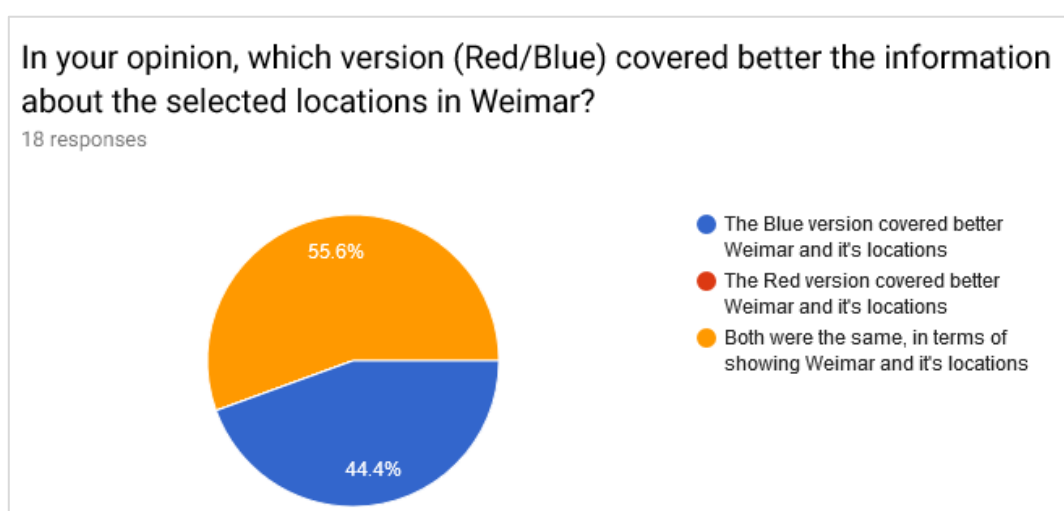
Figure 5.73: Question 66 result; after choosing "Yes" in Question 65.

Considering those who have never been in Weimar before (Figure 5.74), when asked if they would like to visit the city to see the attractions in person, 50% voted yes, and the other 50% voted maybe. This result shows the importance and impact of having dedicated Apps as a WHS promotion.
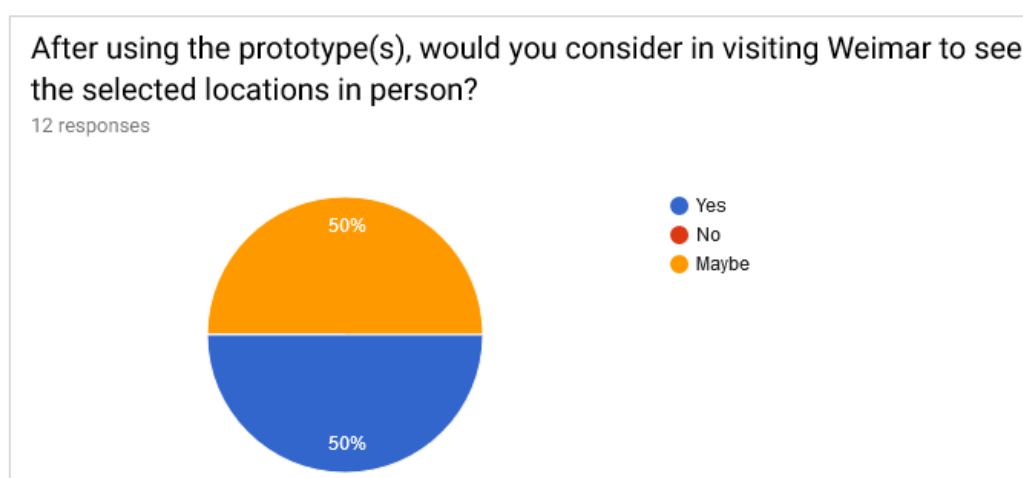
Figure 5.74: Question 67 result; after choosing "No" in Question 65

At the end of the questionnaire, an optional open-ended question was presented to the participants, asking: "After reviewing some screenshots on both versions, would you like to add or suggest something?".

This optional question received 15 responses, described below:

- *Better design for iPhone X (top of the screen)*

- *not at all*

- *It would be nice to keep the Blue version but adding some options of the Red version*

- *I would like to suggest a customised option where the user can add his own favourites locations. It would be useful and helpful to have a fast and easy access to those options when in Weimar.*

- *I prefer the Red prototype but I really liked the routes option, it would be great if it could be integrated as an option in the maps*

- *maybe change the icon Routes coz the idea is good*

- *Some text was cropped mostly on the Red version, which made difficult to get all the info.*

- *Would be nice to have the contact/address of the tourist information centre accessible within the app.*

- *It would be nice to add review section by visitors so that other tourists can see different experiences and which place is more beautiful and important to visit by adding tourist id option via Facebook, g plus , google guide or log in (etc)option. Night life of Weimar, important festivals of Weimar, staying options and cafe's and bars section can be added because tourist don't know where to eat. Plan a trip menu item would go nice for those who plans their trips in advance by adding favourite icon under sites.*

- *when you select something at the app, all icons turn in to Blue and you end up not sure where you clicked, if its right and what is going to open then*

- *After using both prototypes, i notice one thing in locations section. when i click on map, it takes me to the google map but there is no way back to prototype. You have to type the code again to enter into prototype.*

- *Just a hint: I started with the Red version and when I switched to the Blue, I tried to perform the same tasks in different ways, so my answers about which way did I choose to find a location are somehow influenced by this fact.*

- *May be some audio accompanying and connection to Wikipedia content about the sights*

- *The backwards buttons were not always available/apparent. After entering a map, I had to re-enter the App because I didn't find any way to go back to it (on both versions)*

- *it would be good if the texts would provide information on three levels: – what motivated that a site/building was selected world heritage, – description of it, – some anecdote or quote or quirky thing which will make it more memorable and which will connect on a direct human level to the reader*

The given feedback relates to some previous answers, such as the icon used for the "Routes" option, and gave some suggestions, such as the use of Audio (despite going in the same issue presented in "Videos").

At the very end, a final question was asked related to how easy it was to fill out the questionnaire, despite its length. Apart from three testers who quit while filling it, the majority of the participants found the survey easy to answer, according to the Question 69 (Figure 5.75).
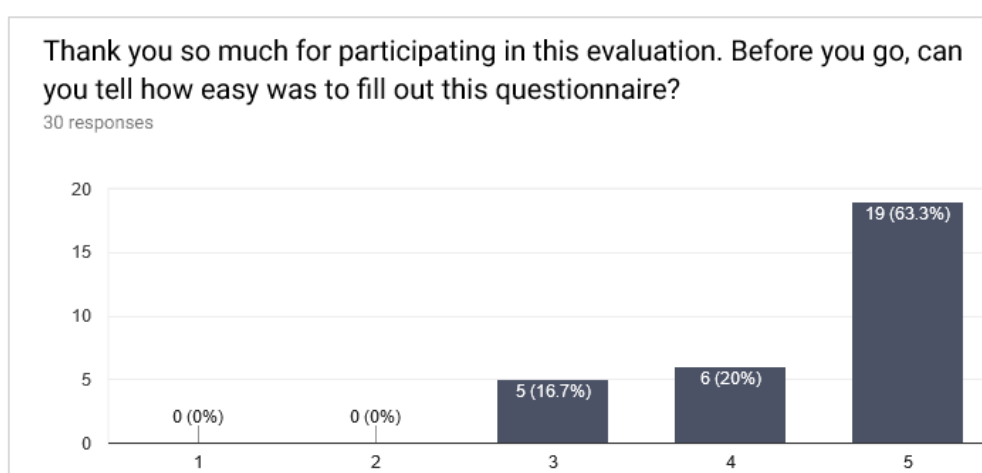
Figure 5.75: Question 69 result.

5.5 – Considerations

In general, both versions were found to be easy to navigate and easy to use the menu. The main menu is the preferred path to access the content, despite the Apps offering other ways to access the same information, so its development must be carefully planned.

The evaluation questionnaire was divided into seven sections: About you, About the attractions, About the Red Prototype, About the Blue Prototype, Comparing the two versions (Red/Blue), About Weimar, and Final opinion. Among the questions (About the attractions), for example, the testers were asked if they could recognise the UNESCO's WHS logo after using the prototypes, confirming if they acquired this information by using the prototypes or if they already knew it. The feedback suggested that using the UNESCO's WHS logo helps reinforce its branding, with 59% of the testers who recognised the symbol claiming they learned if from the prototypes.

The "About Weimar" identified if the testers have been to city beforehand, to verify if the familiarity with the locations and previous knowledge about the WHS site would affect the answers. But the results were inconclusive in this regard. However, when checking if the prototypes could serve as an incentive for people to travel to Weimar, the evaluation suggested that the users who never been in the location will consider visiting the city after using the App. It allows one to conclude that dedicated Apps can be a tool to promote the city.

The core-questions – "About the Red Prototype" and "About the Blue Prototype" and the comparisons – identified the testers' views on each one of the prototypes but also inquired about exclusive features/pages, such as Routes, Settings, and Right-Top-Menu available on the Blue Prototype only. At the end, as a summative evaluation of the implemented features, the testers answered which one of the prototypes they would prefer to use, resulting in 83,3% in favour of the Blue Prototype (academic literature-based guidelines), and 16,7% for the Red Prototype (industry-based guidelines).

The exclusive features (not revealed by any of the initial set of guidelines) were also tested. It is important to mention that, by making the literature review more inclusive – adding tailored characteristics for specific target groups, such as elderly people and studies on open-air media and urban integration using Apps – resulted in a more inclusive set of guidelines in general.

As seen, the results were by far more favourable to the academic literature-based prototype (Blue version), confirming the found guidelines suggested by academics, reports, and official documentation for developers work better than the products released on the market that might be developed in a trial and error basis. It can support the idea that, sometimes, the Apps offered at the official stores might be closer to the developers' taste and expertise than to the real needs and requirements of a niche sector.

Chapter 6 – App Guidelines for UNESCO WHS

Despite the core concepts and disruptive features that initially defined the smartphones remaining the same in the last decade, the mobile industry is in constant change due to the rapid advances in technology. New features are implemented in every new major release by the leading brands; others became faster and smaller. Many others receive improvements that might go unnoticed for the lay user but affect the hardware performance in a high level. So, creating an application that will positively impact the lives of people has never been an easy journey (Curwen and Whalley, 2010). Considering the touristic scope, the applications must have an attractive and comfortable user interface that contains all essential features that the user can navigate through the city (Cutrí et al., 2008, pp. 410–420).

To achieve such result, well-designed guidelines and recommendations are a safe starting point to build efficient mobile interfaces, but also to evaluate usability aspects on Apps. Generating guidelines and/or effective evaluation framework is not an easy task, especially considering the volume of variables involved. There is no *vade-mecum for* such task, opening infinitive possibilities and source combinations to address on this matter (Lee et al., 2015, pp. 295–304). This chapter is one attempt to summarise a feasible and practical set of guidelines that could be applied for different open-air WHS Apps.

As explained in the previous sections, it uses an analysis of commercial Apps available on popular markets and a thorough review of the academic literature-based review. In this case, trustworthy articles on mobile usability in general, WHS mobile studies, industry recommendations (iOS and Android), travel and city App studies, and mobile studies dealing with different age groups (such as teenagers and elderly) were analysed. A schematic representation of the approach can be seen in (Figure 6.1).

Overall, the empirical evaluation went almost unanimously in favour of the App built following the academic literature-based guidelines, with only one exception: the preferred GPS based map style was the one developed based on the industry review.
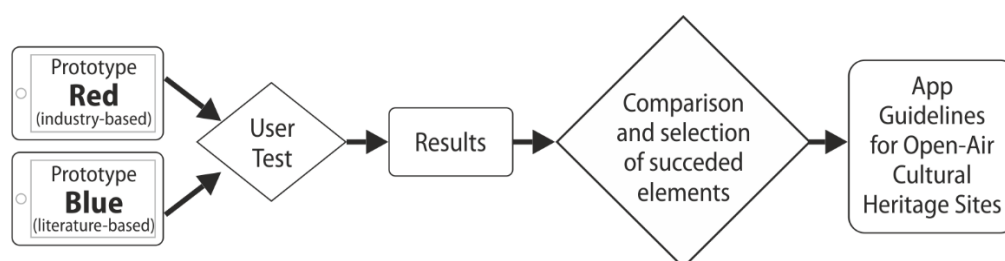
Figure 6.1: *Implemented Methodology.*

The evaluation results confirmed the importance of academic studies as a source for interface guidelines. It showed that commercial solutions are not necessarily the best ones and, sometimes, they are being used due to the lack of better Apps. In some ways, it is possible to assume that the industry of tourism and cultural Apps only adapted styles, interfaces and features from other areas in a trial and error practice. However, well-researched and tested guidelines such as the ones this research will offer can save time and money for developers, providing the users with a better experience and enhancing the appeal of WHS. This study reinforces the idea that checking the competition is not enough to ensure a successful App. Still, it is also worth to check proper academic sources before stepping into the App development.

It is essential to say that some minor and already well-tested features were not included in the test due to prototype limitations, such as search bar. Still, following the results, it is possible to rely on academic literature for future development. Together with the test, it is possible to affirm that the following guidelines will help future developments for Apps dealing with open-air heritage sites and – to some extent – to most touristic destinations.

Details on most of the guidelines were described in Chapter 4 (Prototypes Development), but a summary will be offered in this chapter. To avoid confusion with the previous guidelines codes used in Chapter 3, such as L, D, C, and M, the selected final set of guidelines will be using the letter W (from WHS) in from of them.

6.1 – Layout

The layout refers to how the visual structure is placed on the screen, without considerations on the design aspects (Dirin and Nieminen, 2015). Below it is possible to find a set of guidelines on how the Layout can help the user during the navigation.

W1 – Place Content in One Screen / Minimising-avoiding Scrolling

Placing the content in a way that avoids scrolling, helps the user to get the most of the information in a faster fashion. This guideline was supported already by studies found in the literature review (Ahmad et al., 2017; Antoun et al., 2017; Carmien and Manzanares, 2014; Díaz-Bossini and Moreno, 2014; Kaur and Haghighi, 2016; Kumar and Mohite, 2016; Miniukovich et al., 2017; Shitkova et al., 2015; Silva et al., 2014). Ahmad et al. (2017, p. 26) justify the need of providing a limited amount of information "considering the limitation of small screen, very limited information should be provided on the screen".

During the test, this guideline was supported by the results obtained through Questions 14 and 28. The participants found it easier not to seek further information beyond what is presented at the screen. As Kaur and Haghighi (2016, p. 5) suggested, this preference has a physiological reason that "removing scrolling functionality can make the application simple and easy to remember and reduce cognitive load".

W2 – Consistency Between Different Sections

The need for consistency is a well-known norm in usability studies. Inostroza and Rusu (2014, p. 2) recommend following the established conventions, as "the user should be able to do things in a familiar, standard and consistent way". In this research, it appeared in both, industry and academic literature-based guidelines (Ahmad et al., 2017; Antoun et al., 2017; Carmien and Manzanares, 2014; Cota et al., 2014; Díaz-Bossini and Moreno, 2014; Inostroza and Rusu, 2014; Jailani et al., 2015; Kumar and Mohite, 2016; Miniukovich et al., 2017; Nayebi et al., 2013; Ropponen, 2016; Zamri and Al Subhi, 2015).

In fact, "using different designs between screens can cause frustration and confusion" (Carmien and Manzanares, 2014, p. 8). As a consequence, offering consistency among different sections makes the user more familiar with the presented content and navigation, as they are not required to learn new formats and/or interface elements as they navigate through the App.

W3 – Orientation: Provide Session Title

Offering a distinct title for each of the App' sections and displaying it helps users situate themselves while navigating inside the app. It proves to be helpful, especially on complex Apps that provide a considerable amount of content (Ahmad et al., 2017; Cota et al., 2014).

Ahmad et al. (2017, p. 32) specify that each screen must have a unique self-explanatory title, allowing the user to understand the content it is referring to easily. According to Cota et al. (2014, p. 6), the use of titles is indeed an efficient tool to orient the user but also allows them to quickly come and go back and forward to the main menu.

W4 – Providing a Search Bar

As already said, the prototype limitations did not allow to test the use of search bars. Still, it must be considered among the guidelines for being a widely available and accepted feature. Search bars have proven to be helpful, especially on Apps with an extensive length of content (Ahmad et al., 2017; Cota et al., 2014; Nayebi et al., 2013). In Weimar, where it is possible to find more than one WHS, spread through direct 13 locations (and other related places), a search bar would help the users find the desired location in a faster way.

Ahmad et al. (2017, p. 24) relate the use of search bars to the constraints of the small screen, as it can work as a way to prevent scrolling, thus enhancing user satisfaction. For that reason, it also helps WHS with a small number of attractions – like a cathedral, for example, where all the POIs are concentrated in one location – as it enables to optimise the screen space. Nayebi et al. (2013, p. 6) detail the approach by suggesting that the search must be "quick and rewarding, by making the search function the primary one, and following the guidelines below to ensure that it performs well". The search could also offer rules and filters to optimise the results and make access to the desired content more straightforward.

6.2 – Navigation

The navigation category is not related to how the App and its content are cosmetically presented but focused on the screen transitions and interactions. It includes the steps the user might take to reach the desired information, and how easy it is to find the desired content, including how the main menu is displayed and elaborated.

W5 – Number of Taps to WHS Information

A well-known rule of thumb in any software development is providing fast access to the main content. The same is valid for Apps, where the ideal is having up to three taps (clicks) to reach the desired content (Cota et al., 2014, p. 6). One of the most straightforward approaches is to use the main menu to lead the users. From the test results, this has been proven, as the users relied on the main navigation menu to access most of the content inside the App, and doing so, they reached the content in the fastest way, requiring as fewer taps as possible.

W6 – Number of Items in the Main Navigation up to 5

During the test, participants liked more the prototype version with more items on the main menu. That said, it is crucial to not forget the need for a comfortable distance between the clickable/tapeable elements on the screen, especially considering the interaction with elderly groups. With this in mind, the recommendation is to implement up to five items in the main menu, to avoid overcrowded elements for the content navigation. As mentioned by van Biljon and Renaud (2016, p. 10), one should use "simplified menu structures to minimize nesting of functionality". In case more items/sections are required withing the App, the guideline is to adopt a "hamburger" menu for extra content.

W7 – Navigation Menu Visible

Having the navigation menu always visible was a guideline recommended by several scholars (Ahmad et al., 2017; Inostroza and Rusu, 2014; Jailani et al., 2015; van Biljon and Renaud, 2016); however, the instruction is not always followed by the touristic Apps analysed during the industry review. Among the sample, there were Apps in which the main menu disappeared during the navigation. It requires an unnecessary mental effort from the user. Inostroza and Rusu (2014, p. 2) reinforce the claim by saying the "device should offer visible objects, actions and options in order to prevent users to memorize information from one part of the dialogue to another".

Having the main menu always visible helps the App navigation by allowing the user to change the content as they see fit. Following this guideline with properly labelled buttons is an efficient way to enhance usability (Ahmad et al., 2017, p. 52).

W8 – One Level Navigation Menu

This guideline complements the previous one. As the main menu is the primordial source of navigation inside an App, the main content must be concentrated on it, and the App structure should avoid trapping the content inside each other, by avoiding creating pages where the user needs to click several times inside it. The literature-review addressed this issue in several studies (Petrovčič et al., 2017; Shitkova et al., 2015; Zamri and Al Subhi, 2015), bringing recommendations, such as "do not use many levels of sub-menu" (Zamri and Al Subhi, 2015, p. 3).

It is crucial to observe this guideline especially if the target audience includes older adults – as it is the case for Weimar and, in general, for most of the cultural tourist attractions. It happens because "older adults' mental models are not always hierarchical; one-level menu navigation may be easier to manage" (Petrovčič et al., 2017, p. 4). The scholars suggest that older generations could become disoriented while using the App, especially adding the navigation complexity to the constraints of a small screen, "not large enough to provide a full image of the menu but just a glimpse of a few icons at a time" (ibidem).

W9 – Offering Visible (tabs) Sub-menu Navigation

This guideline is a direct result of the evaluation, and it was included in the test as a new aspect, as it was not present in the industry guidelines nor the academic literature-based review. It helps to enhance further navigation inside a page, without the need to include more items in the main menu. It consists of the use of "tab-liked" clickable elements that lead to different sub-sections.
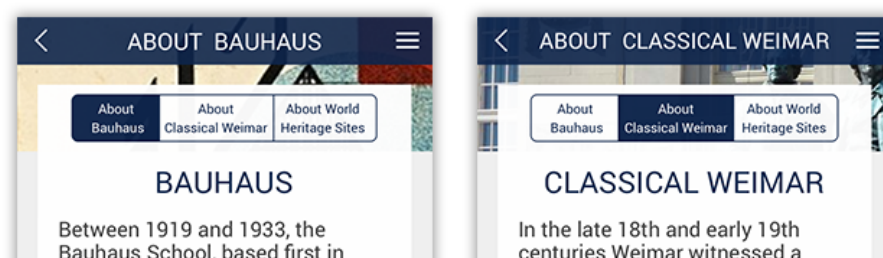
Figure 6.2: *Example of in-tab navigation.*

The test showed that sub-menu navigation is a very efficient way to hierarchise the content and help the user to locate themselves during the navigation. From the evaluation, 86.7% of the participants preferred when the page presented the in-tab navigation.

W10 – Self-explanatory Menu

As discussed, the main menu must be the primary navigation within an App. During the evaluation, participants relied on the use of the main menu to reach the information about the POIs, confirming what was suggested by the academic literature-review (Costa et al., 2016; Cota et al., 2014; Kumar and Mohite, 2016; Petrovčič et al., 2017; Ropponen, 2016; Shitkova et al., 2015). The items placed in the menu must indicate the main sections of the App, with the visual aid of icons and text, to reinforce the content division. Overall, "applications should not be too complicated to remember and moving information from menu to menu should be minimal" (Ropponen, 2016, p. 20). As Kumar and Mohite (2016, p. 11) suggest, menus must also create a sense of familiarity and offer the necessary descriptions of the app sections.

W11 – Presence of the Back button

Many devices running Android OS still offer a physical button in addition to an interactive menu with the "back", "home" and "options" buttons – although this feature might change across the wide variety of devices running Android OS. The most important is to recognise that the "back" feature is essential for intuitive navigation in any App. So, as a guideline, offering the "back" button in the interface improves the navigation (Ahmad et al., 2017; Jailani et al., 2015; Silva et al., 2014). Together with "home" and "go-to" buttons, it works as a shortcut to help the user to navigate inside the App (Jailani et al., 2015, p. 5). However, it is crucial to ensure the functionalities of the button, such as preserving the content of forms or returning only one level per click. In summary, the guideline consists of always offering the "back" button, but "make sure that the "Back" button behaves predictably" (Silva et al., 2014, p. 6).

6.3 – Design

The set of guidelines related to the design refer to how the layout and navigation are visually treated in the interface. The design might include the use of colours, imagery as visual support, how the elements are placed and spread on the screen, and other visual aids such as icons and graphic elements.

W12 – Limited Use of Colours

Limiting the use of colours helps to make the interactive features clearer and improves the interface learnability (Bhattacharya and Panbu, 2013). From the literature review, this guideline is reinforced, with the recommendation to use a limited pallet of colours (Ahmad et al., 2017; Cota et al., 2014; Díaz-Bossini and Moreno, 2014; Hoehle et al., 2016b; Kaur and Haghighi, 2016; Kumar and Mohite, 2016; Nayebi et al., 2013; Ropponen, 2016; Ross and Gao, 2016; Silva et al., 2014). Ropponen (2016) suggests a neutral colour scheme as the flashy and too colourful interfaces can look untidy and drive users away. According to Ross and Gao (2016), the ideal design for Apps will use no more than five colours. The scholars justify it as a matter of avoiding the users to be required to recall many coded colours in their short-term memory.

W13 – Simple Design

Aligned with the previous guideline, the "simple design" refers to the screen composition and the balance of graphic elements on the screen, avoiding heavy imagery, relying on white spaces and not in an abundance of features that could distract the user (Antoun et al., 2017; Díaz-Bossini and Moreno, 2014; Kumar and Mohite, 2016; Nayebi et al., 2013; Ross and Gao, 2016; Shitkova et al., 2015; Zamri and Al Subhi, 2015). Díaz-Bossini and Moreno (2014) suggest that, as same as happened to the terminology, the screen layout also have to be simple, clear and consistent. Zamri and Al Subhi (2015, p. 6) explain that the simplicity encompasses three characteristics: "to reduce memory load by use of a simple design arrangement - content, menu etc.- which makes the application easy to remember and enables better focus by the user".

W14 – Use of Icons

The use of icons, or pictograms, helps not only to create an attractive design but most importantly, it is necessary to facilitate the communication and to enhance the understanding of the navigation. This guideline was broadly supported by the academic literature-review (Carmien and Manzanares, 2014; Cruz Zapata et al., 2014; Díaz-Bossini and Moreno, 2014; Hincapie et al., 2016; Hoehle et al., 2015; Jailani et al., 2015; Joyce et al., 2014; Kaur and Haghighi, 2016; P. E. Kourouthanassis et al., 2015; Kumar and Mohite, 2016; Nayebi et al., 2013; Petrovčič et al., 2017; Ross and Gao, 2016; Shitkova et al., 2015; Silva et al., 2014; van Biljon and Renaud, 2016; Zamri and Al Subhi, 2015), and it was confirmed during the prototypes' evaluation.

However, it is essential to use the icons to reinforce the message and not to replace it entirely. Carmien and Manzanares (2014) alert that, for some users, even standard icons may be unfamiliar. The scholars suggest using words to reinforce the visual message. Kumar and Mohite (2016) add that the icons also need to be consistent within the application. Also, it is possible to say that they must be carefully studied and personalised for the App, as using generic icons from stock databases could incur in miscommunication (users could be familiar with similar icons within a different context or for a different task in various applications). The guideline on using icons, in this case, can be reinforced by the work of Shitkova et al. (2015,

p. 7): "Delight users with rich, beautiful, and engaging graphics, as they draw users into the app and make the simplest task rewarding, as well as helping to build the app's brand".

W15 – Space Between Buttons or Other Clickable Items

A good layout needs balance and space to allow the elements to flow. The same is valid for the small screens and separating the components make them more distinguishable from each other. Silva et al. (2014, p. 7) recommended to "allow sufficient white space to ensure a balanced user interface design". The prototype test revealed that the users felt more comfortable in using the apps when the different elements within the screen had a broader space among them. The same guideline was also largely supported by the academic literature-review (Ahmad et al., 2017; Antoun et al., 2017; Carmien and Manzanares, 2014; Hoehle et al., 2016b, 2015; Kaur and Haghighi, 2016; H. K. Kim et al., 2016; Petrovčič et al., 2017; Ropponen, 2016; Silva et al., 2014; van Biljon and Renaud, 2016).

This guideline acquires more importance if the App being developed targets elderly individuals, who tend to find more challenging to deal with the touchscreen. Also, as the WHS apps might frequently deal with attractions in open-air spaces, the visual separation can facilitate the use of the App under unfavourable lighting conditions such as reflection or glare. The guideline can be summarised by the instructions provided by van Biljon and Renaud (2016, p. 10): use "wide spacing between the keys" elements.

W16 – Use Standard Icons in Maps

This is another feature revealed by the evaluation. Users preferred a standard location symbol inside the maps instead of the tailored pins. In this specific case, there is a long-term built familiarity with the use of digital and mobile maps, and the users felt more comfortable with the pre-existing pins to indicate a specific location.

6.4 – Content

The content guidelines complement the ones discussing in the layout section. Still, the emphasis is on how the information is offered in terms of length, and the interactions with the content.

W17 – Short text

Prioritise the use of short texts inside the App. "Try using short sentences. If they are longer than one line, use at least usual spacing. Language should be simple and clear" (Carmien and Manzanares, 2014, p. 8). This is a straightforward guideline for WHS App development, confirmed by 81.8% of the testers. However, it does not mean that the application cannot provide complete information. If a longer text is required, 90.9% of the testers indicated they would be happy with a clickable option of "show more information".

The test confirmed the guidelines supported by the academic literature-review (Ahmad et al., 2017; Carmien and Manzanares, 2014; Díaz-Bossini and Moreno, 2014; Inostroza et al., 2013; Jailani et al., 2015; Miniukovich et al., 2017; Shitkova et al., 2015; Silva et al., 2014; Zamri and Al Subhi, 2015). It means the App requires not only a careful design but also a proper curation of the information to be displayed. In summary, as Díaz-Bossini and Moreno (2014, p. 61) suggest: "avoid irrelevant information on the screen".
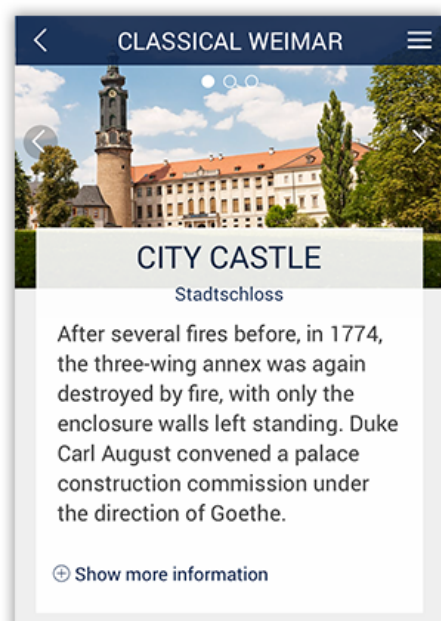
Figure 6.3: Example of a short text with the option of further reading.

W18 – Info at Start Screen

Usually, new electronic devices are sold with a detailed user manual explaining its functions and where to get help, if necessary. Apps should be no different from this scenario. "Make the application more helpful for first-time users by using welcome mats to point out the main features and how to interact with the application" (Joyce et al., 2014, p. 1). In this case, the "info at start screen" is the required feature to explain the functionalities, content and the interface to the users when they open the App for the first time. This feature must have the option to be immediately closed and not re-open in the next times the App runs.

This guideline was supported by 70% of the testers, who felt that the feature "was useful because it clarified the menu and navigation". The recommendations based on the academic literature also suggest that the main features of the App must be explained at the start-screen (Ajibola and Goosen, 2017; Alkhafaji et al., 2017; Costa et al., 2016; Cota et al., 2014; Joyce et al., 2014; P. E. Kourouthanassis et al., 2015).
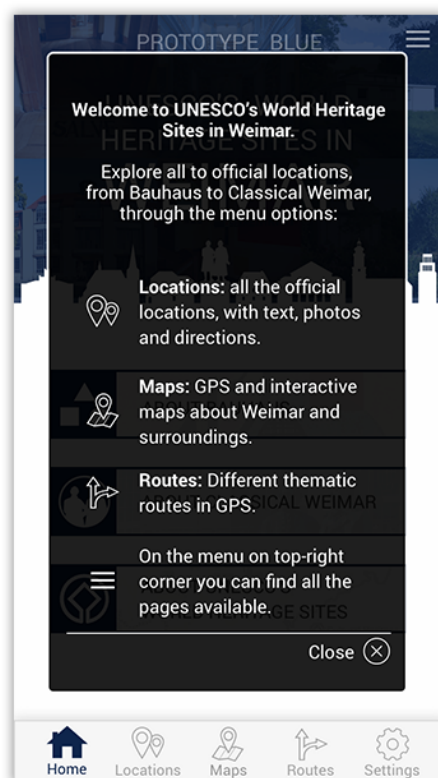
Figure 6.4: *Example of info at star screen.*

W19 – Tours / Routes

There is not much on the academic literature to support the use of touristic routes in mobile applications. Baker and Verstockt (2017) suggest they can combine leisure and educational purposes, "targeting new groups by additional programs and attractions, making them more interesting, attractive, and diversified" (Naggy, 2012 cited in Baker and Verstockt, 2017, p. 24). Gavalas et al. (2016) explored the practical aspects of the feature, saying the tourists must narrow down a set of POIs based on their interests, organising them in a reasonable sequencing inside a route.

However, expecting someone unfamiliar with a destination to organise all the details for a touristic route can be time-consuming and frustrating. For this reason, the feature was tested and the empirical approach revealed they must figure in the guidelines, as they can provide a complete service and a rewarding experience for the users' interest in exploring a specific WHS.
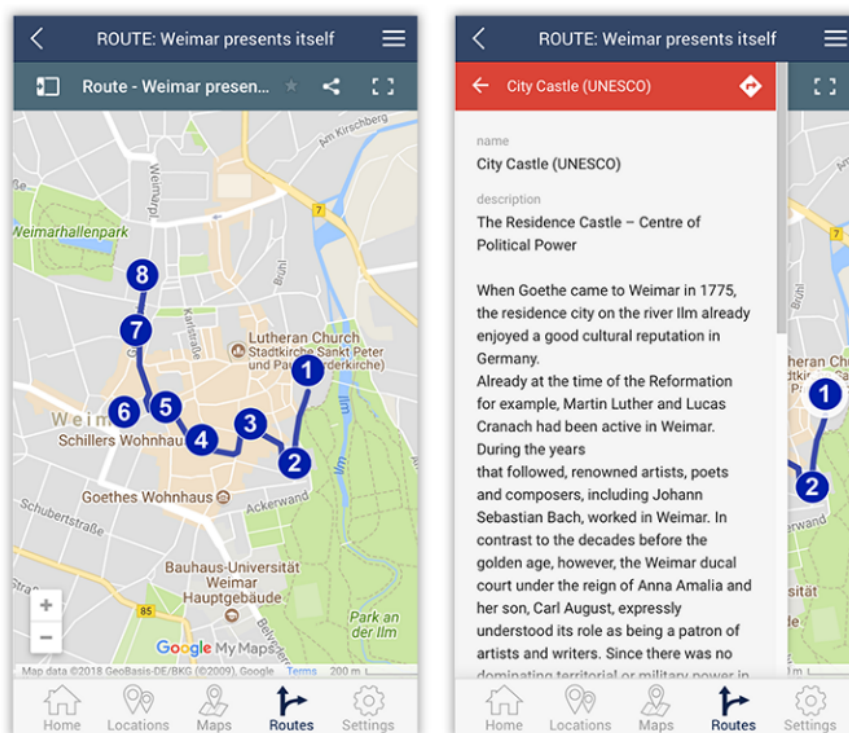
Figure 6.5: *Example of a route, implemented by customised GoogleMaps.*

W20 – Focus / Only display essential information

This guideline somehow complements an even overlaps the instructions provided by W1 – "place content in one screen". It also complements the instructions given by W17, when the use of short text was recommended. In this case, again, the academic literature supports the idea of providing only a summary of the information on the screen, allowing the users to tap for further readings (Ahmad et al., 2017; Cruz Zapata et al., 2014; Inostroza and Rusu, 2014).

Inostroza and Rusu (2014, p. 7) offer a direct rule in this direction: "Only show what I need when I need it". According to scholars, this recommendation prevents users from getting overwhelmed by information overload. In addition, the recommendation is for the developers to break tasks and information into small chunks and to hide the additional options, showing only at is needed for the navigation. According to Carmien and Manzanares (2014, p. 5), screens with too many options or buttons can be confusing especially for elderly users, as they tend to scan "the whole screen towards their goal rather than zeroing in, by visual cues, on what they are looking for".

Overall, this guideline can help the App to be optimised for what the popular slang defines as "Smombie"- the pedestrians walking slowly at the same time they are focused on their phones. In this case, offering the information straightforward will allow the users to concentrate more in their surroundings and the WHS, than in trying to figure out how to gather the desired information about a POI in the App. As Cruz Zapata et al. (2014, p. 7) summarised, "present useful content immediately to give a better user experience".

W21 – Use of Aesthetics Graphics

Balance is the key for an attractive design, and generally, the visual aspects are the first to be captured by the eye. For that reason, the use of adequate imagery helps to reinforce the information regarding the WHS. Visual aids make the POI more recognisable when the user is searching for the real place. Many scholars support the importance of adequate graphics to reinforce the information (Ahmad et al., 2017; Alkhafaji et al., 2016; Carmien and Manzanares, 2014; Cruz Zapata et al., 2014; Díaz-Bossini and Moreno, 2014; Hincapie et al., 2016; Hoehle et al., 2016b, 2015; Jailani et al., 2015; Kumar and Mohite, 2016; Petrovčič et al., 2017; Ross and Gao, 2016; Silva et al., 2014). The empirical test also confirmed what other researchers have found, and users are attracted to a well-balanced distribution and combination of images on the screen.

This guideline could be related to the "media" category and reinforces the recommendation of using photos as a medium. Still, the way it is applied within the content made it to be placed among the "content" category.

W22 – Considering the Surrounding Environment

As previously mentioned, Apps for WHS will be used in outside spaces very often, and the environment must be considered during the development process. "Ensure that mobile applications cater for factors that affect the context of use such as poor lighting conditions and high ambient noise" (Joyce et al., 2014, p. 2). It is possible to find support on this idea also by other scholars (Alkhafaji et al., 2017; P. E. Kourouthanassis et al., 2015).

Taking the constraints of using the App in open-air spaces, one of the main problems will be to offer videos as part of the content. During the prototype tests, 43% of the users said they found the offer of a video an interesting option, but they did not play it. Just 16.7% claimed the videos were useful.

The same rationale goes for audio. Just one participant suggested the use of audio as a desirable feature to be implemented. It is possible to conclude that the majority of the users were satisfied with text and photo(s). With that in mind, audios and videos can be used as an additional source of information and entertainment. Still, the essential information must be provided in the short text (with the "read more" option) and pictures. Also, the Apps can be improved when the environment is considered as the location context can be used to provide content. Use "GPS sensory data (longitude and latitude) to place users in their environment and provide the content based at their proximity" (P. E. Kourouthanassis et al., 2015, p. 34).

W23 – Large Font Size

Readability is critical when the information must be retrieved quickly and one of the most important aspects to ensure it on a small screen is finding the correct size for the fonts. Academic literature concentrates these debates mostly on elderly groups of users (Ahmad et al., 2017; Antoun et al., 2017; Kaur and Haghighi, 2016; H. K. Kim et al., 2016; Miniukovich et al., 2017; Ropponen, 2016; Silva et al., 2014; van Biljon and Renaud, 2016), but the empirical tests with the prototypes showed that this is a crucial issue across all the age groups involved in the evaluation. Most of the participants preferred the prototype version with a larger font-size over the smaller one. Among them, 84% claimed it was easier to read, and 40% pointed to the "bigger" font-size as the reason for them to choose that specific version of the App.

As a guideline, the developers must prioritise larger fonts, preferably responsive to maintain the balance in relation to the screen size (Antoun et al., 2017). This aspect is important as "a large font size could increase speed and accuracy in reading and performing the tasks on the screen which could have an impact on learnability, memorability, efficiency and effectiveness aspects" (Kaur and Haghighi, 2016, p. 5).

W24 – Display the Locations in a List Format

There are different ways to display a sequence of POIs on a screen. For instance, it may be in a list format, placing one attraction below the other, or in a grid format, generally with quads with more than one location per line.

During the evaluation, a comparison was made between the *List* and *Grid* formats (Figure 6.6), resulting in 60% (18 votes) of the participants preferring the list format. Among them, nine users said they simply liked more the list format, and 11 argued that the list format concentrates more information in the same screen's space
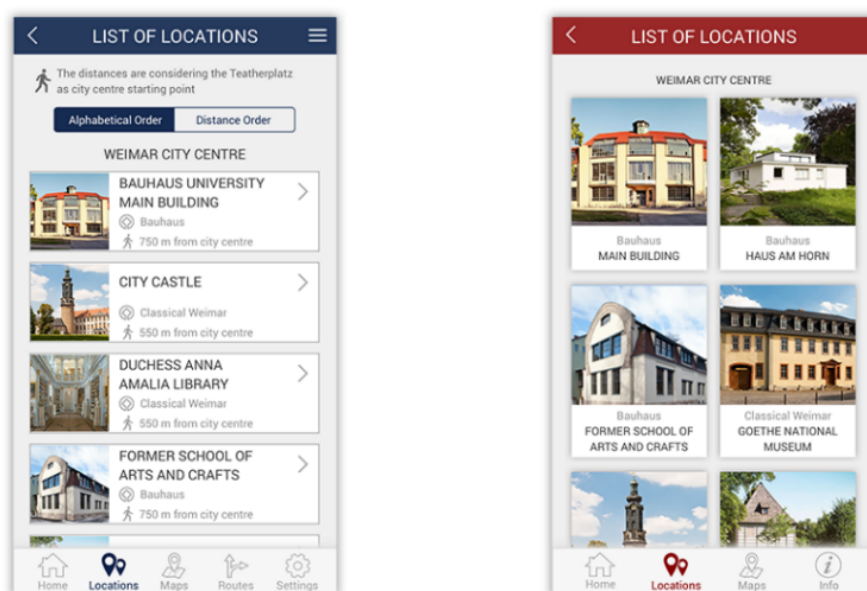
Figure 6.6: *Example of "List" (left) and "Grid" (right) formats, implemented in the prototypes*

W25 – Display More Details on the Locations' Preview

When the testers answered regarding their preference for lists of grids formats, to organise a series of information, they were also asked on the additional information offered together with the preview information of each one of the POIs. Among the top reasons why they chose the list format, 14 (of 19) participants claimed they enjoyed the fact that the list displayed the distance to the POI. Also, 13 participants liked the option to change the order of the list from alphabetical to distance and vice-versa.

Figure 6.7: Example of further information regarding a POI: type of heritage and walking distance

Regarding this guideline, it is essential to remember not to overcrowd the screen with information and save the details from being displayed when the user taps on one specific POI. In this particular example, the information on the screen regarding a POI included the walking distance and the type of WHS – if Bauhaus or Weimar Classic. Suppose the location has a specific timeframe for visiting. In that case, the screen could also include if the attraction is "Open/Closed" at the moment, making it easier for the user to decide what POIs to visit.

W26 – Allow Personalisation/Configuration

Users tend to be more satisfied if they believe to be in charge of their own experience. This affects mostly experienced users, who want the interface to respond to their actions (Zamri and Al Subhi, 2015). Inside an App, this guideline can be implemented in several ways, such as allowing the user to change font-size (Ropponen, 2016, p. 58), allowing GPS based alerts for POIs and additional information, offering different options in units for distance, temperature; information layout (in the case of List/Grid way to display the locations), sounds, among other possibilities. It provides a sense of control and helps the experience to be tailored for each user. "Give them control in the form of discretion to organise and conduct their learning activities" (Zamri and Al Subhi, 2015, p. 6).

The use of personalisation as a guideline was confirmed during the test (Question 32), but it also has support from the academic literature-review (Alkhafaji et al., 2016; Inostroza and Rusu, 2014; Nayebi et al., 2013; Silva et al., 2014; Zamri and Al Subhi, 2015). However, this personalisation is not unlimited; "include settings about preferred app behaviours and

information that users rarely want to change in the app only when it is appropriate to do so" (Nayebi et al., 2013, p. 6).

W27 – Centred Pop-ups

This guideline emerged from the empirical test (Question 57 and 59). It recommends the use of floating windows for information to be placed in the centre of the screen (see Figure 6.8). 77% of the 18 participants who chose the map with this variation during the evaluation preferred the "floating-centred information" when a POI was clicked on a map. This guideline is strongly connected to the W15, reinforcing that providing the space around a specific element can improve the experience with the interface.
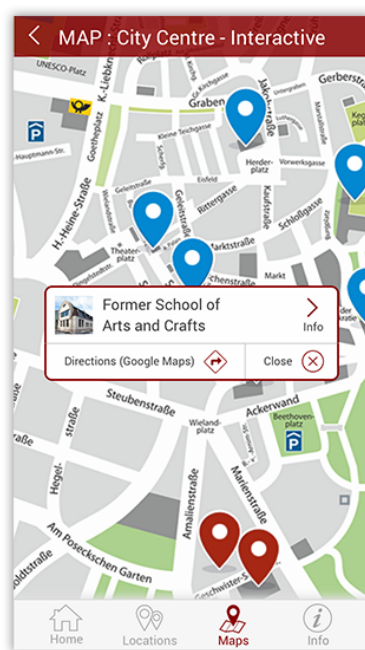
Figure 6.8: Example of centred pop-up information.

6.4.1 – Technicalities

The following five guidelines offer a set of guidances developers should follow regarding the content. They have not been tested explicitly in the prototypes due to the technological restrictions of the emulations, but they have been largely used and tested by industry and are

recommended by scholars. They are included here to make the final set of guidelines as comprehensive as possible, not neglecting these aspects. They have been detailed in Chapter 3, but it is possible to find a summary in the following sections (W28 to W32).

W28 – Prevent Information Loss

This guideline works as a follow up for W11 (providing a "back" button) and recommends that the developers pay attention to prevent the information loss, especially when users tap the back button. "Since the users' fear of losing data. Users of mobile applications are worried and fear the loss of inputted data, because typing on mobile devices is cumbersome" (Ajibola and Goosen, 2017, p. 5). In general, it means that when going back to the previous screen, especially if a search, form, or another interaction were performed, it should be shown as it was before moving from the current screen. The recommendation is strongly supported by academic literature (Ajibola and Goosen, 2017; Cota et al., 2014; Inostroza and Rusu, 2014; Nayebi et al., 2013; Shitkova et al., 2015; Zamri and Al Subhi, 2015).

W29 – Provide Action Feedback

The action feedback informs the user about the actions that are occurring in the app (Ahmad et al., 2017, p. 30). It can be provided in different ways: it might be a confirmation before choosing or deleting an item, an animated download/loading bar, or any other type of warning. This guideline is broadly supported by academic research (Ahmad et al., 2017; Cruz Zapata et al., 2014; P. E. Kourouthanassis et al., 2015; Nayebi et al., 2013; Shitkova et al., 2015; van Biljon and Renaud, 2016; Zamri and Al Subhi, 2015), having a clear reason for it: "Users need some feedback of their actions" (Cruz Zapata et al., 2014, p. 7) as it makes clear what is happening in the App after an action takes place.

This guideline helps to improve the user experience, especially if the action may take some time to be fully executed, such as loading a page, downloading/uploading a file, or as a warning that it might not be able to overturn the action when an "undo" might not be possible. This guideline is strongly connected to W30.

W30 – Clickable Buttons with Tactile Feedback or Sound

As the same time as the users must know about the actions taking place on the App, it is essential to provide them with the confirmation that the desired command was accepted. Having a haptic feeling in a button, or even a sound, makes the clickable item more obvious (Petrovčič et al., 2017; Ropponen, 2016; Silva et al., 2014; van Biljon and Renaud, 2016).

This guideline is especially important for less experienced users. The guideline can be summarised by Silva et al. (2014, p. 6): "Provide not only visual feedback, but also tactile and auditory". According to Carmien and Manzanares (2014, p. 5) "most of elderly prefer to have haptic (vibratory) or sound alarms". However, it is crucial to provide enough customisation for the ones who want to disable such redundant confirmations.

W31 – Provide Location-based Notification

The lock screen of a mobile phone is the holy grail for developers interested in pushing content. WHS can benefit from this perspective, and dedicated Apps can push notifications based on the users' current location to promote a POI, preventing visitors from missing an attraction. The test (question 32) showed that 66.6% of the participants considered this to be a very useful feature. This guideline also finds resonance in the academic literature, suggesting developers to use geolocation to trigger the delivery of information regarding a nearby POI (P. E. Kourouthanassis et al., 2015, p. 34).

W32 – Use of Visual Clues for Visited POI

Visiting a different location can sometimes be overwhelming. On top of the information overload, the need to separate the trustworthy content will consist in an extra challenge if the visitors are not familiar with the local language – or even with the local alphabet. Overall, having a dedicated App helps to keep the information organised, but this guideline assists in pushing this process a step further. The recommendation is to provide visual clues to identify which locations have been visited, allowing the user to better organise their time to explore the route or the POI as a tourist (Alkhafaji et al., 2017; Hermansson et al., 2014; McGookin et al., 2017).

These visual clues can be applied by using special colour codes (Galatis et al., 2016, p. 9), differentiating the visited places to the ones to still needed to be visited. It can be related to the geolocation, making the change automatic, or providing the user with the chance of tapping the visited POI to mark it as completed.

6.5 – Media and Features

The combination of different media needs to be done in a balanced way, in order to complement the written information. It must complement the text but not create constraints to the App load or along with content, the features and media shows which mediatic content support is used in the app. The use of media and features in the application has attracted the App users' attention, thus facilitating the wide use of the application.

W33 – Photos and Galleries

"Pictures are more efficient than words to explain ideas" (Cruz Zapata et al., 2014, p. 7) and it must be explored by developers. This guideline is closely connected to W21 but reinforces the importance of photographies to make it easier for the user to recognise a specific attraction.

During the evaluation, a distinction was made to evaluate separately if the users prefer the use of single images or if photo galleries have a better appeal. Overall, participants enjoyed most the photo-gallery at the top of the articles, providing more than one picture of each one the POIs. This indication meets Alkhafaji et al. (2016, p. 3) findings on learning aspects of cultural heritage, pointing that features and "services that people would like to use through their mobile device which include information in multiple modes: images (74 %), texts (70 %), audio (49 %) and video (47 %)".

This recommendation can be considered at first, similar to the W21 – related to the use of Aesthetics Graphics, but the primary differentiation and uniqueness is related to the result extracted from the evaluation, which recommends the use of a photo gallery to represent a POI.

As a guideline, a dedicated WHS App must use images, and they will work better if displayed as a gallery. The photo gallery can explore features that can not be seen from the outside (in

case of a POI with the possibility to enter inside it), in order to provide a more accurate preview of the location and influence the visitors' wiliness to visit the place.

W34 – Map GPS

Among all the tested guidelines, the use of GPS based maps is the only one extracted exclusively from the Apps available on the market (industry-review) that won the preference of the participants. The academic literature did not explore this topic specifically (using GPS for cultural open-air setting), and in part, it can be justified by the wide adoption of such model of navigation as a default feature

The testers indicate their familiarity with GoogleMaps as the main reason they preferred GPS-based maps compared with tailored/interactive maps presented during the evaluation. One advantage of using such an option is the secure connection to the hardware geolocation features, making it easier to add different layers of information. For instance, it can easily be converted to a traditional navigation system, offering data on traffic.

6.6 – Heritage Related

The last series of guidelines are focused on cultural heritage aspects. Combined with navigation, design, content, technical and media aspects, they complete the set of guidelines for the development of effective WHS Apps.

W35 – Displaying the WHS Logo

As discussed in the initial chapters, for a place to be awarded the status of WHS is not a simple task; it requires a detailed study and the collection of evidence to ensure a successful application. As a reward, all the official WHS are allowed to use and display the WHS logo, and the Apps cannot neglect it. Even though this symbol is not as popular among the general population (King and Halpenny, 2014) as one could assume, its use might help to reinforce the WHS branding and to legitimate the importance of the site's heritage. The use of the WHS logo

highlights the historical and/or natural importance of the attraction for the visitors, and works almost as a guarantee of quality.
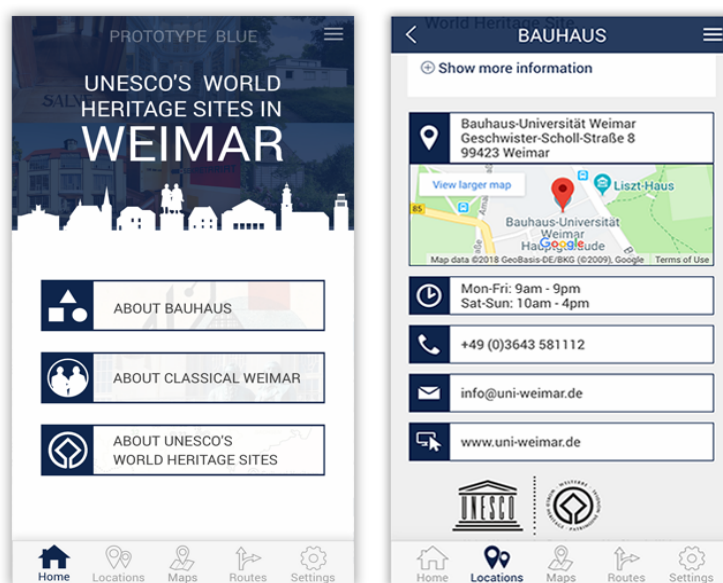
Figure 6.9: Example of the appliance of the WHS logo, at the home screen and below the articles.

W36 – Provide an "About" WHS Page

The WHS recognition is indeed an important recognition for an attraction, but not all the visitors are familiar with this importance, and a dedicated App cannot neglect this information. As same as it is wrong to assume the visitors will immediately recognise the WHS logo, it is also unwise to expect they have information regarding the attraction and the reasons why it configures as a WHS. During the evaluation, 63% of the participants accessed the "About Classical Weimar" page, 56.7% visited the "About Bauhaus", and 50% accessed the "About UNESCO WHS" one. The existence of such feature and the information provided by the "About" pages was positively evaluated by the participants.

W37 – Curated Content

There is plenty of information regarding touristic attractions around the world. The modern problem is precisely the opposite: the information overload and the difficulties in separating what is correct, accurate, and trustworthy. For that reason, the last one of the guidelines tackles

this issue precisely: a dedicated App must contain curated information tailored to offer the user the best possible experience when visiting a WHS.

There is evidence that when the information "is tailored to the potential needs, interests, personality, usage context" it will be more persuasive (Sunio and Schmöcker, 2017, p. 44). With this in mind, developers must work closely with WHS managerial teams if possible, as they certainly will be able to provide accurately, updated, and a vast amount of material and evidence.

6.7 – Considerations

Creating an App is far from being only an exercise of creativity. If at the beginning of the smartphone era, the developers based their decision on their very own taste, nowadays it is not enough to make it succeed. This research made clear that it is crucial to base the development not only on the competitors but also consider academic research. The set of guidelines present in this chapter covers it.

Technological developments will always open space for new developments, but some principles will remain the same for a while. There are also features that did not make to the final list as they are still not consolidated enough to be cemented as a guideline. The use of AR (Augmented Reality) is one of these features. The idea of creating an additional layer of information over a real background is supported by some studies (Chung et al., 2017; Dieck and Jung, 2015; Hincapie et al., 2016). From a study developed along with this doctoral research (Dutra and Ebel, 2014), when AR technology was applied and tested for WHS in open-air conditions, some technical constraints became evident: the high demand on the processor, the rapid consumption of battery, the complexity of the task for inexperienced users. From that, it was possible to verify that, despite its potential, it is still more a gimmick than a feature that can make a substantial contribution to the average visitor to enjoy a WHS. Therefore the use of AR was not included in the final guidelines.

The following table (Table 6.1) summarises the final selection of guidelines, providing the information regarding its origin: if from the industry review, if from the academic literature-review, or both; or if they were insights exclusively brought up by the empirical evaluation.

Final Guidelines		Origin		
		From Industry-Review	From Literature-Review	From the Evaluation
Layout				
W1	Place Content in One Screen / Minimising-avoiding Scrolling		x	
W2	Consistency Between Different Sections	x	x	
W3	Orientation: Provide Session Title		x	
W4	Providing a Search Bar *		x	
Navigation				
W5	Number of Taps to WHS Information (up to 3)		x	
W6	Limited Items in the Main Navigation (up to 5)			x
W7	Navigation Menu Visible	x	x	
W8	One Level Navigation Menu		x	
W9	Offering Visible (tabs) Sub-menu Navigation			x
W10	Self-explanatory Menu	x	x	
W11	Presence of the Back Button		x	
Design				
W12	Limited Use of Colours	x	x	
W13	Simple Design	x	x	
W14	Use of Icons	x	x	
W15	Space Between Buttons or Other Clickable Items		x	
W16	Use Standard Icons Inside Maps			x
Content				
W17	Short Text		x	
W18	Info at Start Screen		x	
W19	Tours / Routes		x	
W20	Focus / Only Display Essential Information		x	
W21	Use of Aesthetics Graphics		x	
W22	Consider the Surrounding Environment		x	
W23	Large Font Size		x	
W24	Display the Locations in a List Format			x
W25	Display More Details on the Locations' Preview			x
W26	Allow Personalization / Configuration		x	
W27	Centred Pop-ups			x
W28	Prevent Information Loss	x	x	
W29	Provide Action Feedback *		x	
W30	Clickable Buttons with Tactile Feedback or Sound *		x	
W31	Provide Location-based Notification *		x	
W32	Use of Visual Clues for Visited POI *		x	
Media and Features				
W33	Photos & Gallery			x
W34	Map GPS	x		
WHS Related				
W35	Use of WHS Logo			x
W36	Provide an About WHS Page			x
W37	Curated Content			x
Total		(Exclusive from each)		
		1	18	10
		+ 7 (Common on both)		
* Not tested in the prototypes, due to implementation constraints.				

Table 6.1: *Guidelines for open-air WHS apps*

From the final 37 guidelines, ten were exclusively found during the evaluation, reinforcing the contribution of this work to the field. The original input of 10 recommendations, distributed among the *Navigation, Content, Media,* and *WHS* Related categories, corresponds to 27% of the total recommended guidelines.

Chapter 7 – Final Considerations

During the development of this work, each chapter brought a set of considerations summarising its content and making contributions to the field. To avoid unnecessary repetition, this final chapter will not retake those narratives but will briefly analyse this work's original contributions.

As seen, the popularity of smartphones is consolidated, and they are now a helpful tool for many daily activities, including tourism. The phones' efficiency in performing a task is directly connected to the hardware capabilities and the efficiency of the installed pieces of software, the so-called Apps. As the technological advances are fast improving the hardware performance, App developers must keep the pace in offering users experiences. It might sound like an obvious observation, but a detailed analysis of the Apps specifically targeting the WHS showed that developers might have been working closely with the idea of repeating features and functions offered by competitors, than in looking closer to what their target groups want. When the commercial applications for WHS were directly compared with the latest academic research on the field, the divergences were even more evident. Despite the Apps for tourism being around for more than a decade now, not much has changed, and there is space for important – and necessary – improvements.

This research is an effort in aligning the industry and the academic perspectives to make WHS Apps more efficient and tailored for two distinct groups: the WHS itself, that can benefit with a good marketing strategy adding to their brand and reinforcing their importance as a touristic destination; and the targeted users, who can have a better experience exploring the WHS by having a dedicated App, without unnecessary information overload nor unuseful features. To achieve this objective, this research aimed to investigate state of the art in the App industry (based on the German App market for WHS), and the latest progress in academic research,

combining both in a set of practical guidelines to facilitate the development of useful and reliable WHS Apps. The result of an extensive and careful implementation of combined methods was a set of 37 guidelines.

It can be argued that the impact of this research goes beyond the WHS scope, as the guidelines can be applied for virtually most of the outdoor touristic attractions in general, as visitors can explore them in a very similar way. Apps for WHS and other touristic locations, in general, require wayfinding and points of interest (POI) descriptions, alongside with efficient navigation, a careful design, a balanced layout and trustworthy content. These recommendations were detailed in this work.

During this research, users were invited to test the guidelines extracted from the App market (industry-based guidelines) and literature contributions (academic literature-based guidelines). However, the combination of both sets of guidelines did not extinguish the features, and a set of unique elements was also tested, amplifying the scope of the research and making it unique, adding new perspectives and contributions to the field.

These exclusive findings resulted in tested and confirmed guidelines discovered during this research. For example, when the description of a POI has a long text, the best way to present it is to provide the user with a concise summary on the screen and a button/link that allows them to explore/read further on the topic. By itself, it reveals a tested solution that offers a better interaction than the traditionally adopted scroll bars. Another exclusive contribution refers to the media use along with the content, such as audio and video. Despite the video popularity and audioguides being intrinsically associated with tourism, the tests revealed that they are not effective solutions for content to be consumed in open-air scenarios and should be used only to complement/overlap the information provided text and pictures.

This research also revealed the importance of implementing routes in the Apps dedicated to WHS. The function can help users to explore different locations and POIs within a city or region. Still, it can also be useful for WHS concentrated in one location, as it allows to create an intuitive – and time-saving – sequence for the visitor to explore the attraction.

Some of the exclusive findings have a more technical aspect. For instance, it was confirmed that simple personalisations and adjustments could significantly impact the user's experience while using a dedicated App to explore a WHS. One of the most important ones is the font size. On top of the small screens' constraints, one must pay attention to the age group of visitors that

traditionally access a WHS. In Weimar, for example, groups of elderly visitors are very common, and it is a basic need to provide and App with the information they can easily read. Another technical guideline recommended by this research refers to notifications on POIs based on GPS. It means that users are willing to accept notifications on their lock screens to prevent them from missing essential spots in the area they are visiting.

As the same time as the contributions to the field must be recognised, it is important to say that – as it happens in most of the independent projects – this research faced constraints of time and budget for the prototype development and testing, which brought limitations in some features to be tested, such as the use of GPS warning for POIs. In addition, academic changes brought different challenges during this work development. In an ideal scenario, the work could continue with implementing a commercial App for Weimar's WHS based on the final guidelines and another round of tests with different demographics. Another improvement could be made by focusing the development more specifically on inclusion, by checking the elderly-friendly features' extension and extending the user-friendly approach to different body disabilities and special needs. For now, this is part of the future steps.

Overall, this research reached a point in which its main objectives were fulfilled. It covered how mobile devices can be used for WHS and, among other findings, it gives essential insights on how touristic applications, in general, can benefit from context-awareness. This work has a summary of practical recommendations and design patterns to facilitate the integration of real-life scenarios and digital systems, focusing on wayfinding, content presentation and interface usability.

It is important to say that, like any other research, there is space for further developments. In this case, some future work could concentrate on implementing the chosen guidelines for a more robust development, avoiding the constraints from prototype tools, to test all the features until achieving a successful threshold. In addition, a definitive version of the App "World Heritage Sites in Weimar" could then be developed for the main available mobile OS (iOS and Android), being offered to the visitors of Weimar, such as tourists and schoolers. This App could be developed in association with the direct and indirect WHS stakeholders of Weimar, such as the city's official tourist office (holder of the most content used in the prototypes), together with the *Klassik Stifftung* and the Bauhaus-University Weimar.

Overall, it must be said that the final set of guidelines are important recommendations for developers, but they are not a rigid formula. Every project must be tailored to follow a detailed briefing, and specific requirements will emerge in the process. However, finding the best solutions does not have to be a costly and time-consuming process of trial and error. The found guidelines can benefit developers, users, and help to promote WHS. They have proven to work successfully for Weimar, and they can repeat the performance in different places.

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Appendix

Appendix from Chapter 3

A.3 – Description and analysis of selected apps

In this section, is presented how the industry/market overview of dedicated Apps for WHS was presented and analysed.

A.3.1 – Aachen Cathedral / Aachener Dom /

The Aachen Cathedral is the third WHS from Germany. Aachen was the capital of the Charlemagne's Holy Roman Empire, and its chapel was built between 793 and 813, being on 814 the place where Charlemagne was buried. "The Cathedral Treasury in Aachen is regarded as one of the most important ecclesiastical treasuries in northern Europe", and it continued to be until 1531 the place where the German emperors were crowded ("Aachen Cathedral – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Churches & Abbeys

A.3.1.1 – App 01: Aachener Dom

The "Aachener Dom" is a dedicated WHS app, developed by the universities of the RWTH Aachen University (Rheinisch-Westfälische Technische Hochschule Aachen) and Aachen University of Applied Sciences (FH Aachen). It is placed on the iOS App Store in the Education category. The App has linear navigation, allowing the user to follow back and forward through a pre-determined guided tour inside the cathedral, showing pictures and explaining the elements and history of the building.

	Content Structure • Start • Rundgang (Tour) • Overview (Static Map with links) • Zeittafel (Chronology) • Info (Services, Opening Time, Impressum) Developer(s) • RWTH Aachen University • © FH Aachen Category on official App Market • Education Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/aachener-dom/id477737478?l=en&mt=8 Last Update • iOS: 16 December 2012 (v. 1.2)
Aachner Dom – Main Screen	

Table App 01: Aachner Dom – Technical Info

a) Layout

The content is built in a linear narrative, substituting the vertical scrolling by the option of "next" page/screen. It is possible to access more information regarding the current screen, by taping in any place, displaying the options like "Mehr" (more) / "Weniger" (less) text, "3D" (it is actually a 360° photo image) and "Audio". The "3D" and "Audio is not available in all pages/sections. This extra information feature is not intuitive, the user needs to click on the screen without having previous knowledge about those options, and there is no visible hint that it is possible to find further information by tapping on the screen. Some users could find it by chance, but many could just not be aware of such a possibility.

On the options "Zeittafel" and "Info", it displays vertical scrolling, with a text above a faded photo as background.

The App uses a short text above photos of the church's interior without any fixed form, changing the text position in relation to the photo.

b) Navigation

The initial screen displays the information that the Aachner Dom was the first building to be included in the WHS list. Once clicked it substitutes this message by the navigation menu.

The main navigation menu is always presented on the bottom, with five options (Start, Rundgang, Übersicht, Zeittafel and Info). As the user advances on its content, it also displays "Back" and "Next" navigation on the top. Despite its linear navigation, the always presented a bottom menu that offers the option to change the screen or to go back to the start at any moment.

On the home screen, it offers the "Anreise" (Getting there) option which opens an Apple Map showing the position of the Cathedral with navigation options, together with the regular navigation of the App. If the user chooses to not access this feature, it disappears, being accessible again just if the App is closed and opened.

The content's options are divided and not intercalated, meaning the user has to choose what kind of information will be accessed by the navigation menu. In other words, each option of the menu leads to a different section inside the App.

c) Design

The design is dated, probably in reason of not offering an update since 2012, not using the entire screen space of the device models released after this date, as it can be seen on the black spaces above and below the App main screen. The design is not clean. The user of text above background images makes difficult to read all the written words sometime.

It uses a combination of icon and text on the main navigation menu, which may make clearer to the user to understand what each one of the options is about.

d) Content

Texts are short, with the possibility to read more. On its format, the content pages lack on consistency, by displaying several screens formatted in different ways: sometimes the text is on left, right, bottom. Different font size and font types are used across the App.

On the opening page, it shows short information regarding the Cathedral, which disappears after taping in any part of the screen. By using linear navigation, the user can go back without any content loss.

e) Features and media

- Short Text, with the possibility to read more.

- Photo Gallery

- Photo 360°

- Audio

- Map Static (interior of the Cathedral)

- Map GPS ("Getting There" feature on the opening screen).

A.3.2 – Speyer Cathedral / Dom zu Speyer

The Speyer Cathedral was founded in 1030 by Conrad II, Emperor of the Holy Roman Empire. The cathedral is considered "one of the most important Romanesque monuments from the time of the Holy Roman Empire", being the burial place of German emperors for almost 300 years ("Speyer Cathedral – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Churches & Abbeys

A.3.2.1 – App 02: Dom zu Speyer / Speyer Cathedral

The "Dom zu Speyer" App was developed by a private company using copyrighted material from the Speyer Cathedral, and it is placed at the Travel category. It has a German and English version for iOS and just English version for Android. The German version has more options on the main menu, such as "News" and "Termine", being the chosen one for the analysis. The App aims to divulge the cathedral services and to provide a guided tour inside the building.

Dom zu Speyer – Main Screen	Content Structure • Dom (Cathedral) • News • Termine (Meeting) • Guide (Tour) • Akteure (People) Developer(s) • abcdruck GmbH (iOS) • abcmedien GmbH (Android) Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/domspeyer/id778505962?l=en&mt=8 and https://itunes.apple.com/de/app/speyer-cathedral/id977152429?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=de.i42.domspeyer&hl=en Last Update • iOS: 3 August 2015 (v. 1.1 DE / v.1.0 EN) • Android: 12 October 2015 (v. 1.0)

Table App 02: *Dom zu Speyer – Technical Info*

a) Layout

Most of the screens place the content without the need for scrolling. The layout presents two different navigation bars, with the main one on the bottom and secondary one on top. On its Android version, the top navigation bar presents a bigger font-size and highlighted section, providing feedback about where you are inside its content; on another hand, the iOS version presents a quite small font-size without any feedback about the content location.

On "Tour" section, sometimes it is provided with an audio option but it is mandatory the use of headphones, otherwise, the audio will not play. This feature may be understood to not disrupt the other visitors inside the cathedral.

b) Navigation

The App has main navigation on the bottom, with five options, and secondary navigation on top, varying the number of options according to the chosen section. Sometimes this top navigation bar needs to be scrolled horizontally, signalizing with a small ">" symbol that may be difficult to be interpreted as more options available.

The Tour section has linear navigation, by swapping the screen from right to left, showing first a text above a background image and then the image alone for a better view of the photo.

c) Design

The design is very clean and very consistent between sections. The use of colours is limited and light, making the main content more in evidence. When a text is displayed above a photo, it has a white-shaded background, helping for the reading.

The font-size, especially on the top menu, is a bit small. If changed for a bigger size, it would make easier to read. The same applies to the content.

The use of icons together with text on its main navigation menu makes the options self-explanatory.

d) Content

The use of short texts provides a quick understanding of the sections. Once opened, the App does not provide any information regarding the content or navigation, leaving to the user to discover its contents and features.

The navigation is quite linear, by swapping the screens, preventing any data loss – as the user does not need to provide/type any additional information.

e) Features and media

- Short Text.

- Photo

- Audio

- Map Static (interior of the Cathedral)

- Map GPS (on "Anfahrt" subsection, from "Dom" main menu).

A.3.3 – Hanseatic City of Lübeck / Hansestadt Lübeck

The Hanseatic City of Lübeck was founded in 11143 and it was the former capital of the Hanseatic League, being in 16th Century the major trading centre of northern Europe. ("Hanseatic City of Lübeck – UNESCO World Heritage Centre," n.d.). The old city of Lübeck remained preserved, with 15th-16th centuries houses, public monuments, and other buildings.

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Historical Town Centres

A.3.3.1 – App 03: (Quaterquest) Altstadt von Lübeck

The App is a Quiz game style (Quarterquest), with multiple choice answers about the old town of Lübeck. It is recommended for those who already know the history and places of the city, instead of tourists who never went to the city. It is possible to find Quarterquest Apps for several other cities in Germany, always following similar structure and game mechanics. Despite having the name "Altstadt von Lübeck" at the official App market, the App presents itself as "Weltkulturebe Lübeck" on the game. The App is a game quiz with multiple-choice, based in the old town of Lübeck. The player needs to go to certain marked points to find the answer to the questions. Once you solved a question, more information regarding it is released.

Altstadt von Lübeck – Main Screen
	Content Structure
	   • Dein Quest (Your Quest)
	   • Spielregeln (Play Rules)
	   • Quest jetzt starten (Start Quest)
	
	Developer(s)
	   • Linkwerk GmbH
	
	Category on official App Market
	   • Travel
	
	Operational System(s) and URL(s)
	   • Android:
	     https://play.google.com/store/apps/details?id=
	     com.linkwerk.quarterquest.de.luebeck.luebeckAltstadt
	
	Last Update
	   • Android: 07 April 2015 (version 1.7.1)

Table App 03: Altstadt von Lübeck – Technical Info

a) Layout

Despite just having three options on its start screen, it is needed to scroll down the page to access these options. As the game goes, every screen needs to be scrolled vertically to access all the content, with the option to expand it even more to access facts regarding the locations, map and the game questions.

It offers pieces of cultural information regarding the locations where the quiz question is taken place, suggesting the player to find complementary information on the real location to answer the question.

b) Navigation

The App is a linear quiz-based game, once answeRed a question it gives you immediate feedback, as "False" and "Correct" marks, and also a progressive timeline of the quiz. The App offers the possibility to access a static map with the POIs or accessing a GPS Map for directions of the next question location.

The player cannot advance in the game if answeRed wrong, although it is possible to try a correct answer as many times possible.

c) Design

The design is very simple, with text with photo followed by multiple choice answers designed as standards buttons. The contrast between the buttons and the background is very low, both on black colour.

The game uses colour elements on the actions of the chosen button(s) and answer feedback.

d) Content

The use of long texts can be a problem in this time-based quiz game. The game allows the player to correct wrong answers, in order to continue the quiz. Once answeRed correctly, the game displays complementary information regarding the question, sometimes with an illustration.

For every question is presented a static map, text and photo, with the possibility to access a GPS based map for directions.

e) Features and media

- Long Text, with the possibility to read more.

- Photo

- Map GPS

- Map Static

A.3.3.2 – App 04: iTour Lübeck

The iTour App is present in some cities in Europe, developed by iTour city guide GmbH based in Weimar, Germany. The App is an audio-guide based, without text. The App presents also a GPS Map navigation.

	Content Structure
●●○○○ o2-de 📶 6:23 PM ✈ 100% 🔋⚡ LÜBECK [city aerial photograph] 🏠 ℹ️ ▶️ *iTour Lübeck – Main Screen*	• Home • Imprint • Start audio-guide **Developer(s)** • iTour city guide GmbH • Lübeck und Travemünde Marketing GmbH **Category on official App Market** • Travel **Operational System(s) and URL(s)** • iOS: https://itunes.apple.com/de/app/itour-lubeck-english/id857735284?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=com.tourias.android.guide.itour.luebeck_en and https://play.google.com/store/apps/details?id=com.tourias.android.guide.itour.luebeck_de **Last Update** • iOS: 04 November 2014 (v. 1.2) • Android: 04 November 2014 (v. 1.0 EN) 23 April 2014 (v. 1.0 DE)

Table App 04: iTour Lübeck – Technical Info

a) Layout

The App has a minimalistic design, without texts or explanations. The only text present it is to signalize the audio files. Through the app, there are more options displayed my icons without text, which may be difficult to be interpreted by the user.

b) Navigation

The user must tap on the icons to discover where it will land. The layout is practically identical on both OS, with some minor changes due to each OS guidelines (especially on GPS Map). There are two options of navigation: through the map, with numbeRed POI; or by a list of places. Once finished the chosen audio, it returns to the previous screen (map or list).

On the map mode, once a POI is chosen it displays the title on the top of the screen with a "play" sign.

c) Design

The design is very simple and consistent through the options. It is based on icons to display the available sections, but without any further explanation, leaving to the user to discover what each option is.

d) Content

One positive feature is the offer to download the map before its use outdoor, with the possibility of using an offline map. The options are very few, due to the nature of the App being an audio guide.

The movement through the App does not inflict in data loss, giving the user the freedom to choose what audio will be played in any kind of order.

e) Features and media

- Audio
- Map GPS

A.3.4 – Palaces and Parks of Potsdam and Berlin / Schlösser und Parks von Potsdam und Berlin

The Palaces and Parks of Potsdam and Berlin is a complex of 500 ha of parks and 150 buildings, going from the district of Berlin-Zehlendorf to the Brandenburg's capital Potsdam. One of the highlights from this WHS added to the list in 1990, is the Sanssouci Palace, built between 1745-1747 under the reign of FRederick II. ("Palaces and Parks of Potsdam and Berlin – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Castles & Palaces

A.3.4.1 – App 05: Sanssouci – The Park and its buildings

The App addresses to the Sanssouci complex buildings and park, but also to historical people connected to its history. The App was developed by a private company, under the supervision of official cultural foundations of the area, offering information about the opening hours, prices and orientation.

  Sanssouci – The Park and its buildings – Main Screen	Content Structure • Buildings & Places • People • Orientation & Map • Information & Service • About the Publisher Developer(s) • K-u-K Apps (V-i-s-d-P.) • © Deutscher Kunstverlag GmbH, in cooperation with Stiftung Preußische Schlösser und Garen Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/sanssouci-park-its-buildings/id541005815?l=en&mt=8 Last Update • iOS: 18 September 2013 (V. 2.0)

Table App 05: *Sanssouci – The Park and its buildings – Technical Info*

a) Layout

The App has two distinct interfaces, one for the initial screen and other for the content part. Once on the second level, the user has control about displaying or not the texts above the images. The App utilises long texts to explain its sections, promoting vertical scrolling on the text box, without moving the images.

b) Navigation

On the initial screen has five options spread through the screen, after choosing an option the App displays a navigation bar on top with from two to five other navigation options: start, back, share, text, location. These options change according to the chosen content and information level. It also provides tours on the static map, without any further interaction possibility.

The navigation is very bureaucratic, by making the user tap several times in a linear direction to achieve WHS information, forcing to go back and start over to another direction. It could be optimized by unifying image and text, taking at least one tap less.

c) Design

The App relies on the use of icons with text, although the icons may be misleading, by repeating icons for different sections: at start page the "crown" shaped icon it is used on "about the publisher", once inside the App this icon is used for "start".

The navigation bar utilises two colours, but on its content, there are several other colours on the text background, according to where you are in the App.

d) Content

The user of long texts can be a disadvantage by forcing vertical scrolling. The App includes a static map, with two possible routes with numbers, which doesn't offer any further information, or explanation about each number.
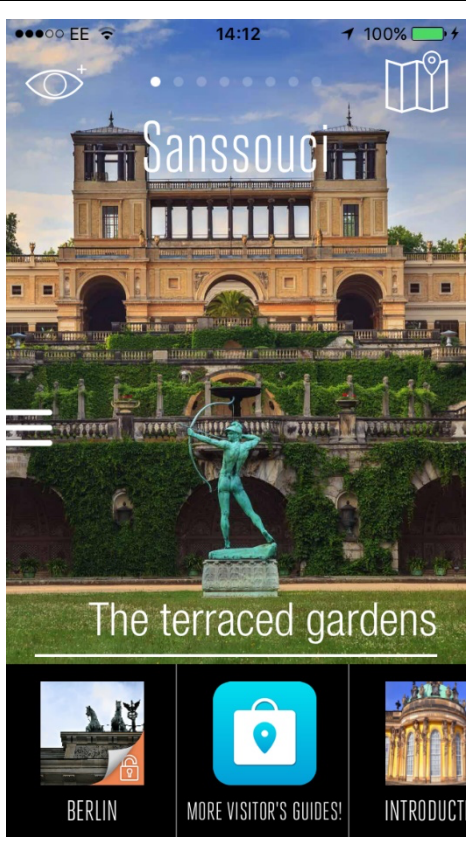
On the dynamic map, the use of the same icon doesn't add any preview clue regarding each displayed POI.

e) Features and media

- Long Text
- Photo
- Map Static
- Map GPS

A.3.4.2 – App 06: Sanssouci Palace Visitor Guide

This App provides information regarding the WHS, being focused on making their users make purchased-in content. One highlight of the App is an introductory screen, explaining its navigation, making clear to the user how to explore the App possibilities.

Sanssouci Palace Visitor Guide – Main Screen
	Content Structure
	  • *Berlin (* to be purchased)*
	  • *More visitors' Guides! (* to be purchased)*
	  • Introduction
	  • FRederick The Great
	  • House of Hohenzollern
	  • Ethos
	  • Architecture
	  • Interior of the Palace
	  • The Terraced Gardens
	  • Saunssouci Park
	  • Neighbouring Area of Sanssouci
	  • Practical Information
	
	Developer(s)
	  • eTips LTD
	
	Category on official App Market
	  • Education
	
	Operational System(s) and URL(s)
	  • iOS: https://itunes.apple.com/de/app/sanssouci-palace-visitor-guide/id1018600219?l=en&mt=8
	
	Last Update
	  • iOS: 04 October 2016 (v. 1.6)

Table App 06: *Sanssouci Palace Visitor Guide – Technical Info*

a) Layout

The App relies on long texts for each section with vertical scrolling, with the possibility to access a respective photo gallery. It offers a static map on its initial screen, without any further interaction, just as a regular image with a drawn map and POIs. It would benefit if the map was linked somehow to the content of the App.

b) Navigation

The App presents a navigation bar with all the 12 sections available, causing a horizontal scrolling, making difficult to access the WHS content. Another negative issue is putting emphasis on purchase options rather than the content regarding the Sanssouci, as can be seen on the print-screen. This navigation uses photo (thumbnail) with text.

Once opened an article, the navigation bar changes three options, with icon and text: back, info (text) and images (photo gallery). Despite being just three options, is there also a horizontal scrolling that could be avoided just simply Reducing the size of the icons.

c) Design

Despite the mentioned navigation flaws, the App maintains a consistent design on its sections, utilising a clean design with limited colours and limited font types. The use of icons on the articles helps to understand the available options.

d) Content

The use of long texts may be seen as a flaw, where the user must read a lot of text on a mobile screen. The content is spread without any linear logic, it seems like a collection of articles regarding the Sansoussi than a "Palace visit guide" as the App's name suggests.

One positive feature is immediate feedback on the article navigation menu, changing colours of the icons according to the displayed content.

e) Features and media

- Long Text

- Photo Gallery

- Map Static

- AR (* to be purchased, and not clear if it is about Potsdam or Berlin)
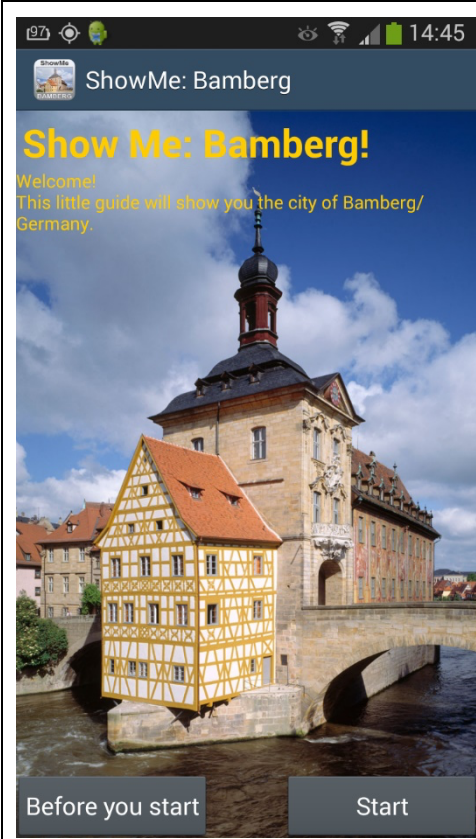
A.3.5 – Town of Bamberg / Altstadt von Bamberg

Situated in the Franconian area of Bavaria, Bamberg was added in 1993 to the WHS list due to its well preserved old town, an architectural reference for central Germany and Hungary. Bamberg has over 1000 buildings from 11th to 18th centuries listed as protected monuments ("Town of Bamberg – Deutsche UNESCO-Kommission," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Historical Town Centres

A.3.5.1 – App 07: Show Me: Bamberg!

The App is a guide to the old town of Bamberg, relying on GPS Map and Text. The App proposes itself to be a two-three hours guide in Bamberg. The App was developed by a private person, without any relation to Bamberg's tourist office.

Show Me: Bamberg! – Main Screen	Content Structure
	   • Before you start
	   • Start (going to the list of POI)
	
	Developer(s)
	   • Christoph von Both
	
	Category on official App Market
	   • Travel
	
	Operational System(s) and URL(s)
	   • Android:
	     https://play.google.com/store/apps/details?id=de.netzabdruck.showme_bamberg
	
	Last Update
	   • Android: 03 July 2012 (V. 1.1)

Table App 07: *Show Me: Bamberg! – Technical Info*

a) Layout

The App offers 29 locations, plus Tourist office information, accessed by a POI list after the initial screen. On the initial screen there are two buttons: "Before you start" – explaining how the App works in a pop up alert style window with vertical scrolling, despite it could be avoided by making this windows a bit larger, and "Start" leading to a POI list. Every POI has a large text with the option to access its location in a GPS map or returning to the POI list. From its current layout, it is possible to notice no use of margins. One positive feature is the "Before you start" button, introducing how the App works, despite this dated style feature.

b) Navigation

The App does not provide a navigation bar, working on back and forth activity. Once accessed a POI the user needs to go back to previous screen in order to access another one. It is possible to access all POIs in a map by taping in the physical "option button" (usually available on Android devices), which can be confuse for the users as such function cannot be accessed through the App interface.

c) Design

It is an old app, due to its last update in 3rd July of 2012, not following later GUI standards from Android, such as material design[49]. Despite its dated style, it offers a consistent layout applying the same style in all available content. On the POI list, it is displayed a thumbnail and description of the attractions.

d) Content

The App utilises a short text on the description of each POI, leading to a long text page with a photo on top and map option on the bottom. Once accessed a POI, it shows on top its title, giving feedback about where you are inside the provided locations' list.

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[49] https://material.io/guidelines/

e) Features and media

- Long Text

- Short Text

- Photo

- Map GPS
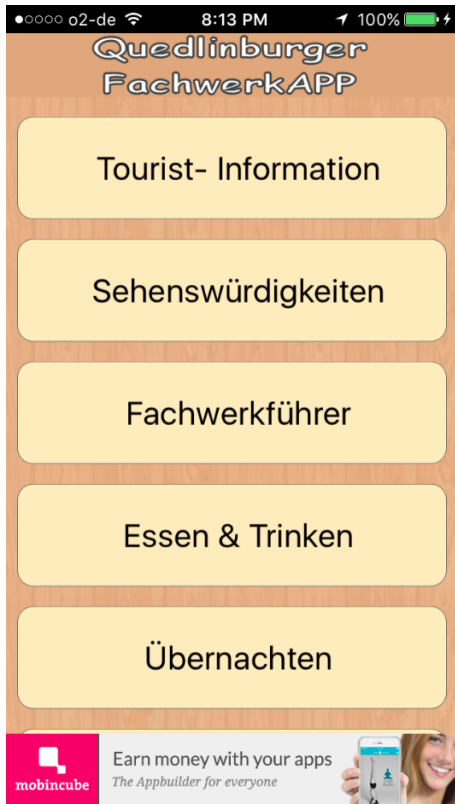
A.3.6 – Collegiate Church, Castle, and Old Town of Quedlinburg / Stiftskirche, Schloss und Altstadt von Quedlinburg

The Collegiate Church, Castle and Old Town of Quedlinburg were added at WHS list in 1994. Quedlinburg was the capital of the East Franconian German Empire, being a trading town on middle ages. The city is notable for the timber-framed (*Fachwerk* in German) buildings spread along with the old town, having its medieval appearance preserved ("Collegiate Church, Castle and Old Town of Quedlinburg – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Historical Town Centres

A.3.6.1 – App 08: Quedlinburger FachwerkAPP – Das Welterbe City-Guide

The App has a similar design on both available OS, not following any official GUI guidelines. Despite several menu options, the App mainly relies on offering several maps, especially focused on the locations of timber-framed buildings in different periods.

	Content Structure
Quedlinburger FachwerkAPP – Main Screen	• Tourist- Information (Touristic Information) • Sehenswürdigkeiten (Sightseeing) • Fachwerkführer (Timber-framed buildings) • Essen & Trinken (Eat & Drink) • Übernachten (Accommodation) • Freizeit / Kultur (Leisure / Culture) • Die FachwerkAPP (About the App) • Weitere Tipps (Other tips) • Kontakt/Feedback (Contact / Feedback) • Impressum (Ownership/Authorship) Developer(s) • Andy Stuetzer • © 2015 Fachwerkfreunde.de Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/quedlinburger-fachwerkapp/id982246292?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=com.mobincube.android.sc_G7IY2 Last Update • iOS: 01 October 2015 (v. 1.4) • Android: 16 April 2016 (v 21.0.0)

Table App 08: *Quedlinburger FachwerkAPP – Technical Info*

a) Layout

The available WHS information has long texts, mostly taken from Wikipedia, causing long vertical scrolling. It offers also an audio file, which the content is the same as the provided text. The pages show a top navigation menu regarding the location, the location/article title, photo, audio options (play/stop), long text, and references.

b) Navigation

Once chosen an option from the initial screen, the App provides a simple navigation bar with two options: back and home. Inside each POI, the App displays a top navigation menu about the current location with the options: "A-Z" (backing to POI list), "Nähe" (sorting the POI list by distance from you), "Karte" (GPS location) and "LiveView (which instead of opening live

feed camera of the location, as the name may suggest, it just plays a video advertising). If the user wants to access the initial displayed option, must use the back function.

It also has a full-screen advertisement when the App is opened, forcing one to more tapping to achieve the WHS information.

c) Design

The App design is not consistent, by using different font formats and heavy colours. It also applies several advertisements, creating a polluted visual. The WHS content is not highlighted (it is under "Sightseeing" option) and may be lost among several other options (10 in total).

d) Content

By extracting its information from Wikipedia, the App creates long horizontal scrolling, but it offers the same content in audio format which can be a good feature for those who do not want to read long texts. It applies a large font-size in the articles, on both OS, that may make easier to read on the screen.

It is a web-based content, which requires time to load the content.

e) Features and media

- Long Text
- Photo
- Audio
- Map GPS

A.3.7 – Völklingen Ironworks / Völklinger Hütte

The Völklingen Ironworks founded in 1873 was added to the WHS list in 1994, and it is the only intact example about Ironworks in Western Europe ("Völklingen Ironworks – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Industrial Heritage

A.3.7.1 – App 09: Freizeitführer Saarmoselle

The App refers, among other routes in the region, to the WHS Völklingen Ironworks at the "Völklinger Hütter" option, providing a tour through its six hectares area, with eight points of interest marks.

Freizeitführer Saarmoselle – Main Screen	Content Structure • Saarbrücker Stadrundweg (Saarbrücken City trail) • BarockStraße: Köllertal-Warndt-Schleife • BarockStraße: Hauptroute (Saarbrücken – Ottweiler) • BarockStraße: Hauptroute (Ottweiler – Saarbrücken) • Stengelpromenade (Stem Promenade) • Völklinger Hütte (Völklinger Ironworks) Developer(s) • EUROKEY Software GmbH Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/freizeitfuhrer-saarmoselle/id896186317?mt=8 • Android: https://play.google.com/store/apps/details?id=air.de.eurokey.freizeitfuehrer.demo Last Update • iOS: 04 August 2014 (v. 1.00.06) • Android: 19 September 2014 (v. 1.00.07)

Table App 09: *Freizeitführer Saarmoselle – Technical Info*

a) Layout

The App adopted a minimalistic design, demanding from the user to discover how it works and navigate without any explanation. The content utilises long texts, creating vertical scrolling on its articles regarding the WHS POIs.

On its initial screen, it is possible to access all the five main options, with the WHS highlighted with a different colour. It presents also a bottom bar, with QR Code scanner, Imprint and Settings, which disappears once the user goes to other pages.

b) Navigation

Once in the WHS section of the app, it displays two sets of navigation bars, one on top with "back", "my position" and "tour options". At the bottom, the navigation bar goes with three arrows, as "previous", "next" POI and a third one point up/down to switch between map or text about the current POI.

c) Design

The design is very clean with intense use of icons to navigate through the app, applying a limited range of colours. The App maintains its consistency between the pages and how it works.

The user of icons without any text to support its navigation and functions may be challenging at first, but once the user is familiarized with its minimalistic design and navigation, it turns easier to access its content.

d) Content

Along with long texts, the App also offers in some pages with audio files regarding the POIs. The content distribution is based on a pre-defined tour with eight POIs. The pages always display a top navigation bar, content (a POI photo with long text, or a map with the POI highlighted) and bottom navigation bar. The App offers also the possibility to download the route before accessing it outside.

The App provides immediate feedback in some pages, especially on settings and tour options, by highlighting the chosen options. It also provides a visible title, regarding the chosen POI.

e) Features and media

- Long Text.

- Photo

- Audio

- Map Static

- Map GPS (directions to the WHS).
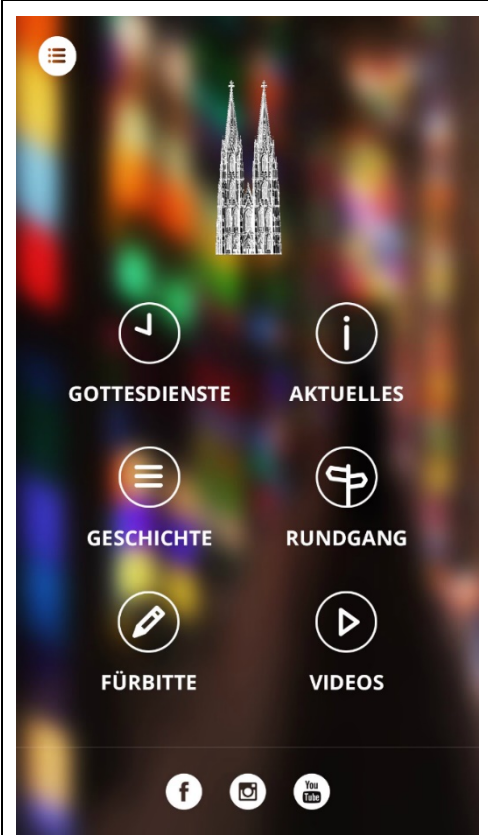
A.3.8 – Cologne Cathedral / Kölner Dom

The Cologne Cathedral is considered a masterpiece of High Gothic style, began its construction in 1248, being finished by 1880. Inside the cathedral, it is possible to find several works of art, as carved oak choir, painted choir screens, and stained-glass windows ("Cologne Cathedral – UNESCO World Heritage Centre," n.d.). Its stained-glass windows dated from c. 1330 to more recent artwork in 2007, by the artist Gehard Richter ("Window of the South Transept, 2007," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Churches & Abbeys

A.3.8.1 – App 10: Der Kölner Dom

The App was developed by a private company, on behalf of the Media Centre of the Archdiocese of Cologne, providing information about the services and history of the building. The App provides a non-linear tour inside the cathedral through a static map with marked POIs. The user can access a variety of information regarding the Cathedral, including videos.

	Content Structure
	• Gottesdienste (Services)
	• Aktuelles (News)
	• Geschichte (History)
	• Rundgang (Tour)
	• Fürbitte (Intercession)
	• Videos
	Developer(s)
	• Cologne Digital GmbH
	• Erzbistum Köln
	• © Metropolitankapitel Köln
	Category on official App Market
	• Travel
	Operational System(s) and URL(s)
	• iOS: https://itunes.apple.com/de/app/der-kolner-dom-basic/id451451728?l=en&mt=8
	• Android: https://play.google.com/store/apps/details?id=de.colognedigital.dom14
	Last Update
Der Kölner Dom – Main Screen	• iOS: 22 February 2017 (v. 2.1)
	• Android: 31 January 2017 (v. 1.9.902)

Table App 10: *Der Kölner Dom – Technical Info*

a) Layout

The App content is clear divided on its initial screen, without giving emphasis in any particular content. It offers six main sections in its initial screen, with the possibility to access more information through a "hamburger menu" on top-left, and official social media channels on the bottom.

The layout of other pages is not consistent, changing font-size and background colour depending on the section.

b) Navigation

Once a section is chosen, it appears a top navigation bar with "back" function, making mandatory to come back to the initial screen to navigate in other parts of the App.

One aspect that could be improved, is when the "Tour" option is chosen, after taping in a POI it appears a very small title box that needs to be tapped again to access the chosen content.

Despite it is possible to zoom in on the map, it is barely impossible to read it without recurring to this action.

c) Design

The App was drawn with the iOS flat design style, applied also to the Android version. The design is clean in some pages but polluted in others, showing a lack of consistency.

The use of icons associated with text helps to understand the sections. This design choice could be repeated inside the "Tour", which shows icons in top navigation without any explanation.

d) Content

The layout of the articles follows two different design, on "History" it gives long texts with vertical scrolling on a white background colour, with spaces and sections well delimited. On the other hand, at "Tour", the text appears with a faded white background above an image, making more polluted, with a narrow margin. It also uses different font-size between different sections of the App.

e) Features and media

- Long Text
- Photo
- Map Static (interior of the Cathedral)
- Video

A.3.8.2 – App 11: Der Kölner Dom – Ein Hörführer

The app, like some others from Pausanio GmbH, it is an audio guide. The App relies just on the audio format to explain the POIs spread inside the building or related to the Cologne Cathedral. It is possible to find text format on other parts of the app, such as the glossary.

	Content Structure
Der Kölner Dom – Ein Hörführer – Main Screen	• Audioguide • Map • Booklet Developer(s) • Pausanio GmbH & Co. KG Category on official App Market • Travel Operational System(s) and URL(s) • Android: https://play.google.com/store/apps/details?id=de.pausanio.koelner_dom Last Update • Android: 17 November 2015 (v.1.2)

Table App 11: *Der Kölner Dom – Ein Hörführer – Technical Info*

a) Layout

The layout places the content without the need of vertical/horizontal scrolling (except on "Glossary" part, which is long). The App maintains visual consistency between the sections and follows the Android GUI.

b) Navigation

On its initial screen, the App presents an action bar tab with three options, followed by the respective chosen content. Once tapped in an audio POI the interface changes for a top title menu with back function and a bottom navigation menu to control the audio. It is possible to choose between playing the audio on the speaker or on headphones.

c) Design

The design is quite clean, with limited use of colours. On the audio pages, the bottom navigation bar user icon to illustrate the commands, but without any text or explanation.

d) Content

As an audio app, the text is limited to the audio titles and peripherical information. For each audio, there is a respective photo. The content could be improved by providing written content for the audios.

The App provides feedback about where you are in terms of content or chosen option.

e) Features and media

- Photo

- Audio

- Map Static (interior of the Cathedral)

- Short Text (with several options, causing vertical scrolling)

A.3.8.3 – App 12: Cologne Cathedral Tour Guide

The App displays information about the Cologne Cathedral, especially about the building interior through an introductory text and photo gallery. It is promised to be also an audio guide, as the icon on the main screen suggests, but once inside the App there is no audio available displaying an alert pop up written: "Audio coming soon!". The App also drags the attention to other topics not related to the WHS. It would be accurate to affirm that the App aims to sell tours in the city of Cologne, rather than to address to the WHS.

Cologne Cathedral Tour Guide – Main Screen

Content Structure
- Tours & Activities
- Travel Guides (with small info about the Cathedral)
- Places of Interest
- Travel Tools

Developer(s)
- Guiddoo Tour Guide

Category on official App Market
- Travel

Operational System(s) and URL(s)
- Android: https://play.google.com/store/apps/details?id=com.wi.guiddoo.colognecathedral

Last Update
- Android: 07 February 2017 (v. 30.1)

Table App 12: *Cologne Cathedral Tour Guide – Technical Info*

a) Layout

All the displayed content and navigation bars need to be scrolled, horizontally and vertically. Even when the text about the WHS appears in a floating window, the text demands an inner scrolling. Despite these observations, the App maintains this layout consistency among at the WHS section.

b) Navigation

At first sight, it is not clear how many sections the App presents, due to its horizontal scrolling menu. The navigation demands the user to tap more than necessary. When a topic (such as "introduction", "mosaic flooring", "windows in the cathedral", etc) is chosen, after getting the alarm text that "audio coming soon", the user needs to tap again in a minimalistic icon to read about the respective content.

The App offers several levels of navigation, not making clear what are they or how to access them.

c) Design

The App utilises a wide range of colours, making the visual very polluted. The visual solutions applied in this App can be confusing to understand. The App also applies some icons in its navigation, without a text or explanation, making the user tapping to discover.

d) Content

The content put emphasis on audio files, that are not available. Apart from the audio problem, the App offers a photo gallery regarding each available POI, with a hidden (need to be activated) long text with vertical scrolling.

e) Features and media

- Long text
- Photo Gallery
- Map GPS

* Audio is present in the interface, but unavailable to access, so it will not be considered in the analysis.

A.3.8.4 – App 13: WDR 360 VR

The App is focused on the use of Virtual Reality and 360° photos and videos to address to the Cologne Cathedral. Differently from the other apps, the WDR 360 VR encourages the use of VR headset, such as Google Cardboard [50], although it is possible to use the App without any

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[50] https://vr.google.com/intl/en_uk/cardboard/get-cardboard/

extra gadget. The App displays information about the building, related activities and historical facts, within the appealing VR environment.

	Content Structure
WDR 360 VR – Main Screen	• Reise durch die Zeit (Travel trough time) • Bei den Skulpturenrettern (Sculpture rescuers) • Privatkonzert bei Nacht (Private concert by night) • Geheimnisvolle Ecken (Mysterious corners) • So klingt der Dom (How the cathedral sounds) • Einstellungen (Settings) Developer(s) • Westdeustcher Rundfunk (WDR) Category on official App Market • Entertainment Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/wdr-360-vr/id1203716951?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=de.WDR.VR&hl=en Last Update • iOS: 29 April 2017 (version 1.0.1) • Android: 28 April 2017 (version 1.0.1)

Table App 13: *WDR 360 VR – Technical Info*

a) Layout

The App is based on VR, meaning that it cannot be measuRed as the other selected Apps, due to its unique navigation and structure. Apart from this observation, the App maintains consistency between the sections, offering similar content format and navigation.

The App is best experienced if used together with a VR headset, but it operates normally without it.

b) Navigation

The App offers a 3D navigation, based on gyroscope/movements of the smartphone. The navigation consists of floating icons inside the cathedral that when selected display a sentence

explaining what the content is about. Once a chosen topic is loaded, it appears a "Start / Delete" option, to play another video 360 or animation 360.

c) Design

The graphical elements to support the navigation in the App are very clean and consistency in its use. The use of icons and auxiliary texts makes the options very self-explanatory.

d) Content

The App is based on 360 video/photo/animations, meaning that the user can move its sight in any direction possible. Initially, it was designed to be used in a horizontal position, due to the VR glass feature, but it is possible to use it without any external gadget and with the vertical position without any content loss. The texts are short, in reason that the App relies on video and animations for its narrative.

e) Features and media

- Photo 360

- Video 360

- Animation 360

A.3.9 – Bauhaus and its Sites in Weimar and Dessau / Das Bauhaus und seine Stätten in Weimar und Dessau
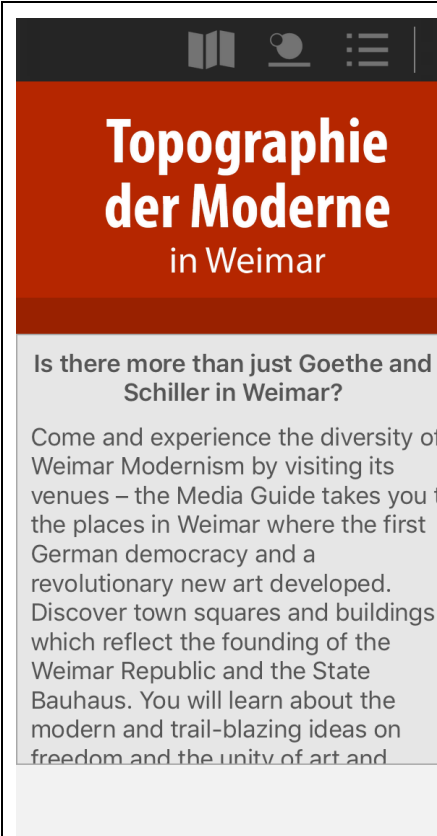
The Bauhaus School (1919-1933) launched the modernist artistic movement, revolutionizing architectural and aesthetics concepts, shaping the design and architecture of 20th Century. The Bauhaus had notable professors as Walter Gropius, Hannes Meyer, Laszlo Moholy-Nagy, Paul Klee and Wassily Kandinsky, and its historical legacy and places in Weimar and Dessau enteRed in WHS list in 1996 ("Bauhaus and its Sites in Weimar and Dessau – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Other World Heritage Sites

A.3.9.1 – App 14: The topography of modernism / Topographie der Moderne in Weimar

As the name suggests, the App refers to the modernism sites in Weimar, which includes also the Bauhaus School. The App is developed for Weimar GmbH, the Economic Development Corporation, Conventions and Tourism Service of Weimar city.

The App also deals with historical content regarding building constructed before the modernism period, such as the German National Theatre, just to mention one example. The App holds its structure in three main features: text, audio, and map. From the introductory text, the App aims to explore other touristic destination beyond the "Classical Weimar".

Topographie der Moderne in Weimar
 	
 Is there more than just Goethe and Schiller in Weimar?
 	
 Come and experience the diversity of Weimar Modernism by visiting its venues – the Media Guide takes you t the places in Weimar where the first German democracy and a revolutionary new art developed. Discover town squares and buildings which reflect the founding of the Weimar Republic and the State Bauhaus. You will learn about the modern and trail-blazing ideas on freedom and the unity of art and
 	
 The topography of modernism – Main Screen
	Content Structure
	 • Map
	 • Articles (in a linear sequence)
	 • Places of Modernism
	 • Other Information (list of other pages:)
	     o Tourist Information
	     o Events
	     o Aspiration of the app!
	     o Glossary
	     o Reset
	     o Imprint
	
	 Developer(s)
	 • Weimar GmbH
	
	 Category on official App Market
	 • Travel
	
	 Operational System(s) and URL(s)
	 • iOS: https://itunes.apple.com/de/app/topographie-der-moderne-in-weimar/id871844497?l=en&mt=8
	 • Android: https://play.google.com/store/apps/details?id=de.mad.tdm
	
	 Last Update
	 • iOS: 17 August 2015 (v. 1.1.0)
	 • Android: 06 May 2014 (v. 1.201)

Table App 14: *The topography of modernism – Technical Info*

a) Layout

The layout is consistent between its sections, combining audio, photo and icon (as identification) with long texts on its main part (the articles). The use of long texts creates vertical scrolling.

b) Navigation

The first time the App is open, it features the page "Aspiration of the app!", from this page the user needs one tap to achieve a WHS content. When the App is opened by a second time, it goes directly to the WHS content (articles).

A minimalistic navigation bar is always present at the top. The only difference between the iOS and Android it is the "other information" option: on iOS, it is present with a three dots icon, and on Android, it is not visible – being accessed by "menu options" physical (or virtual in some models) button at the bottom of the device.

c) Design

The design is very clean, with limited colours and the use of icons on navigation and map.

The icons are placed without text, making it harder to be self-explanatory. Although the use of distinctive icons for each POI in the map and articles can be seen as a positive feature, they are designed inspiRed on the respective content/location demanding a previous knowledge about the locations to be understandable without any explanation.

d) Content

On its start screen, the App shows its intention in promoting other touristic sites in Weimar than the traditional ones related to the so-called "Classic Weimar", linked to Goethe and Schiller legacy.

The content of the WHS articles always has a location photo, title, map/direction option, audio and long text. Most of the articles have audio, which can be played by the user. Once triggeRed, the audio plays uninterrupted, even if changing the topic/screen, needing to be stopped by the user on its original page. The audio icon displays a "play" symbol, but its relation to the audio medium is not so obvious.

A positive feature is a visible feedback about where you are in the linear WHS content, that can be accessed by swapping the screen or choosing a POI in the map.

The App also provides other official weblinks regarding the city of Weimar.

e) Features and media

- Long Text

- Photo

- Audio

- Map GPS

A.3.9.2 – App 15: Bauhaus Archive

The App is developed for the Bauhaus Archive, a design museum in Berlin. Despite not being directly connected to the Bauhaus locations in Weimar and Dessau, the App provides information regarding the Bauhaus history, focused on the original teaching content from Albers, Kandinsky among others. For providing solid information about the Bauhaus' history and legacy, this App was included in the list.

No Service 6:31 PM 100% **Main menu** **bauhaus-archiv** museum für gestaltung outdoor tour of the building the bauhaus collection special exhibitions calendar service imprint *Bauhaus Archive – Main Screen*	Content Structure • Outdoor tour of the building • The Bauhaus collection • Special exhibitions • Calendar • Service • Imprint Developer(s) • tonwelt professional media GmbH Category on official App Market • Education (iOS) • Travel & Local (Android) Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/bauhaus-archive/id445567759?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=com.tonwelt.bauhaus Last Update • iOS: 15 October 2015 (v. 2.0) • Android: 08 Ocbober 2015 (v. 1.0)

Table App 15: *Bauhaus Archive – Technical Info*

a) Layout

The App presents small differences between iOS and Android platforms, being the iOS one more complete with navigation introduction and more visualization options for the audio guide. In general, the layout is very consistent between the sections, having a differential design for audio and text parts.

The main part of the App is audio guides (about the Bauhaus collection, with a kids' version available, and about the museum building), it usually presents the audios with thumbnails and after one option is chosen it expands for most of the screen to show audio options: play control, related photo, audio transcript and share option. Once the audio transcripts are accessed, it goes to another page presenting vertical scrolling according to the content size.

b) Navigation

The navigation follows a linear format, just presenting on top of a navigation bar with "back" function. If the user goes, for instance, to three levels taps information, it would be needed to press back the same amount of time to access the initial screen again.

Every time it opens, the App offers a language option (Deutsch, English) which is positive from a content perspective, but it counts one tap more to achieve a Bauhaus related content. The App presents diverse levels of content, without making it obvious to the user, for instance, some titles are actually linked to another page, but the is no indication of this feature.

c) Design

The design is very clean with colour limitations. For the audio guide, the colours are used to differentiate the topics, but the navigation frame maintains its neutral aspect.

The App applies icons to address to some navigation features, without any text despite the chosen pictograms could be interpreted to its functions.

d) Content

On the historical part, the App relies on audio, with respective photo gallery and text transcripts from the audios. One positive feature is the immediate visual feedback when audio is chosen, showing the download bar in an alert window.

It is possible to access links related to the museum website and telephone.

e) Features and media

- Long Text
- Audio
- Photo
- Map Static
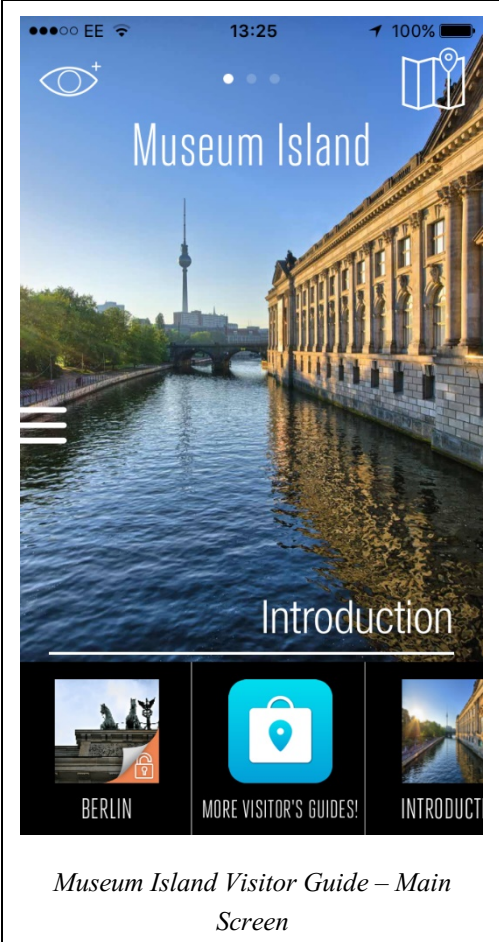
A.3.10 – Museumsinsel Berlin /Museum Island Berlin

The Museumsinsel (Museum Island) is a conglomerate museums from 1824 to 1930 at the heart of Berlin, added to WHS list in 1999, due its importance for being "part of the cultural heritage of the 19th century, the age of education and the sciences" ("Museum Island Berlin – Deutsche UNESCO-Kommission," n.d.). Five museum buildings belong to the complex of the Museum Island, which was declaRed part of the World Heritage by UNESCO in 1999: the Pergamon Museum, the Old Museum, the National Gallery, the Bode Museum and the New Museum.

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Other World Heritage Sites

A.3.10.1 – App 16: Museum Island Visitor Guide

The App follows the same interface and purchase-in strategies from the App "Sanssoussi Visitor Guide", being just a "facade" for selling other content, such as maps and information regarding each museum from the Museum Island. Regarding the WHS, the App just offers two pages for free: Introduction and History of Museum Island. There are other pages offers, about the main museums on the island, but it is needed to be purchased.

	Content Structure
	   • *Berlin (* to be purchased)*
	   • *More visitor's guides! (* to be purchased)*
	   • Introduction
	   • History of Museum Island
	   • *Altes Museum (* to be purchased)*
	   • *Neues Museum (* to be purchased)*
	   • *Alte Nationalgalerie (* to be purchased)*
	   • *Bode Museum (* to be purchased)*
	   • *Pergamon Museum (* to be purchased)*
	   • *Practical Information (* to be purchased)*
	
	Developer(s)
	   • eTips LTD
	
	Category on official App Market
	   • Education
	
	Operational System(s) and URL(s)
	   • iOS:
	     https://itunes.apple.com/de/app/museum-island-visitor-guide/id999419049?l=en&mt=8
	
	Last Update
	   • iOS: 29 September 2016 (v. 1.2)

Museum Island Visitor Guide – Main Screen	

Table App 16: *Museum Island Visitor Guide – Technical Info*

a) Layout

For the available free content, the App shows long texts for each section with vertical scrolling, with the possibility to access a respective photo gallery. It offers a static map on its initial screen, but it needs to be purchased. On introduction article, there is a static map of the island in the photo gallery.

b) Navigation

The App presents a navigation bar with all the sections available, causing a horizontal scrolling, putting the WHS pages hidden from the initial screen.

As in other *eTips LTD* Apps, once opened an article, the navigation bar changes three options, with icon and text: back, info (text) and images (photo gallery), presenting the same design flaws as mentioned at *Sanssouci Visitor Guide* App.

c) Design

The App maintains a consistent design on its sections, utilising a clean design with limited colours and limited font types. The use of icons on the articles helps to understand the available options.

d) Content

The use of long texts may not ideal for location-based content. It is clear that the main objective of the App is to sell articles and map about the Museum Island, then offering good content for the users who downloaded the App.

One positive feature is immediate feedback on the article navigation menu, changing colours of the icons according to the displayed content.

e) Features and media

- Long Text

- Photo Gallery

- Map Static (* to be purchased)

- AR (* to be purchased, and not clear if it is about Potsdam or Berlin)

A.3.11 – Garden Kingdom of Dessau-Wörlitz / Gartenreich Dessau-Wörlitz

The Garden Kingdom of Dessau-Wörlitz is located in the Middle Elbe Region, and it was included in the WHS list in 2000 for being an example of designed landscape influenced by the 18th century Enlightenment, presenting a diverse style buildings, parks and gardens, developed under the reign of Prince Leopold III Friedrich Franz of Anhalt-Dessau ("Garden Kingdom of Dessau-Wörlitz – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Nature, Garden & Landscape

A.3.11.1 – App 17: WelterbeRegion

The App offers several tours for the Middle Elbe Region. Despite being named as "WelterbeRegion" which can be translated as "World Heritage Region", the App is not focused on any particular WHS route, by offering a diverse set of routes that may – or not – cover all the WHS places in the region. One curious fact about the App is offering information regarding the Bauhaus site in Dessau and Luther in Wittenberg, without mentioning these sites in the name and description, being in this way, out of the App selection those sites.

WelterbeRegion – Main Screen	**Content Structure** • Luther, Wein und Gartenreich (Luther, wine and garden) • Auf Grand Tour am Eichenkranz (On Grand Tour on the Eichenkranz) • Charme, Courage & Contenance (Charm, Courage & Countenance) • Höflischer Klang und Volkes Gesang (Sound and folk song) • Erscheint demnächst (Coming soon) **Developer(s)** • Perspektivmedien UG Berlin **Category on official App Market** • Travel **Operational System(s) and URL(s)** • iOS: https://itunes.apple.com/de/app/welterberegion/id1088698503?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=me.cultain.welterberegion **Last Update** • iOS: 14 March 2016 (v. 1.0) • Android: 08 March 2016 (v. 1.0)

Table App 17: WelterbeRegion – Technical Info

a) Layout

The App mixes a tour with encyclopaedia format, creating long texts with images and links support. The layout maintains its consistency between the pages, facilitating the navigation once masteRed by the user.

b) Navigation

The navigation is quite confusing, offering different levels of information. There is no navigation bar visible, being accessed by the "back" physical Android button, which in this case does not correspond for the standard Android back function. Here a suggestion would keep this hidden menu accessible by the "menu" Android button, and leaving the "back" to its original purpose.

Actually, there is no "back" option in the App. Once the hidden navigation bar is accessed the user can go to another section or keeping the current one, but no backing one step is available.

c) Design

The design is clean with few colours used, with the white colour as pRedominant in the layout. Once in a chosen tour, icons appear along with the long texts, leading to complementary information about persons and locations. Here the icons appear without any explanatory text, leading to the user to discover where the symbol will lead.

d) Content

On its initial page, the App explains in one sentence what is its objective, by "Spielend durch die WelterbeRegion: Anhalt – Dessau – Wittenberg", which could be translated as "Playing through the World Heritage Region: Anhalt – Dessau – Wittenberg". The App goes on long texts with options to access related information and a static map linked to POI titles (and thumbnails in some cases).

e) Features and media

- Long Text

- Photo

- Map Static

A.3.12 – Zollverein Coal Mine Industrial Complex in Essen / Industriekomplex Zeche Zollverein in Essen

The Zollverein is a coalmining complex situated in Essen, added to the WHS list in 2001 for being an example of "development of traditional heavy industries in Europe" ("Zollverein Coalmine Industrial Complex in Essen – Deutsche UNESCO-Kommission," n.d.). From the period of activities, the Zollverein was the largest and most modern coal processing plant, until its closure in 1986.

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Industrial Heritage

A.3.12.1 – App 18: UNESCO-Welterbe Zollverein App

The App refers directly to the WHS, offering directions and information for visitors. It has the same interface for iOS and Android OS.

UNESCO-Welterbe Zollverein App – Main Screen

Content Structure
- Orientierung (Orientation)
- Orte (Places)
- Angebote (Deals)
- Besucherinfos (Visitor Info)
- Business
- Social Media
- Info

Developer(s)
- GeoMobile GmbH
- © Stiftung Zollverein

Category on official App Market
- Travel

Operational System(s) and URL(s)
- iOS:
  https://itunes.apple.com/de/app/unesco-welterbe-zollverein/id627887691?l=en&mt=8
- Android:
  https://play.google.com/store/apps/details?id=de.geomobile.zollverein

Last Update
- iOS: 05 April 2013 (v. 1.0)
- 18 April 2013 (v. 1.0)

Table App 18: *UNESCO-Welterbe Zollverein App – Technical Info*

a) Layout

The main keep visual consistency between its sections and OS versions, despite the dated GUI applied (due to its last update, dated in April 2013). When the Apps open, it places all the options on the same screen; afterwards, it presents vertical scrolling for the contents.

b) Navigation

The App is clear on its linear navigation, substituting the initial screen options by a top navigation bar with "back" and content related options (varying according to the respective sections), meaning going back and forth in its content levels. For articles, the top navigation bar options are a "compass", a static map or GPS map, and an augmented reality feature to navigate to the respective site.

c) Design

The use of colours is limited, with the pRedominance of black colour as a background. The design is simple but dated due to its age.

The App also uses icons on the navigation bar, but without any previous or present explanation. The user needs to discover where the symbols will lead.

d) Content

The App varies in long and short texts, according to the sections. Despite having a "social media" page in it, it just goes to the official sites in social media applications, such as Facebook, Twitter, Instagram, Google +, Pinterest and Vimeo, not offering any participation activity (share, upload, etc).

e) Features and media

- Long Text
- Photo
- Map Static
- Map GPS
- AR

A.3.13 – Historic Centres of Stralsund and Wismar / Altstädte von Stralsund und Wismar

The Historic Centres of Stralsund and Wismar were added to the WHS list in 2002, due its importance in the Hanseatic League in Baltic Sea region, during 14th and 15th centuries, with a well-conserved medieval old town, taking as highlight the buildings with Brick Gothic style ("Historic Centres of Stralsund and Wismar – UNESCO World Heritage Centre," n.d.)

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Historical Town Centres

A.3.13.1 – App 19: Wismar Tourist Guide

The App is focused just in Wismar, and not Stralsund, being developed in partnership with the Ostsee-Zeitung. It is a generic tourist guide, without emphasis on WHS, despite it is possible to find the world UNESCO on its description at the official App market. The WHS information is accessible after entering the "Wismar" option at the main screen.

Wismar Tourist Guide – Main Screen	**Content Structure** • Wismar • Wellness • Worth Seeing • Mobility • Culture • Information • Gastro • Weather • Stay • Imprint • Shopping • Bookmark • Experience • Settings • Activity • Home • Family • Close to it **Developer(s)** • ars publica Marketing GmbH • © OSTSEE-ZEITUNG GmbH & Co. KG **Category on official App Market** • Travel **Operational System(s) and URL(s)** • iOS: https://itunes.apple.com/de/app/wismar-tourist-guide/id953797001?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=com.arspublicaruegen.wismar&rdid=com.arspublicaruegen.wismar **Last Update** • iOS: 18 December 2016 (v. 2.1.0) • Android: 17 February 2017 (v. 2.1.1)

Table App 19: Wismar Tourist Guide – Technical Info

a) Layout

The initial screen has all the navigation options fit without the need for vertical scrolling. Once an option is chosen, the content goes on long pages. The layout maintains consistency between its sections.

b) Navigation

The App is not focused on WHS content, but it appeaRed in the list using the described search strings. The user needs to tap on "Wismar" and them after scrolling, tap on "UNESCO wold heritage" option, opening a singular screen about the WHS with long text and no images, despite it is possible to find information about the old town buildings in other sections. The App offers several levels of information, that may not clear for the user, although there is

always the main navigation bar visible with two options: home and close to it (with a list of POI with marked distance).

c) Design

The App maintains a limited range of colours on its main navigation, but inside the content, it adds other ones. It has a simple design allied by the use of icons combined with text on its navigation and inside article options.

d) Content

The articles use long texts with some links to external websites to support the content. On the articles, it is possible to find a gallery of photos, but once accessed it just displays a picture on a black background screen, without any text to explain. The App is web-based content, that sometimes demands to the user to "reload" it, in order to access the content.

The App offers a "close to it" option, similar to "near me" available on other Apps, open access to directions and GPS map.

e) Features and media

- Long Text
- Photo Gallery
- Video
- Map GPS

A.3.14 – Upper Middle Rhine Valley / Oberes Mittelrheintal

The Upper Middle Rhine Valley consists of an extension of 65km along the Rhine river, between Bingen, Rüdesheim, and Koblenz, with "its castles, historic towns and vineyards, graphically illustrates the long history of human involvement with a dramatic and varied natural landscape" ("Upper Middle Rhine Valley – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Nature, Garden & Landscape

A.3.14.1 – App 20: Rheintour DE

The App provides an audio tour through the WHS along the Rhine (Rhein) River. It is a paid App available on both OS, but unfortunately, the iOS version is not functional.

  Rheintour DE – Main Screen	Content Structure • Sehenswürdigkeiten (Sightseeing) • Tour • GoogleMaps • Einstellungen (Settings) • Info • Hilfe (Help) • Teilen (Share) • Loreley rockt (Rocking Loreley) • Foto Machen (Take Picture) • Galerie (Gallery) • Rheintour Blog Developer(s) • TaleTekk UG Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/rheintour-de/id905718758?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=ams.dradda.rheintour Last Update • iOS: 15 August 2014 (v. 1.5) • Android: 19 July 2015 (no version information)

Table App 20: *Rheintour DE – Technical Info*

a) Layout

The App has no consistency in its layout, by presenting a different content format for each available section. Sometimes it displays a short text with white background, sometimes a long text with a colourful background, on other parts no text at all, with no other displayed information.

b) Navigation

The navigation is very confusing, marking the user interacting in different ways on its content. The menu is hidden by a "hamburger menu", that just appears on the initial screen, forcing the user to use the "Android back button" to navigate back and forth. It offers navigation options based on a customised Google Map, with two navigation options: open directly in other Google Map screen, or "directions" function.

The App offers to swap action on the gallery, but without any content context regarding the displayed photos.

c) Design

The use of colours changes from different sections inside the app, applying in some cases a minimalistic design (just short text with white background), but also some polluted design (with colour and image behind long texts).

d) Content

The App relies on audio to explain the sites. The tour option is available but has no visual feedback about how it is supposed to work. The alternation of short and long texts shows a not organized content structure where the user has no idea about what is expected on each available option.

e) Features and media

- Short Text

- Long Text

- Photo Gallery

- Audio

- Map Static (initial screen)

- Map GPS
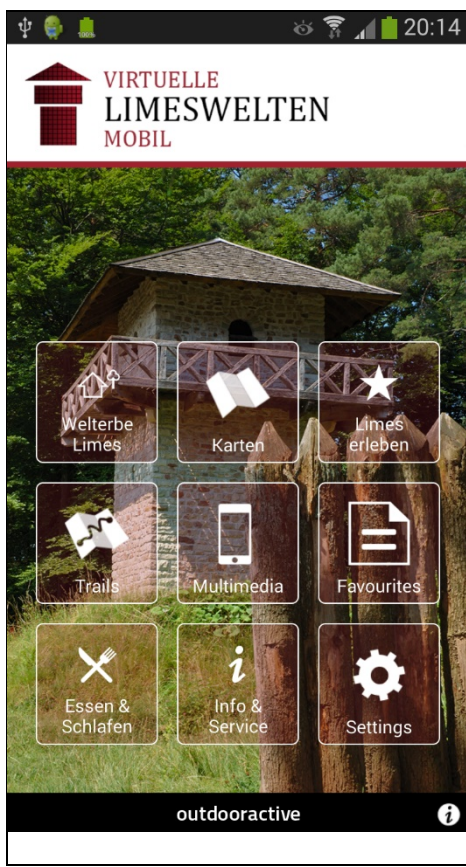
A.3.15 – Frontiers of the Roman Empire: Upper German-Raetian Limes / Grenzen des Römischen Reiches: Obergermanisch-raetischer Limes

The Frontiers of the Roman Empire, known also as 'Roman Limes', feature the border of the Roman Empire back in the 2nd Century AD. In Germany, the two sections "cover a length of 550 km from the north-west of the country to the Danube in the south-east" ("Frontiers of the Roman Empire – UNESCO World Heritage Centre," n.d.), being the longest monument in Europe ("Frontiers of the Roman Empire: Upper German-Raetian Limes – Deutsche UNESCO-Kommission," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Other World Heritage Sites

A.3.15.1- App 21: Virtuelle Limeswelten mobil

The App provides information and navigation regarding the Roman Limes, but also for other activities surrounding these monuments, associated with the touristic offices of the region. The App is related to the website http://limeswelten.de/, where some of the content, such as animations, are used in the App content.

	Content Structure
Virtuelle Limeswelten mobil – Main Screen	• Welterbe Limes (Limes World Heritage) • Karten (Maps) • Limes erleben (Limes Experience) • Trails • Multimedia • Favourites • Essen & Schlafen (Eat & Sleep) • Info & Service • Settings • More (* on bottom of the screen) Developer(s) • Outdooractive GmbH & Co. KG Category on official App Market • Travel Operational System(s) and URL(s) • Android: https://play.google.com/store/apps/details?id= de.alpstein.alpregio.Limes Last Update • Android: 17 June 2015 (v. 1.7.12)

Table App 21: *Virtuelle Limeswelten mobil – Technical Info*

a) Layout

Some pages show the content in one screen, but most of the text use vertical scrolling. The App varies its layout from different sections, not following a rigid consistency.

b) Navigation

On its first time, the App presents a dialogue explaining some functions and download options for offline use. The App is very straight on the WHS information, putting emphasis on Roman Limes content, but also offering other touristic services.

The navigation changes according to the chosen sections, sometimes presenting an action menu on top with content related options, such as Maps, Details, Distance, Quality and others, depending on the content. The navigation options are based on text, with no icon support (except the initial screen).

c) Design

The design uses several colours, without any particular reason for it. The design can be considered simple, as it is just based on the text for its navigation.

d) Content
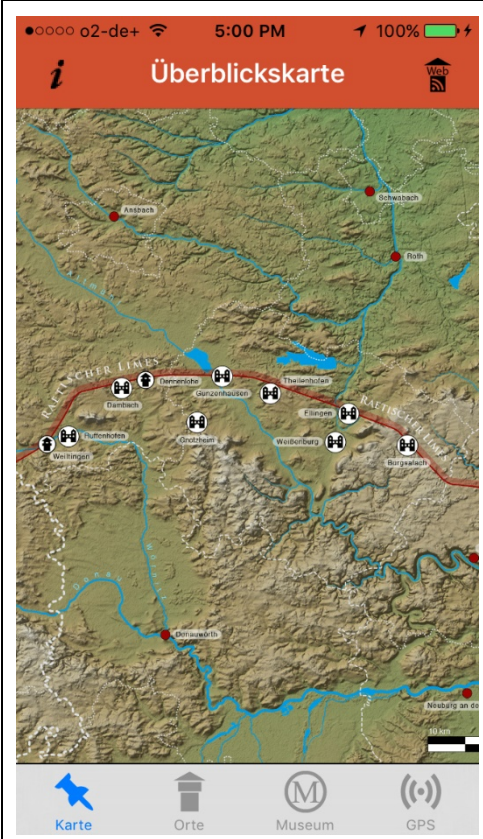
Besides long text pages, the App also offers audio and video (animations) about the Roman period. It provides good feedback on all actions, highlighting the tapped options or information regarding content download options/situation. The App also offers external links to support its contents.

e) Features and media

- Long Text
- Photo Gallery
- Audio
- Animation
- Map Static
- Map GPS

A.3.15.2 – App 22: Limes Mittelfranken Mobil

The App was developed to promote the WHS places in middle Franconia (Mittelfranken), offering video, audio and text formats to guide its users. On its iOS version, is also placed the museum's information in the region.

	Content Structure
	• Karte (Map)
	• Orte (Places)
	• Museum (just on the iOS version)
	• GPS
	• Info
	• Web
	Developer(s)
	• edufilm und medien Ges.mbH (iOS)
	• P.medien GmbH (Android)
	Category on official App Market
	• Travel
	Operational System(s) and URL(s)
	• iOS: https://itunes.apple.com/de/app/limes-mittelfranken-mobil/id610299032?l=en&mt=8
	• Android: https://play.google.com/store/apps/details?id=com.mainlimes
	Last Update
Limes Mittelfranken Mobil – Main Screen	• iOS: 10 December 2015 (v. 2.0)
	• Android: 30 August 2015 (v. 1.0)

Table App 22: *Limes Mittelfranken Mobil – Technical Info*

a) Layout

The App presents small changes in its interface on different OS, not related to the GUI which each OS recommend. On the iOS version, there is a "museums" option, missed on the Android version, although the layout is very consistent between the sections.

b) Navigation

The App is very direct on its approach, showing a static map with links direct to WHS POI. The navigation menu is always present on the bottom. On there is a secondary navigation bar that changes according to the chosen content, which helps on the access and navigation to further levels.

c) Design

The design is simple with limited use of colours, maintaining this consistency along the sections. The use of icons combined with text makes the bottom navigation bar self-explained.

d) Content

The articles are built with long texts combined with several other support media (accessible by icons inside the text) making the articles a bit long, with the need for vertical scrolling.

e) Features and media

- Long Text
- Photo
- Audio
- Video
- Map Static
- Map GPS

A.3.16 – Berlin Modernism Housing Estates / Siedlungen der Berliner Moderne

The Modernism Housing Estates in Berlin were implemented between 1910 – 1933, combining urbanism, architecture, garden design and social standards concepts from modernism movement, with the participation of leading architects such as Bruno Taut, Martin Wagner and Walter Gropius. The six selected house states were built using iron, glass and concrete taking in consideration the improvement of living conditions of people with low income, becoming an example on housing developments ("Berlin Modernism Housing Estates – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Other World Heritage Sites

A.3.16.1 – App 23: Gropius to Go (Architekturführer der Moderne)

The App was developed by the federal state of Berlin, and it is focused on the architectural legacy of Walter Gropius placed in Berlin and its surroundings. The App also provides information regarding other architects and buildings from the modernist movement, by offering several tours in Berlin.

 Gropius to Go – Main Screen	Content Structure • Themen (Topics) • Karte (Map) • Touren (Tours) Developer(s) • Land Berlin Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/gropius-to-go-architekturf%C3%BChrer-der-moderne/id1163814466?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=de.berlin.gropiustogo Last Update • iOS: 14 November 2016 (v. 1.1) • Android: 07 November 2016 (v. 1.1)

Table App 23: *Gropius to Go – Technical Info*

a) Layout

The App is very similar on both OS and very consistent on its sections. Apart from the Map, basically, all the pages present vertical scrolling. The App presents good font-size for reading and navigate.

b) Navigation

The navigation bar is always present on the bottom; on top, there is another bar offering options according to the content, varying on back, compass, map and others. The top bar helps on further navigation inside the available content, normally on back and forth actions.

Although it is possible to find the Berlin Housing States inside the app, it is not focused on UNESCO WHS, but on Gropius legacy. This difference may demand further navigation to find WHS information.

c) Design

The design is very clean, with limited use of colours. The use of icons is very discreet, limited to content options placed on the top mar, such as map or compass, without any text to support these function (although the icons are quite self-explained).

d) Content

The articles are based on long texts, normally with a picture of the location/building on top. On the map, there are two colours of pointers: Red for buildings from Gropius, and Blue for tour-circuits.

e) Features and media

- Long Text
- Photo
- Map GPS

A.3.17 – Prehistoric Pile dwellings around the Alps / Prähistorische Pfahlbauten um die Alpen

The Prehistoric Pile dwellings around the Alps is a WHS divided in 111 small individual sites spread in Germany, Switzerland, Austria, Slovenia, France and Italy. These sites "encompasses the remains of prehistoric pile-dwelling (or stilt house) settlements in and around the Alps built

from around 5000 to 500 B.C." ("Prehistoric Pile dwellings around the Alps – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Other World Heritage Sites

A.3.17.1 – App 24: Palafittes Guide

The App was developed by a Swiss company, focusing on showing the prehistoric Pile WHS in Switzerland, but it also presents POIs in other countries, such as Austria, France, Slovenia, and Germany. It is an audio-based guide but presents also text as support content regarding the WHS and related museums in different locations along the Alps.

	Content Structure
 Palafittes Guide – Main Screen	- Welcome - News - Map - Knowledge (Play/Mute Sound) Developer(s) - Texetera Category on official App Market - Education Operational System(s) and URL(s) - iOS: https://itunes.apple.com/de/app/palafittes-guide/id433162169?l=en&mt=8 - Android: https://play.google.com/store/apps/details?id=com.applica.palafittes Last Update - iOS: 16 June 2016 (v. 2.1) - Android: 26 April 2013 (v. 1.2)

Table App 24: Palafittes Guide – Technical Info

a) Layout

The App presents a similar interface on both OS, with the basic difference of placing the navigation bar on the bottom at iOS, and on top of the Android version. For the pages based on text, it normally demands vertical scrolling; for the audio ones, all the content is placed in one screen. The App keeps consistency on all the sections and OS versions, with a similar format.

b) Navigation

The navigation is very linear, based on back and forth actions. It is not clear how many levels of information is available, making the user tap and discover its contents. Despite the navigation menu uses icon associated with the text, the sections are not well described, the open margin for interpretation from the user about what each part of the App is about.

c) Design

The layout is a bit dated, using previous iOS GUI (as gradient background colour on bars), replicated on its Android version. The design uses several colours, giving a polluted impression. The use of bright colours does not give enough contrast, if it is in use in outdoor under the sun.

The use of icons to support the navigation is positive, despite the chosen ones can be hard to understand by it selves (i.e: exclamation mark in two of them).

d) Content

The App alternates between text and audio sections, using a different layout on both cases. It has no information at the initial screen, just a sea / under-the-water sound, making it a bit useless and forcing the user to add one more tap to achieve WHS information.

The map is very confusing, showing two different icons without any explanation and very agglutinated on the first view. The user needs to zoom in to differentiate the POIs, in order to be able to properly tap on the chosen option.

A positive aspect in the layout is the constant feedback when downloading audio, and showing on the navigation bar where you are in the App.

e) Features and media

- Long Text

- Photo

- Audio

- Map GPS

A.3.18 – Bergpark Wilhelmshöhe

Marked by a giant Hercules statue and its hydro-pneumatic devices, the Bergpark Wilhelmshöhe enteRed the WHS list in 2013. "The great size of the park and its waterworks along with the towering Hercules statue constitute an expression of the ideals of absolutist Monarchy while the ensemble is a remarkable testimony to the aesthetics of the Baroque and Romantic periods" ("Bergpark Wilhelmshöhe – UNESCO World Heritage Centre," n.d.)

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Nature, Garden & Landscape

A.3.18.1 – App 25: Bergpark

The App was developed by a private company on behalf of the Kassel city. The App guides the user along the park and its attractions. The App maintains the same structure and similar design on both OS versions, with small variations.

	Content Structure
Bergpark – Main Screen	• Wilkommen (Welcome) • Karte (Map) • Seheswertes (Sightseeing) • Service • Anreise (Getting There) • Allgemeine Informationen (General Information) • Schloss Wilhelmshöhe (Castle Wilhelmshöhe) • Herkules (Hercules) • Wasserspiele (Fountains) • Impressum (Imprint) Developer(s) • Softwarehaus-Kassel GmbH • © Stadtverwaltung Kassel Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/bergpark/id537206857 ?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=de.softwarehauskassel.bergpark&rdid=de.softwarehauskassel.bergpark Last Update • iOS: 14 March 2017 (v. 1.5.5) • Android: 22 June 2017 (v. 1.3.3)

Table App 25: *Bergpark – Technical Info*

a) Layout

The App uses long texts on its articles, leading to the user of vertical scrolling. The layout is similar on both OS versions, with some differences related to each GUI standards. The App maintains a layout consistency on its sections.

b) Navigation

The App is very direct to the WHS attractions, with shortcuts from its initial screen. The navigation bar combines the use of icon and text, making it self-explained. The App works also on back and forth basis, with a top auxiliary bar with back and map options.

c) Design

The App keeps a clean style, with a low range of colours and simple design. The use of icons on the navigation menu reinforce the section division. The map uses an own graphic style, with icons and signs that are explained in another page, accessible by *"Informationen"* link on the top bar. Still regarding the map, the chosen style may mislead it as a static map, but it is a GPS based one, with content links spread on its screen.

d) Content

The articles related to the WHS locations utilises long text, with a photo gallery afterwards that can be navigated by swapping the images without changing page. The App provides links for support material, including contact e-mails.

On both OS the App provides feedback about where the user is, by highlighting the selected option on the navigation menu.

e) Features and media

- Long Text
- Photo Gallery
- Map GPS

A.3.19 – Carolingian Westwork and Civitas Corvey / Karolingisches Westwerk und Civitas Corvey

The Carolingian Westwork and Civitas Corvey were added to the WHS list in 2014, being erected between 822 and 885 AD. **"**The Westwork is the only standing structure that dates back to the Carolingian era, while the original imperial abbey complex is preserved as archaeological remains that are only partially excavated" ("Carolingian Westwork and Civitas Corvey – UNESCO World Heritage Centre," n.d.).

- UNESCO Classification: Cultural Heritage
- GNTB Classification: Churches & Abbeys

A.3.19.1 – App 26: Corvey

It is a historical audio-guide app, showing no articles or text. It is possible to access the Ground Plan of the Corvey and access its respective audios. Together with the audio player, it is possible to access a photo gallery about the displayed content.

Corvey – Main Screen	Content Structure • Start • Guide • Grundriss (Ground Plan) • Service Developer(s) • Pausanio GmbH & Co.KG Category on official App Market • Travel Operational System(s) and URL(s) • iOS: https://itunes.apple.com/de/app/corvey/id849683678?l=en&mt=8 • Android: https://play.google.com/store/apps/details?id=de.pausanio.schlosscorvey Last Update • iOS: 09 April 2014 (v. 1.1) • Android: 01 April 2014 (v. 1.0)

Table App 26: *Corvey – Technical Info*

a) Layout

The App is an audio-based guide, without content in text format, placing all the content in one screen when the audio is playing. Apart from the audio player, the App uses vertical scrolling for the rest of the content; the same goes to the Grundriss, creating scrolling also horizontally. The App is almost identical on both OS, keeping also consistency on its sections.

b) Navigation

The navigation is linear based on a pre-defined path inside the Corvey building. The user has the liberty to play the audios in whatever order, but as it is part of a tour the audios are ordeRed in a walking sequence. The App is very straight on its structure, once an audio ends it goes automatically to the previous guide screen with all the available audios, which makes one less tap to the user.

The navigation bar is always present, with self-explanatory options. Once the audio is chosen, a top bar appears with a back action option. The App also offers an internal static map, with the audio POIs signalised (linked to its respective contents), but it is not possible to zoom in/out on this map.

c) Design

The design is very clean, with few colours and allying icon and text for the navigation menu.

d) Content

The audio parts have no supporting text, which could be a nice feature for people with hearing difficulties or even without a headphone (for a discreet hearing); the only support material for the audios is a photo gallery, without any further explanation. There is no explanation on its initial screen, but the available options are very direct on what is available as content.

The App signalises on the navigation bar about where you are on it, highlighting the chosen option in a different colour.

e) Features and media

- Long Text
- Photo Gallery
- Audio
- Map Static
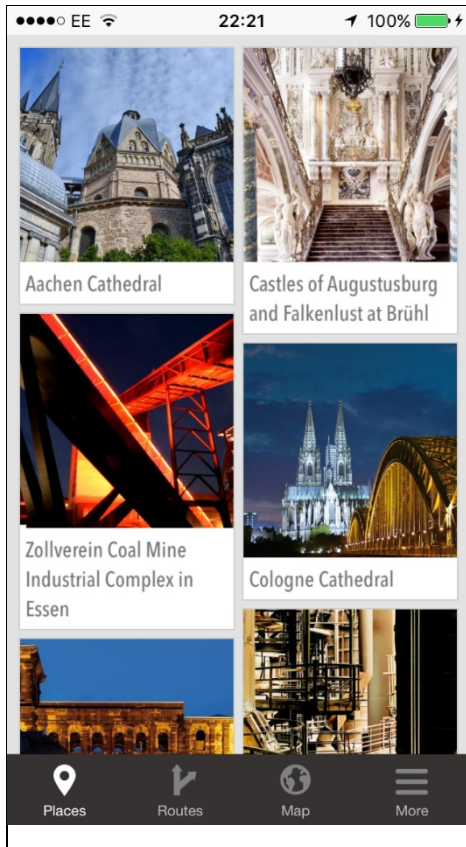
A.3.20 – World Heritage Site / Welterbe

The next Apps felt into the search string "World Heritage Site + Germany" and "Welterbe + Deutschland". Usually, they englobe all the official WHS in Germany, addressing to the sites in a general/introductory view.

A.3.20.1 – App 27: Welterbe – Guide to Germany

The App is the official guide to all the UNESCO world heritage sights in Germany. It was developed by a Danish company on behalf of the German National Tourism Board – GNTB ("Work | UNESCO World Heritage Sites in Germany," n.d.).

The fact that the GNTB works on behalf of the German Federal Government to promote internationally Germany as a travel destination ("The GNTB," n.d.), makes this App a highlight on the available ones.

Welterbe – Main Screen

Content Structure
- Places
- Routes
- Map
- More
- (Shortcut to all available WHS)

Developer(s)
- Triptale ApS

Category on official App Market
- Travel

Operational System(s) and URL(s)
- iOS:
  https://itunes.apple.com/de/app/welterbe-travel-guide-to-germany/id765568889?l=en&mt=8
- Android:
  https://play.google.com/store/apps/details?id=com.everplaces.welterbe

Last Update
- iOS: 30 August 2016 (v. 1.5)
- Android: 07 September 2017 (no version info)

Table App 27: *Welterbe – Technical Info*

a) Layout

The App maintains its structure on both OS, with some design changes. In this case, the advantage of the iOS version is the icon-based menu accompanied with text, making less abstract the navigation options. On another hand, the share and direction possibilities are more clear on the Android version.

b) Navigation

The App shows all the WHS on its initial screen, being very direct on the content approach regarding the official sites. The navigation bar resumes all the sections available, facilitating access to the content options.

On the iOS version, once a WHS is chosen, the navigation bar is substituted by another one, with "back", "share" and "directions" options. At the Android one, the navigation bar is substituted by a "back" option, with the shaRed possibility inside the content; the "directions" option is presented very discreetly at the final of the article. On this secondary navigation bar, the iOS version more in evidence and direct.

c) Design

The design is very clean with limited colours used. There are two main changes between the OS, on iOS the navigation bar is on the bottom, on Android, it is on top. On the initial screen, all the WHS link images have the same size, on iOS it changes according to the length of the WHS name.

d) Content

The App used to provide a gallery with shaRed photos on Instagram using the tag #welterbegermany, but this feature was sacked out on the last update. A positive feature is providing routes using more than one German WHS. At the end of each WHS article, the App gives directions and contact possibilities.

A very positive feature is the "Routes", providing theme-based tours using more than one WHS, such as "Visionaries and pioneering thinkers" including the "Housing Estates in the Berlin Modern Style", "Luther Memorials in Eisleben and Wittenbergg", "Bauhaus and its Sites in Weimar and Dessau" and "Wartburg Castle".
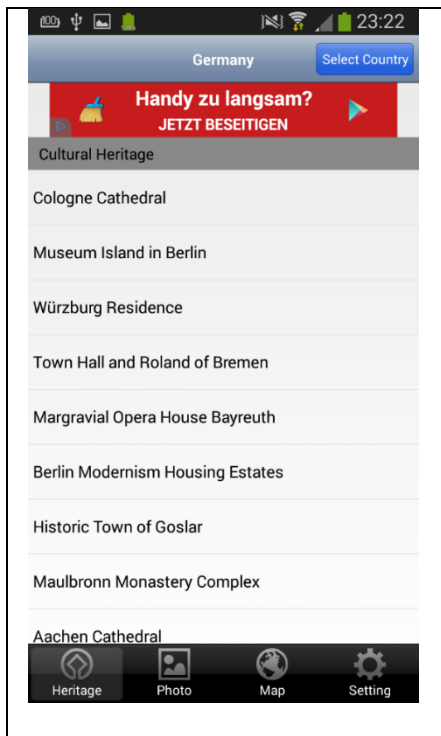
e) Features and media

- Log Text

- Photos

- Map GPS

A.3.20.2 – App 28: World Heritage in Germany

The App curiously is placed at the category "Tools" in the App Market, different from "Travel" or "Education" as the others. The App has an old-iOS style, despite being available just for Android. The App proposes to cover the WHS in Germany, but those included after 2014 in the UNESCO list are not present in it, despite its last update was in June 2015.

The App provides general information about the WHS spread in Germany, not giving directions or further contact information.

World Heritage in Germany – Main Screen	Content Structure • Heritage • Photo • Map • Settings • (Shortcut to some – not all – available WHS) Developer(s) • Qizhi Inc. Category on official App Market • Tools Operational System(s) and URL(s) • Android: https://play.google.com/store/apps/details?id=com.qizhi.worldheritagege Last Update • Android: 28 June 2015 (v. 1.2)

Table App 28: *World Heritage in Germany – Technical Info*

a) Layout

The App is web-based content, with some load problems, such as in the Map section – where it displays the WHS POIs, but not the map per se. It also includes an Advertising banner, which decreases its already dated interface value.

The App utilises long texts, with the option to load more paragraphs, supported by an available photo gallery on a different page. The App maintains visual consistency between the pages, applying the same structure for each respective sections available.

b) Navigation

The navigation bar is always present, with a WHS list on the main screen making access to the official sites very direct. Once a location is chosen, a second navigation bar appears on the top with the options "back" and "photos" (a respective photo gallery with swapping action enabled).

On the main screen, there is an option on top to change the country, opening option to download another country with WHS.

c) Design

The App uses different colour background for the navigation bar (black) and top bar (gradient). The constant advertisement banner changes its colours and sometimes blinks, making the design very polluted.

The use of icons associated with text on navigation menu makes the sections self-explanatory.

d) Content

The positive point of this App it is the possibility to access WHS from other countries, on another hand it is not 100% updated regarding the German ones, missing the WHS added after 2014. For being a web-based app, this missing information is a quite negative aspect.
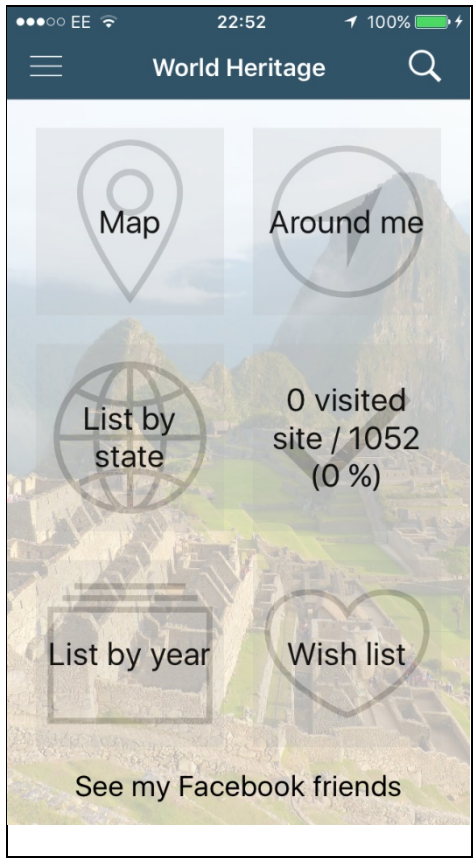
On the photo gallery, it repeats some mistakes already written, such as displaying an image without any information regarding the building/monument.

e) Features and media

- Long Text

- Photos

- Map GPS

A.3.20.3 – App 29: world heritage – The UNESCO World Heritage sites

The main objective of this App is to show all the WHS spread on the planet. Basically, what this App does is reproducing all the content available at the official UNESCO WHS website, using its texts, photos and GPS locations. What this App fails in design, it succeeds in content, despite its obvious plagiarism.

world heritage – Main Screen
	Content Structure
	    • Map
	    • Around Me
	    • List by state
	    • # visited site
	    • List by year
	    • Wish list
	    • * See my Facebook friends
	
	(on the top bar)
	    • Search World Heritage
	    • Menu (with all section options)
	
	Developer(s)
	    • Florian Gerus
	
	Category on official App Market
	    • Reference
	
	Operational System(s) and URL(s)
	    • iOS: https://itunes.apple.com/de/app/world-heritage-the-unesco-world-heritage-sites/id1056312221?l=en&mt=8
	
	Last Update
	    • iOS: 12 June 2017 (v. 10.1)

Table App 29: *world heritage – Technical Info*

a) Layout

The App maintains all the content in one page, creating an internal vertical scrolling for the text, keeping the navigation on top, text in middle, and location & photo(s) on bottom. As it aims to address to all WHS existent, it maintains the same layout to all pages.

b) Navigation

The App applies some Android GUI into the iOS, as using the navigation bar on top with a hamburger menu opening an extended navigation menu on "google material design" style, despite this App being exclusive to iOS.

The navigation is a bit confusing, offering a different top navigation bar according to each available section, just relying on icons without any text – forcing the user to guess what each option is (despite the choice of icons be very related to their respective functions).

c) Design

The App uses limited colours, but applies image background behind the initial screen, making it appears polluted. The App also applies different font sizes on the same text, making it looks less attractive.

d) Content

The content replicates the content available from the UNESCO's website, sometimes copying all the text, sometimes just a paragraph, without any logic by this difference.

Some of the content is place at the very border of the screen, without a margin, making it difficult to read. It also includes a link to the whc.unesco.org on its very bottom, and a link to "booking.com" on its content, linked to the respective location.

e) Features and media

- Long Text
- Photo
- Map GPS

A.4 – List of selected readings for the literature review

The selection list went on 249 papers and book chapters, as listed in the sequence:

1. 10 user interface elements for mobile learning application development (Zamri and Al Subhi, 2015)

2. 3D Cultural Heritage Online; In Search of a User Friendly Interactive Viewer (Gillespie et al., 2014)

3. A comparison of visual and textual city portal designs on desktop and mobile interfaces (Pang et al., 2015)

4. A Context-Aware Usability Model for Mobile Health Applications (Kaur and Haghighi, 2016)

5. A Flexible Learning Framework for Kids (Petersen et al., 2016)

6. A framework for integrating multicultural issues in mobile health Apps design (Chi et al., 2016)

7. A heuristic checklist for an accessible smartphone interface design (Mi et al., 2014)

8. A mobile and interactive multiobjective urban tourist route planning system (Ayala et al., 2017)

9. A Multi-Modal Virtual Walkthrough of the Virtual Past and Present Based on Panoramic View, Crowd Simulation and Acoustic Heritage on Mobile Platform (L. C. Kim et al., 2016)

10. A Participatory Design Approach for a Mobile App-Based Personal Response System (Song and Oh, 2016)

11. A realistic study of user behavior for refining web usability (Mahyavanshi et al., 2017)

12. A Review of the Role of Sensors in Mobile Context-Aware Recommendation Systems (Ilarri et al., 2015)

13. A serious game model for cultural heritage (Bellotti et al., 2012)

14. A Service-Oriented Application Creation Process in Ubiquitous Environments: Travel Assistant Mobile Application (Taktak and Moussa, 2017)

15. † A Study of Mobile Guide Applications in Wayfinding Context (Chen and Chen, 2014)

16. A study on effective knowledge reuse in multi-platform web applications user interfaces (Marenkov et al., 2015)

17. A survey study to gather requirements for designing a mobile service to enhance learning from cultural heritage (Alkhafaji et al., 2016)

18. A theoretical model of mobile augmented reality acceptance in urban heritage tourism (tom Dieck and Jung, 2015)

19. Accessibility and Usability Evaluation of Rich Internet Applications (Fortes et al., 2016)

20. Accessibility to mobile interfaces for older people (Díaz-Bossini and Moreno, 2014)

21. Adapting Heuristics for the Mobile Panorama (Joyce et al., 2014)

22. Advancing Mobile Learning in Formal And Informal Settings via Mobile App Technology: Where to From Here, and How? (Khaddage et al., 2016)

23. AMuse: Connecting Indoor and Outdoor Cultural Heritage Experiences (Wecker et al., 2017)

24. An approach towards development of evaluation framework for usability of smartphone applications (Rahmat et al., 2015)

25. An Augmented Reality and 360-degree video system to access audiovisual content through mobile devices for touristic applications (Bibiloni et al., 2016)

26. An espoused cultural perspective to understand continued intention to use mobile applications: a four-country study of mobile social media application usability (Hoehle et al., 2015)

27. An Evaluation Framework for Cross-Platform Mobile App Development Tools: A case analysis of Adobe PhoneGap framework (Ahti et al., 2016)

28. An Expert-Based Framework for Evaluating iOS Application Usability (Nayebi et al., 2013)

29. An Exploratory Study on Mobile Augmented Reality (AR) Application for Heritage Content (Norsyafawati et al., 2016)

30. An exposition of current mobile learning design guidelines and frameworks (Teall et al., 2014)

31. An Interactive Mobile Augmented Reality for Tourism Objects at Purbalingga District (Tahyudin et al., 2016)

32. An investigation of the suitability of heterogeneous social network data for use in mobile tourist guides (Papadimitriou et al., 2015)

33. Analysis of Sequential Tasks in Use Context of Mobile Apps (Lee and Lee, 2016)

34. Antecedents and consequences of mobile phone usability: Linking simplicity and interactivity to satisfaction, trust, and brand loyalty (Lee et al., 2015)

35. App Design for Use -- A Manager Perspective for In-Memory Technology (Goeken et al., 2014)

36. App mining: finding the real value of mobile applications (Yu and Au Yeung, 2014)

37. App recommendation: a contest between satisfaction and temptation (Yin et al., 2013)

38. Application of Cognitive Load Theory to the Design and Evaluation of Usability Study of mHealth Applications: Opportunities and Challenges (Yang et al., 2017)

39. Apply an Augmented Reality in a Mobile Guidance to Increase Sense of Place for Heritage Places (Chang et al., 2015)

40. Augmented heritage: situating augmented reality mobile Apps in cultural heritage communication (Casella and Coelho, 2013)

41. Augmented Reality Applications in Education (Antonioli et al., 2014)

42. Augmented reality in cultural heritage: Field of view awareness in an archaeological site mobile guide (Kasapakis et al., 2016)

43. Augmented Reality Mobile Tourism Application (Pereira et al., 2014)

44. Augmenting smart objects for cultural heritage: a usability experiment (Romano et al., 2016)

45. Automated mobile user experience measurement: Combining movement tracking with App usage logging (Noldus et al., 2014)

46. Automated model-based Android GUI testing using multi-level GUI comparison criteria (Baek and Bae, 2016)

47. Beyond Smartphone Overuse: Identifying Addictive Mobile Apps (Ding et al., 2016)

48. Block Party: Synchronized Planning and Navigation Views for Neighbourhood Expeditions (Zhou et al., 2017)

49. Bodystorming with Hawkins's block: Toward a new methodology for mobile media design (Oppegaard and Still, 2013)

50. Building a Quality Mobile Application: A User-CenteRed Study Focusing on Design Thinking, User Experience and Usability (de Paula et al., 2014)

51. Can we promote sustainable travel behavior through mobile apps? Evaluation and review of evidence (Sunio and Schmöcker, 2017)

52. Characterizing Smartphone Usage Patterns from Millions of Android Users (Li et al., 2015)

53. Cityzen: a social platform for cultural heritage focused tourism (Olivieri et al., 2016)

54. Co-creation Tourism Experience in Perceived Usability of Interactive Multimedia Features on Mobile Travel Application (Lee et al., 2017)

55. Compliance of blood donation Apps with mobile OS usability guidelines (Ouhbi et al., 2015)

56. Connecting the Dots: Enhancing the Usability of Indexed Multimedia Data for AR Cultural Heritage Applications through Storytelling (Shin et al., 2017)

57. Converging Natural User Interfaces guidelines and the design of applications for older adults (Satoshi Kawamoto et al., 2014)

58. Cultural Heritage Routing: A Recreational Navigation-based Approach in Exploring Cultural Heritage (Baker and Verstockt, 2017)

59. Cyberarchaeology: improved way findings for archaeological parks through mobile augmented reality (Pierdicca et al., 2016)

60. Data Visualization in Mobile Applications: Investigating a Smart City App (Garcia et al., 2016)

61. Data-driven Mobile App Design (Deka, 2016)

62. Demystifying the design of mobile augmented reality applications (P. E. Kourouthanassis et al., 2015)

63. Design and development of mobile campus, an Android based mobile application for university campus tour guide (Bhattacharya and Panbu, 2013)

64. Design and Evaluation of Intelligent Tourist Guide System Based on Mobile Devices (Yu, 2014)

65. Design Considerations for Educational Mobile Apps for Young Children (Mak and Nathan-Roberts, 2017)

66. Design guidelines for adaptive multimodal mobile input solutions (Dumas et al., 2013)

67. Design of Mobile Phones for Older Adults: An Empirical Analysis of Design Guidelines and Checklists for Feature Phones and Smartphones (Petrovčič et al., 2017)

68. Designing Mobile Application to Motivate Young People to Visit Cultural Heritage Sites (Hiramatsu et al., 2017)

69. Designing mobile guide service for small tourism companies using user centeRed design principle (Alamäki and Dirin, 2014)

70. Designing User Experience for Mobile Apps: Long-Term Product Owner Perspective (Kuusinen and Mikkonen, 2013)

71. Destiny: A Cognitive Mobile Guide for the Olympics (Appel et al., 2016)

72. Developing a framework to evaluate usability in m-learning systems: mapping study and proposal (Cota et al., 2014)

73. Developing a ubiquitous tourist guide (Moura et al., 2013)

74. Developing Useful Mobile Applications in Cross-Media Platforms (Hermansson et al., 2014)

75. Development and Evaluation of Mobile Tour Guide Using Wearable and Hand-Held Devices (D. Kim et al., 2016)

76. Development of e-Guide App for the Holy Week (Carvalho et al., 2016)

77. Development of heuristics for usability evaluation of m-commerce applications (Ajibola and Goosen, 2017)

78. Development of Mobile Travel Guide Application for Museums (Hu and Weng, 2016)

79. Directed looking and proximal content: two concepts for designing mobile guides to historic urban places (Smith et al., 2014)

80. Efficiency, effectiveness, and satisfaction of responsive mobile tourism websites: a mobile usability study (Groth and Haslwanter, 2016)

81. Elders using smartphones–A set of research based heuristic guidelines for designers (Carmien and Manzanares, 2014)

82. Empirical study on important elements of mobile augmented reality application for heritage content (Sabri et al., 2016)

83. Enhancing community awareness of and participation in local heritage with a mobile application (Han et al., 2014)

84. Enhancing student learning of human-computer interaction using a contextual mobile application (Alnuaim et al., 2016)

85. Evaluating mobile applications for urban tourism (Peretta, 2014)

86. Evaluating the user experience of a mobile user in a smart city context (Diamantaki et al., 2015)

87. Evaluation of a Mobile Application for Multimodal Land Navigation (Calvo et al., 2013)

88. Evaluation of Health Care Icons (Drews et al., 2015)

89. Evaluation of the User Experience on Mobile Fitness Applications (Almeida et al., 2015)

90. Evaluation of Web Usability Guidelines for Teens (Bailey and Seals, 2017)

91. Evolving Heuristic Evaluation for multiple contexts and audiences: Perspectives from a mapping study (de Lima Salgado et al., 2016)

92. Examining the Usability of Touch Screen Gestures for Older and Younger Adults (Gao and Sun, 2015)

93. Examining User Experiences in a Mobile Augmented Reality Tourist Guide (Střelák et al., 2016)

94. Experimenting on the cognitive walkthrough with users (Lira et al., 2014)

95. Exploring information delivery on a guided tour using mobile projection and visual markers (Häkkilä et al., 2016b)

96. Exploring Seasonality in Mobile Cultural Heritage (McGookin et al., 2017)

97. Exploring the Affective Museum Visiting Experience: Adaptive Augmented Reality (A2R) and Cultural Heritage (Damala et al., 2013)

98. Exploring undergraduate students' usage pattern of mobile Apps for education (Wai et al., 2016)

99. Families and Mobile Devices in Museums: Designing for Integrated Experiences (Rennick-egglestone et al., 2016)

100. From proximity to accurate indoor localization for context awareness in mobile museum guides (Luca and Alberto, 2016)

101. Future of mobile human computer interaction research – A review (Nazir et al., 2014)

102. Gamification in mobile applications usability evaluation: A New Approach (Malatini and Bogliolo, 2015)

103. GeoguideRome, urban geotourism offer poweRed by mobile application technology (Pica et al., 2016)

104. Going Mobile: Defining Context for On-the-Go Travelers (Lamsfus et al., 2015)

105. Going Mobile: Guiding the Development of Safer and More Effective Mobile Access in Healthcare (Lazzara et al., 2017)

106. Guidelines for designing a smart and ubiquitous learning environment with respect to cultural heritage (Alkhafaji et al., 2017)

107. Guidelines for Evaluating Mobile Applications: A Semiotic-Informed Approach (Nicastro et al., 2015)

108. Guidelines for interface development for mobile device application for managing classes to professor for higher education design (Schulenburg and Pezzini, 2014)

109. GuideMe: An innovative mobile application for guiding tourists (Kaushalya et al., 2017)

110. Heuristic Evaluation of Mobile Usability: A Mapping Study (de Lima Salgado and Freire, 2014)

111. Heuristic Evaluation on Mobile Interfaces: A New Checklist (Yáñez Gómez et al., 2014)

112. How efficient can be a user with a tablet versus a smartphone? (Botella et al., 2014)

113. How to develop accessibility UX design guideline in Samsung (H. K. Kim et al., 2016)

114. Implementing Digital Cultural Heritage Map (Mousouris and Styliaras, 2014)

115. Integrating contexts in healthcare: guidelines to help the designers at design process (Abib and Anacleto, 2015)

116. Integrating Universal Design (UD) Principles and Mobile Design Guidelines to Improve Design of Mobile Health Applications for Older Adults (Kascak et al., 2014)

117. Integration of context-aware conversational interfaces to develop practical applications for mobile devices (Griol et al., 2017)

118. Intellectual innovative system for personalized support of tourist trips (Pasichnyk and Savchuk, 2016)

119. Investigating the appropriateness and relevance of mobile web accessibility guidelines (Poong et al., 2017)

120. Investigating the drivers of mobile learning acceptance among young adults in the World Heritage town of Luang Prabang, Laos (Poong et al., 2017)

121. Investigating the Usability of a Mobile App for Finding and Exploring Places and Events (Scherp et al., 2015)

122. Keeping in Touch – Tactile Interface Design for Older Users (Claypoole et al., 2016)

123. KIRKE: Re-engineering of Web Applications to Mobile Apps (Mehra et al., 2016)

124. Lessons learned from evaluating a mobile App out in the field (McDonald et al., 2016)

125. Leveraging Microsoft's mobile usability guidelines: Conceptualizing and developing scales for mobile application usability (Hoehle et al., 2016a)

126. Making a Cultural Visit with a Smart Mate (del Bimbo, 2017)

127. Malang historical tourism guide mobile application based on geolocation (Priandani et al., 2017)

128. Many people, many eyes: aggregating influences of visual perception on user interface design (Reinecke et al., 2013)

129. Mapping usability heuristics and design principles for touchscreen-based mobile devices (Inostroza and Rusu, 2014)

130. Maps and Location: Acceptance of Modern Interaction Techniques for Audio Guides (Wacker et al., 2016)

131. † Marketing Tips for Intelligent Dummies: A Mobile-Friendly Website (Chan, 2013)

132. MATE: a mobile analysis tool for usability experts (Porat et al., 2013)

133. Measuring the usability and capability of App inventor to create mobile Applications (Xie et al., 2015)

134. Measuring the usability of mobile applications for phones and tablets (Kortum and Sorber, 2015)

135. Method for mobile user interface design patterns creation for iOS platform (Wetchakorn and Prompoon, 2015)

136. Methodological Framework for the Design and Development of Applications for Reactivation of Cultural Heritage: Case Study Cisneros Marketplace at Medellin, Colombia (Hincapie et al., 2016)

137. Mixed-Reality Geometric Algebra Animation Methods for Gamified Intangible Heritage (Papagiannakis et al., 2014)

138. mLUX: Usability and User Experience Development Framework for M-Learning (Dirin and Nieminen, 2015)

139. Mobile access to cultural heritage: mobile-CH 2016 (Ardissono et al., 2016)

140. Mobile Application Testing: A Tutorial (Gao et al., 2014)

141. Mobile Application Usability: Conceptualization and Instrument Development (Hoehle and Venkatesh, 2015)

142. Mobile applications for natural parks: guidelines study for the development of a mobile device application (Melo et al., 2014)

143. Mobile Apps in Collection Development: Supporting a Mobile Learning Environment (Arzola and Havelka, 2015)

144. Mobile Augmented Reality Guides in Cultural Heritage (Galatis et al., 2016)

145. † Mobile Design Usability Guidelines for Outdoor Recreation and Tourism (Swierenga et al., 2014)

146. Mobile first?: understanding device usage practices in novel content sharing services (Fedosov et al., 2016)

147. Mobile guide technologies (smartphone apps): Collaborative Heuristic Evaluation (CHE) with expert and novice users (Othman et al., 2014)

148. Mobile guides: Taxonomy of architectures, context awareness, technologies and applications (Emmanouilidis et al., 2013)

149. Mobile PHRs Compliance with Android and iOS Usability Guidelines (Cruz Zapata et al., 2014)

150. Mobile recommender systems in tourism (Gavalas et al., 2014)

151. Mobile services for everyone, anywhere, at anytime: defying universality as a quality attribute (Seffah and Engelberg, 2015)

152. Mobile systems for tourism (Cantoni and Saldaña, 2016)

153. Mobile tourism: Discourse, interactivity and usability in mobile Apps for tourism (Yus, 2014)

154. Mobile tourist guide supporting a smart city initiative: a Brazilian case study (Cacho et al., 2016)

155. † Mobile usability: state of the art and implications (Gallant et al., 2014)

156. Mobile User Research: A Practical Guide (Consolvo et al., 2017)

157. Mobile Web Strategy for Cultural Heritage Tourism: A Study on Italian Opera Houses (Mich and Peretta, 2017)

158. Mobile websites: usability evaluation and design (Tsiaousis and Giaglis, 2014)

159. MobileHelper: remote guiding using smart mobile devices, hand gestures and augmented reality (Robert et al., 2013)

160. Model of augmented reality and pedestrian navigation about the territorial heritage: design, implementation and evaluation (Nagata and Giner, 2014)

161. More than Meets the Eye: The Benefits of Augmented Reality and Holographic Displays for Digital Cultural Heritage (Pedersen et al., 2017)

162. Multi-platform strategies, approaches and challenges for developing mobile applications (Gokhale and Singh, 2014)

163. Multivariate Testing of Native Mobile Applications (Holzmann and Hutflesz, 2014)

164. MUUX-E, a framework of criteria for evaluating the usability, user experience and educational features of m-learning environments (Harpur and Villiers, 2015)

165. New directions for preserving intangible cultural heritage through the use of mobile technologies (Papangelis et al., 2016)

166. Novel individual location recommendation with mobile based on augmented reality (Shi et al., 2016)

167. Offline mobile application for places identification with augmented reality (Marjury et al., 2017)

168. Older People and the Use of Mobile Phones: An Interview Study (Zainal et al., 2013)

169. On Designing UX for Mobile Enterprise Apps (Kuusinen and Mikkonen, 2014)

170. On the Design of a Responsive User Interface for a Multi-device Web Service (Voutilainen et al., 2015)

171. One Day at the Sands: Exploring Las Vegas' Intangible Heritage through Virtual Reality (Martina et al., 2015)

172. Ontology-based mobile augmented reality in cultural heritage sites: information modeling and user study (H. Kim et al., 2017)

173. Overcoming the language barrier in mobile user interface design: A case study on a mobile health App (Ross and Gao, 2016)

174. † PALEOBAS: A Geo-application for Mobile Phones–A New Method of Knowledge and Public Protection of the Paleontological Heritage of Basilicata (Southern Italy) (Lazzari et al., 2014)

175. Perceived usability, attractiveness and intuitiveness of responsive mobile tourism websites: a user experience study (Groth and Haslwanter, 2015)

176. Perception about augmented reality and mobile pedestrian navigation tools with heritage content in the field of education (Nagata et al., 2016b)

177. Performative technologies for heritage site regeneration (Betsworth et al., 2014)

178. Personalized access to cultural heritage (PATCH2014): the future of experiencing cultural heritage (Oomen et al., 2014)

179. Perspectives on usability guidelines for smartphone applications: an empirical investigation and systematic literature review (Ahmad et al., 2017)

180. PRADO: PRedicting App Adoption by Learning the Correlation between Developer-Controllable Properties and User Behaviors (Lu et al., 2017)

181. Preference, context and communities: a multi-faceted approach to pRedicting smartphone App usage patterns (Xu et al., 2013)

182. Projected Fiducial Markers for Dynamic Content Display on Guided Tours (Häkkilä et al., 2016a)

183. Scenic Athens: A personalized scenic route planner for tourists (Gavalas et al., 2016)

184. Semantic infrastructure of a smart museum: toward making cultural heritage knowledge usable and creatable by visitors and professionals (Korzun et al., 2017)

185. Set of guidelines for persuasive interfaces: organization and validation of the criteria (Némery and Brangier, 2014)

186. Skeuomorphism or flat design: future directions in mobile device User Interface (UI) design education (Page, 2014a)

187. Smart Ambient: Development of Mobile Location Based System to Support Informal Learning in the Cultural Heritage Domain (Alkhafaji and Fallahkhair, 2014)

188. Smartphone Text Input Method Performance, Usability, and Preference With Younger and Older Adults (Smith and Chaparro, 2015)

189. Something Old, Something New, Something Borrowed: gathering experts' feedback while performing heuristic evaluation with a list of heuristics targeted at older adults (Silva et al., 2014)

190. Supporting professional guides to create personalized visit experiences (Ardito et al., 2016)

191. Survey Guidelines in Software Engineering: An Annotated Review (Molleri et al., 2016)

192. SUSApp: A Mobile App for Measuring and Comparing Questionnaire-Based Usability Assessments (de Castro and Macías, 2016)

193. The design guidelines of mobile augmented reality for tourism in Malaysia (Shukri et al., 2017)

194. The Google Cultural Institute: Tools for Libraries, Archives, and Museums (Adamczyk, 2015)

195. The impact of mobile tour information services on destination travel intention (J. Y. Kim et al., 2017)

196. The impact of natural utilization of traditional Chinese cultural elements on the user experience in mobile interaction design (Lei et al., 2015)

197. The Internet of Cultural Things: Towards a Smart Cultural Heritage (Chianese et al., 2016)

198. The Mobile App Usability Inspection (MAUi) Framework as a Guide for Minimal Viable Product (MVP) Testing in Lean Development Cycle (Cheng, 2016)

199. The PAediatric Risk Assessment (PARA) Mobile App to Reduce Postdischarge Child Mortality: Design, Usability, and Feasibility for Health Care Workers in Uganda (English et al., 2016)

200. The port of Sheffield: Co-creation in mobile application development for place-based interaction with large-scale urban heritage sites (Park and Peng, 2016)

201. The Role of Augmented Reality for Experience-Influenced Environments: The Case of Cultural Heritage Tourism in Korea (Chung et al., 2017)

202. The Way It Used to Be: Exploring Cultural Heritage through the Augmented Reality Story of a Neighborhood Soul Food Restaurant (Bartley et al., 2016)

203. THERE'S AN App FOR THAT: Using smartphone App design to engage students in biological ecosystems (Bowen and Finch, 2014)

204. Time-Travelling with Mobile Augmented Reality: A Case Study on the Piazza dei Miracoli (Duguleana et al., 2016)

205. To the Castle! A comparison of two audio guides to enable public discovery of historical events (FitzGerald et al., 2013)

206. Touchscreen mobile devices and older adults: a usability study (Page, 2014b)

207. Tourism Mobile Application Usability: The Case of iTicino (Inversini and Violi, 2013)

208. Tourists responses to mobile augmented reality travel guides: The role of emotions on adoption behavior (P. Kourouthanassis et al., 2015)

209. Tourists' Attitudes toward Proactive Smartphone Systems (Tussyadiah and Wang, 2016)

210. Toward a New Model of Usability: Guidelines for Selecting Reading Fluency Apps Suitable for Instruction of Struggling Readers (Rinehart and Ahern, 2016)

211. Toward Building a Mobile App Experience to Support Users' Mobile Travel Needs (Schaefer, 2016)

212. Towards a Model for Evaluating the Usability of M-learning Systems: from a Mapping Study to an Approach (Navarro et al., 2015)

213. Towards Situation Driven Mobile Tutoring System for Learning Languages and Communication Skills: Application to Users with Specific Needs (Khemaja and Taamallah, 2016)

214. Towards ubiquitous location-based audio: challenges and future directions (McGookin, 2016)

215. Towards Usability Guidelines for Mobile Websites and Applications (Shitkova et al., 2015)

216. Towards Using Mobile, Head-Worn Displays in Cultural Heritage: User Requirements and a Research Agenda (Vainstein et al., 2016)

217. Traveler Acceptance of an App-Based Mobile Tour Guide (Lai, 2015)

218. Unsupervised Detection of Abnormal Moments for Usability Testing of Mobile Apps (Xu et al., 2016)

219. Usability evaluation of a wearable augmented reality system for the enjoyment of the cultural heritage (Brancati et al., 2015)

220. Usability evaluation of mobile applications using ISO 9241 and ISO 25062 standards (Moumane et al., 2016)

221. Usability for Accessibility: A Consolidation of Requirements for Mobile Applications (Siebra et al., 2015)

222. Usability guidelines for developing mobile application in the construction industry (Jailani et al., 2015)

223. Usability heuristics and accessibility guidelines: a comparison of heuristic evaluation and WCAG (Casare et al., 2016)

224. Usability Heuristics for Collaborative Augmented Reality Remote Systems (Franklin et al., 2014)

225. Usability heuristics for touchscreen-based mobile devices: update (Inostroza et al., 2013)

226. Usability of "Fatchum": A Mobile Application Recipe Recommender System (Cruz et al., 2017)

227. Usability of Human Factors Standards (Swaminathan and Rantanen, 2014)

228. Usability of mobile applications: literature review and rationale for a new usability model (Harrison et al., 2013)

229. Usability of mobile devices and applications for elderly users (Ropponen, 2016)

230. Usability study of the mobile library App: an example from Chongqing University (Wei et al., 2015)

231. Usability-Oriented Designing in Community Health Management App (Li and Zhou, 2016)

232. Use of Design Patterns According to Hand Dominance in a Mobile User Interface (Al-Samarraie and Ahmad, 2016)

233. User Experience & Usability for Mobile Geo-referenced Apps. A Case Study Applied to Cultural Heritage Field (Bollini et al., 2014)

234. User Experience Evaluation of Chinese Travel App Software (Xu et al., 2014)

235. User interface design for android-based family genealogy social media (Pratama et al., 2017)

236. Using a smartphone App in qualitative research: the good, the bad and the ugly (García et al., 2016)

237. Using Research-Based Guidelines for Developing Mobile Information Technologies (Paschal et al., 2015)

238. UX Design to Promote Undergraduate Projects to Products: Case Study (Patil et al., 2016)

239. Validating Mobile Phone Design Guidelines: Focusing on the Elderly in a Developing Country (van Biljon and Renaud, 2016)

240. Virtual heritage of the territory: Design and implementation of educational resources in augmented reality and mobile pedestrian navigation (Nagata et al., 2016a)

241. VirtualTour: A system for exploring Cultural Heritage sites in an immersive way (Malomo et al., 2015)

242. Visual recognition in museum guide apps: do visitors want it? (Wein, 2014)

243. Walk1916: exploring how a mobile walking tour App can provide value for LAMs (Cushing and Cowan, 2016)

244. Was it worth the hassle?: ten years of mobile HCI research discussions on lab and field evaluations (Kjeldskov and Skov, 2014)

245. Web and mobile based tourist travel guide system for fiji's tourism industry (Singh et al., 2014)

246. Web and mobile visualization for cultural heritage (Di Benedetto et al., 2014)

247. What makes a good App description? (Jiang et al., 2014)

248. Where To Go And How To Get There: Guidelines For Indoor Landmark-Based Navigation In A Museum Context (Wecker et al., 2015)

249. Will we be lost without paper maps in the digital age? (Hurst and Clough, 2013)

* Not found, due subscription and/or accessibility issue.

† Not found, due subscription and/or accessibility issue, but with one to two pages preview available.

The papers/readings not accessed due subscription issues, according to the selection number list:

11, 15, 39, 63, 90, 131,155, 174, 204, 207, 223, 237, 238.

Appendix from Chapter 5

A.5 – Evaluation Questionnaire with Screenshots

The following pages show how the questions were presented to the participants. Most of the questions accompanied screenshots to help the participants.

The questionnaire was deliveRed using GoogleForms; the following questions were adapted for Microsoft Word format, using an *italic* format for the given instructions, and < > for follow-up actions.

A.5.1 – Questions about the participants

01. What is your phone OS?

Mark only one oval.

- ◯ iOS (iPhone)
- ◯ Android (Samsung, Huawei, LG, etc)
- ◯ Windows
- ◯ I don't know

02. What is your age? (just the number)

(short-answer text field)

03. What is your gender?

Mark only one oval.

- ◯ Female
- ◯ Male
- ◯ Prefer not to say
- ◯ Other: _____

04. What is your occupation or area of expertise?

(long-answer text field)

05. What is your experience with mobile apps?

Mark only one oval.

- ○ I have significant experience. Usually, I use many Apps daily
- ○ I have some experience. Usually, I use few apps, such as e-mail, maps, messaging, etc.
- ○ I have little experience. Usually, I just use basic apps, such as phone calls and messaging.
- ○ I have no experience. I normally don't download apps.

06. Have you ever downloaded an App for travel purposes?

Mark only one oval.

- ○ Yes   *< Skip to question 7 >*
- ○ No   *< Skip to question 8 >*
- ○ I don't remember   *< Skip to question 8 >*
- ○ Other:_____   *< Skip to question 8 >*

07. By using an App for travel purposes: was this App a generic one (such as TripAdvisor, GoogleMaps, etc) or was it for a specific location (such as a city app, or attraction)?

Tick all that apply.

- ○ It was a generic touristic app
- ○ It was a specific App for a city/location/attraction
- ○ Both, generic and specific apps
- ○ I don't remember
- ○ Other:_____

08. Do you recognise this symbol?

Mark only one oval.

      O Yes

      O No

09. Can you tell, or guess, what is it?

Mark only one oval.

O Weimar symbol	*< Skipt to question 11>*
O Monument symbol	*< Skipt to question 11>*
O UNESCO symbol	*< Skipt to question 11>*
O UNESCO's World Heritage Site symbol	*< Skip to question 10>*
O Sorry, no idea	*< Skipt to question 11>*

10. You got it right! Can you tell how did you know about the UNESCO's World Heritage Site symbol?

Mark only one oval.

- ○ I learned from the prototypes
- ○ I knew this symbol before
- ○ I just guessed it

A.5.2 – Questions about the Red Prototype

11. Red Prototype] In terms of using the App and accessing its content and features, how easy it was to use it? *

Mark only one oval.

|	1	2	3	4	5	
Very hard	O	O	O	O	O	Very easy

12. [Red Prototype] Regarding the main menu, how easy was to understand the content division/sections of the app, based on the menu design? *
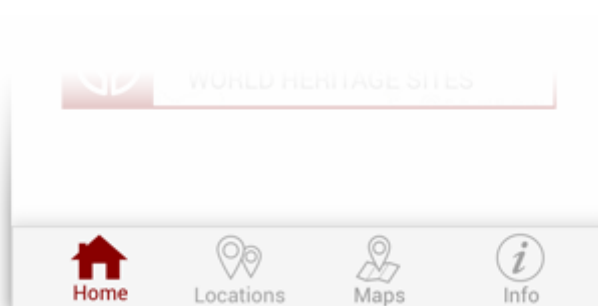
Mark only one oval.

1   2   3   4   5

Very hard   ○   ○   ○   ○   ○   Very easy

13. [Red Prototype] The App has more than one way leading to a location's page, such as illustrated below. How did you access the information about a specific location? (Multiple choice) *

Tick all that apply.

○ Using the "Locations" at the bottom main menu
○ Using the main/home page buttons (about Bauhaus, about Classical Weimar)
○ Using the maps
○ I didn't manage to find it
○ Other:_____

14. [Red Prototype] Regarding the offer to access further content: have you tapped/clicked in any external link presented at the bottom of each location page? *
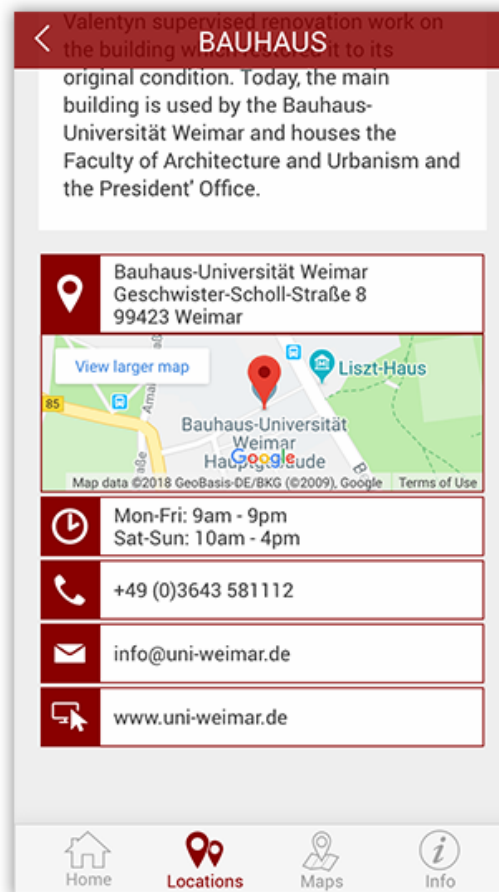
Mark only one oval.

- O Yes
- O No, but I noticed the offer
- O No, because I didn't notice it
- O Other:_____

15. [Red Prototype] Regarding the "About(s)" pages from the home screen, select all the answers reflecting your experience: *
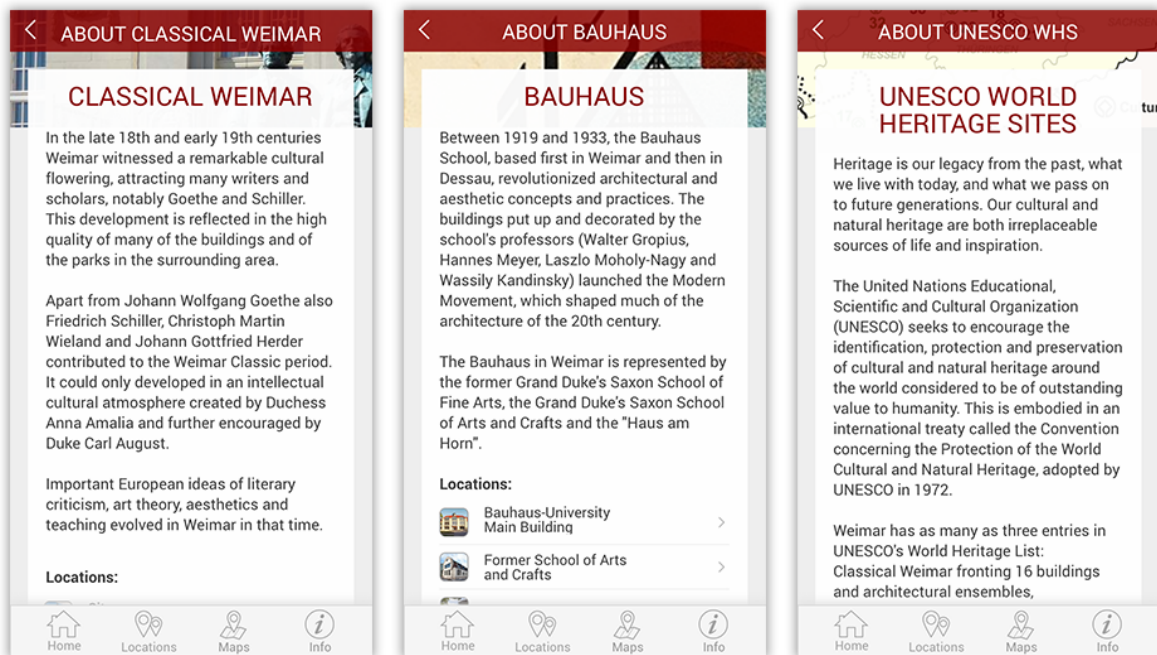

Tick all that apply.

- ○ I didn't access them
- ○ I accessed them to find the locations, as part of the assigned task
- ○ I found the information useful
- ○ I accessed "About Classical Weimar"
- ○ I accessed "About Bauhaus"
- ○ I accessed "About UNESCO World Heritage Sites"
- ○ Other:_____

16. [Red Prototype] Regarding the maps: considering the two types of maps (interactive and GPS based) offered in the app, which one do you prefer? *
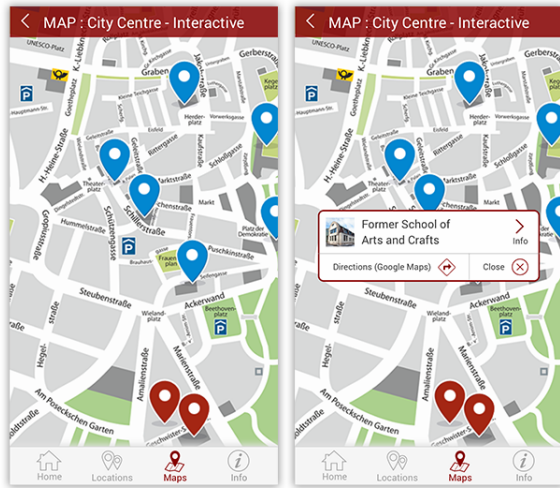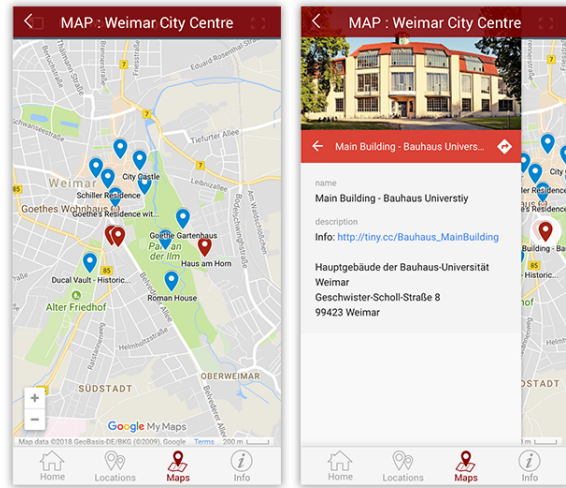
Interactive Map   **GPS Map** (GoogleMaps based)

Mark only one oval.

    O I liked the interactive map better   *< Skip to question 17 >*
    O I liked the GPS map better   *< Skip to question 18 >*
    O I liked both equally   *< Skip to question 19 >*
    O I don't think they are relevant   *< Skip to question 19 >*

17. [Red Prototype] Can you point the reasons why did you like the interactive map better? You can select more than one answer. *
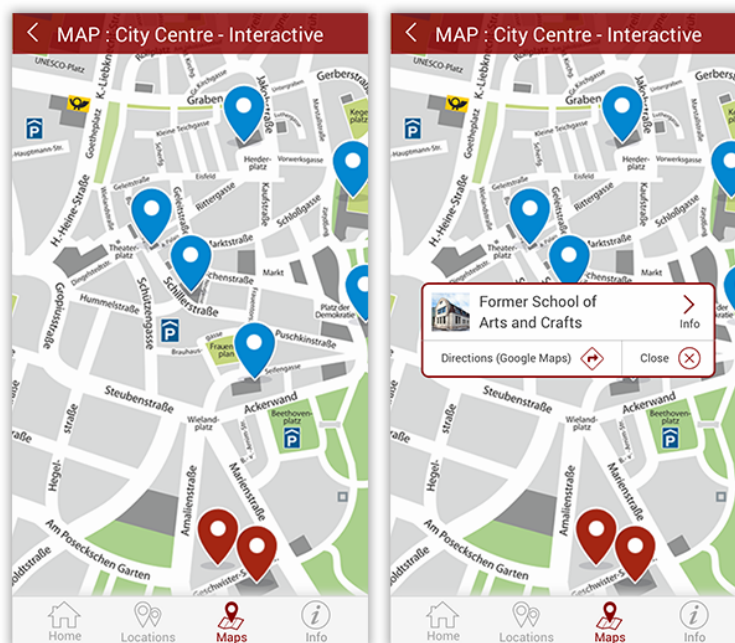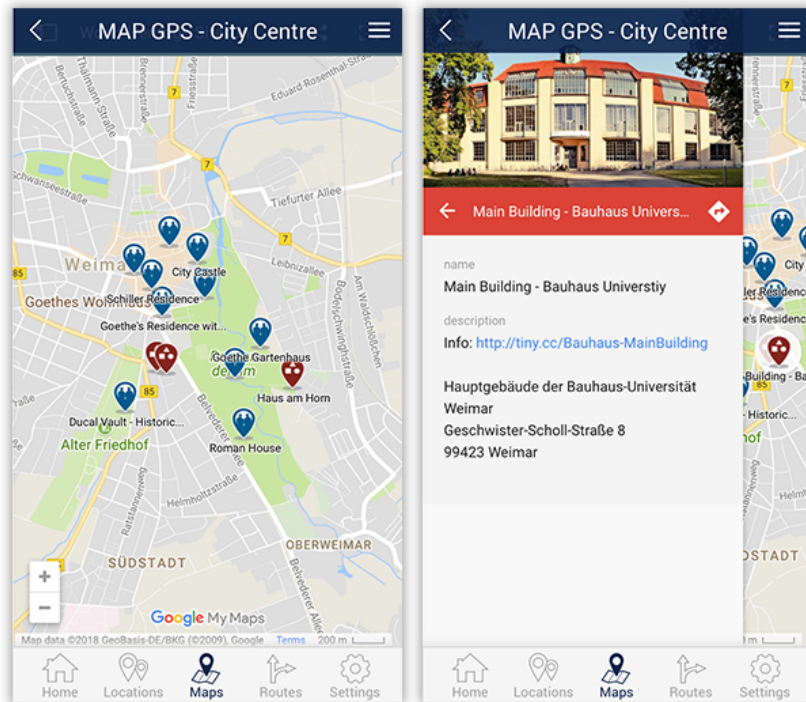

Tick all that apply.

- ○ It offered more tailoRed information regarding the locations
- ○ The map does not look generic. It seems to be specific for the App and more trustworthy
- ○ The icons are bigger
- ○ I liked the design
- ○ Other:_____

< Skip to question 19 >

18. [Red Prototype] Can you point the reasons why did you like the GPS map better? You can select more than one answer. *

Tick all that apply.

       ○ The GPS helps to find where I am in relation to the location
       ○ I am more familiar with the GoogleMaps format
       ○ The icons are smaller
       ○ I liked the design
       ○ Other:_____

A.5.3 – Questions about the Blue Prototype

19. [Blue Prototype] In terms of using the App and accessing its content and features, how easy it was to use it? *

Mark only one oval.

	1	2	3	4	5	
Very hard	O	O	O	O	O	Very easy

20. [Blue Prototype] Regarding the main menu, how easy was to understand the content division/sections of the app, based on the menu design? *
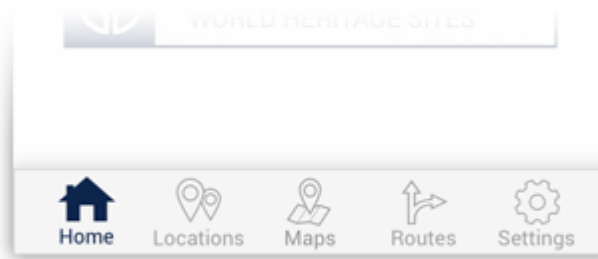
Mark only one oval.

	1	2	3	4	5	
Very hard	O	O	O	O	O	Very easy

21. [Blue Prototype] The App has more than one way leading to a location's page, such as illustrated bellow. How did you access the information about a specific location? (Multiple choice) *
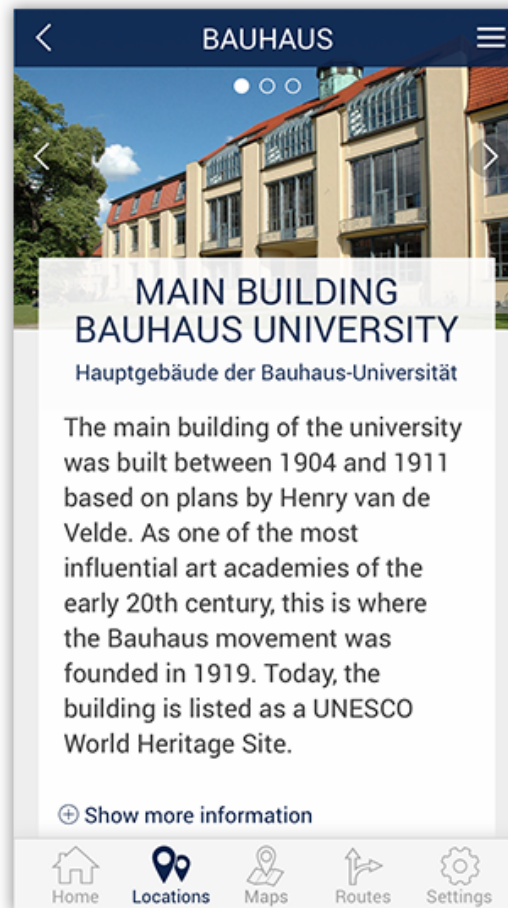
Tick all that apply.

- ○ Using the "Locations" at the bottom main menu
- ○ Using the main/home page buttons (about Bauhaus, about Classical Weimar)
- ○ Using the maps
- ○ Using the top-right "hamburger" menu
- ○ Other:_____

22. [Blue Prototype] Regarding the offer to access further content: have you tapped/clicked in any external link presented at the bottom of each location page? *

Mark only one oval.

- ○ Yes
- ○ No, but I noticed it
- ○ No, because I didn't notice it

23. [Blue Prototype] Regarding the "About(s)" pages from the home screen, select all the answers reflecting your experience: *
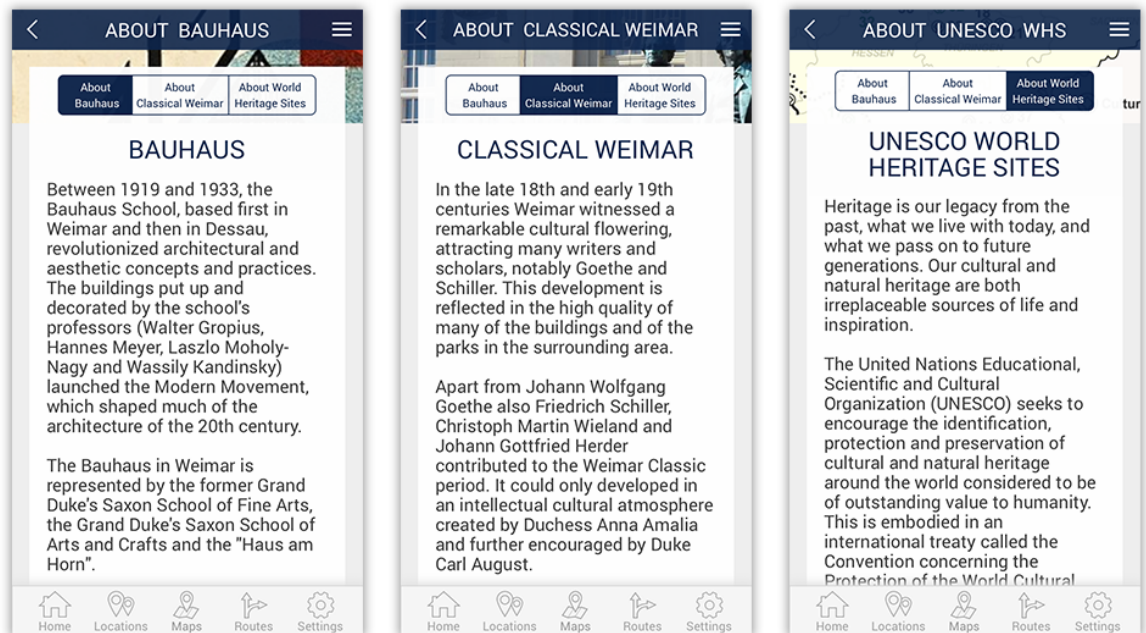
Tick all that apply.

- ○ I didn't access them
- ○ I accessed them to find the locations, as part of the assigned task
- ○ I accessed "About Classical Weimar" found the information useful
- ○ I accessed "About Bauhaus"
- ○ I accessed "About UNESCO World Heritage Sites"
- ○ Other:_____

24. [Blue Prototype] Regarding the maps: considering the two types of maps (interactive and GPS based) offered in the app, which one do you prefer? *
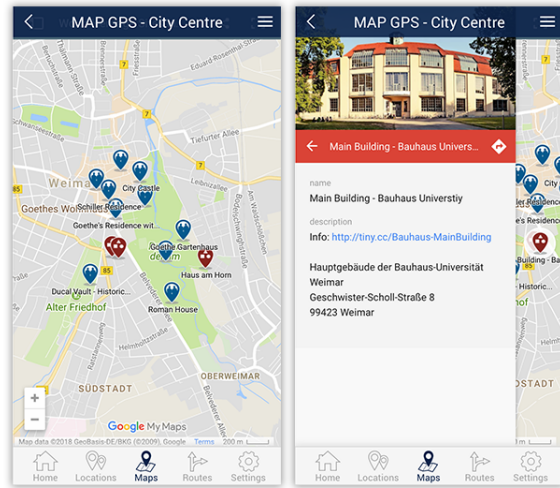
Interactive Map   **GPS Map** (GoogleMaps based)

Mark only one oval.

       ○ I liked the interactive map better   *< Skip to question 25 >*
       ○ I liked the GPS map better   *< Skip to question 26 >*
       ○ I liked both equally   *< Skip to question 27 >*
       ○ I don't think they are relevant   *< Skip to question 27 >*

25. [Blue Prototype] Can you point the reasons why did you like the interactive map better? You can select more than one answer. *
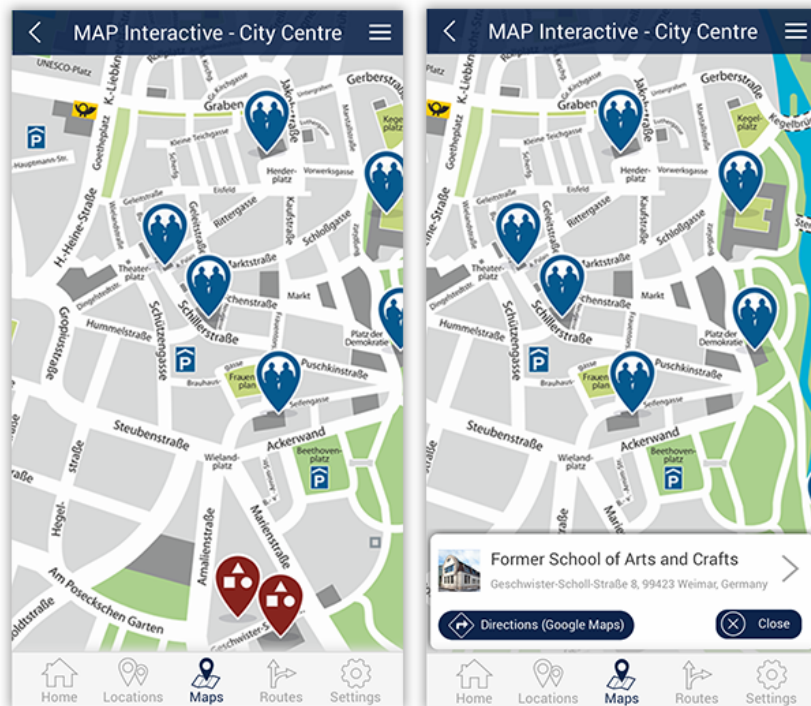
Tick all that apply.

- ○ It offered more tailoRed information regarding the locations
- ○ The map does not look generic. It seems to be specific for the App and more trustworthy
- ○ The icons are bigger
- ○ I liked the design
- ○ Other:_____

< Skip to question 27>

26. [Blue Prototype] Can you point the reasons why did you like the GPS map better? You can select more than one answer. *

Tick all that apply.

- ○ The GPS helps to find where I am in relation to the location
- ○ I am more familiar with the GoogleMaps format
- ○ The icons are smaller
- ○ I liked the design
- ○ Other:_____

< Skip to question 27 >

27. [Blue Prototype] What is your opinion about the home screen pop-up explanation? (Multiple choice) *
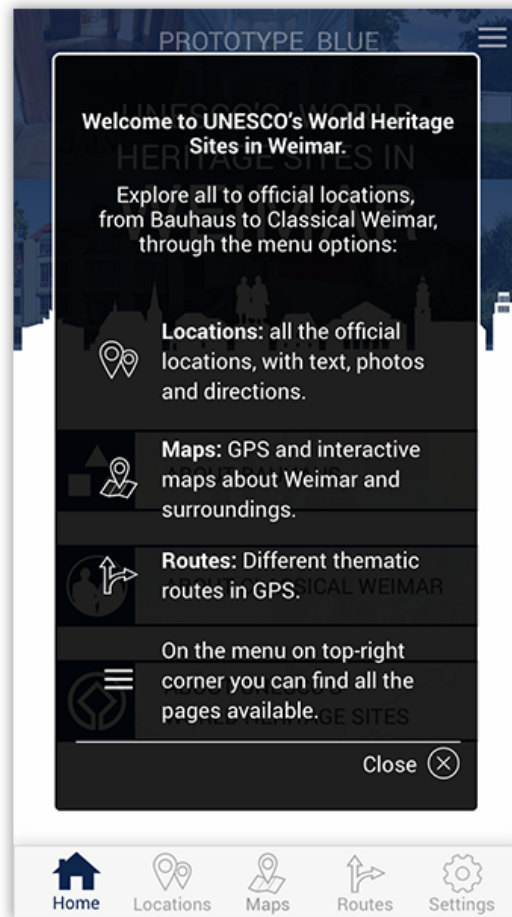
Tick all that apply.

       ○ It was useful because it clarified the menu and navigation
       ○ I would like to have a similar explanation in other touristic apps
       ○ It was irrelevant because the menu was understandable enough
       ○ I think this created an unnecessary extra tap/click
       ○ Other:_____

28. [Blue Prototype] Inside the "About" pages from the home screen, have you played the available video(s)? *
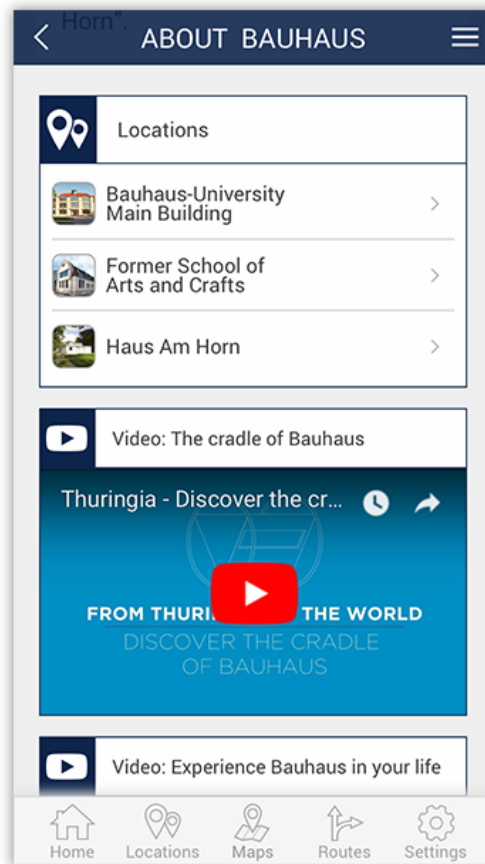
Mark only one oval.

- ○ Yes, the video was helpful
- ○ Yes, but I don't think it is necessary
- ○ No, but I think it is an interesting option
- ○ No, I don't think a video is helpful in this kind of app
- ○ I didn't access the "About" pages
- ○ I didn't notice any video there
- ○ Other:_____

29. [Blue Prototype] Regarding the "Routes", did you use this feature? *
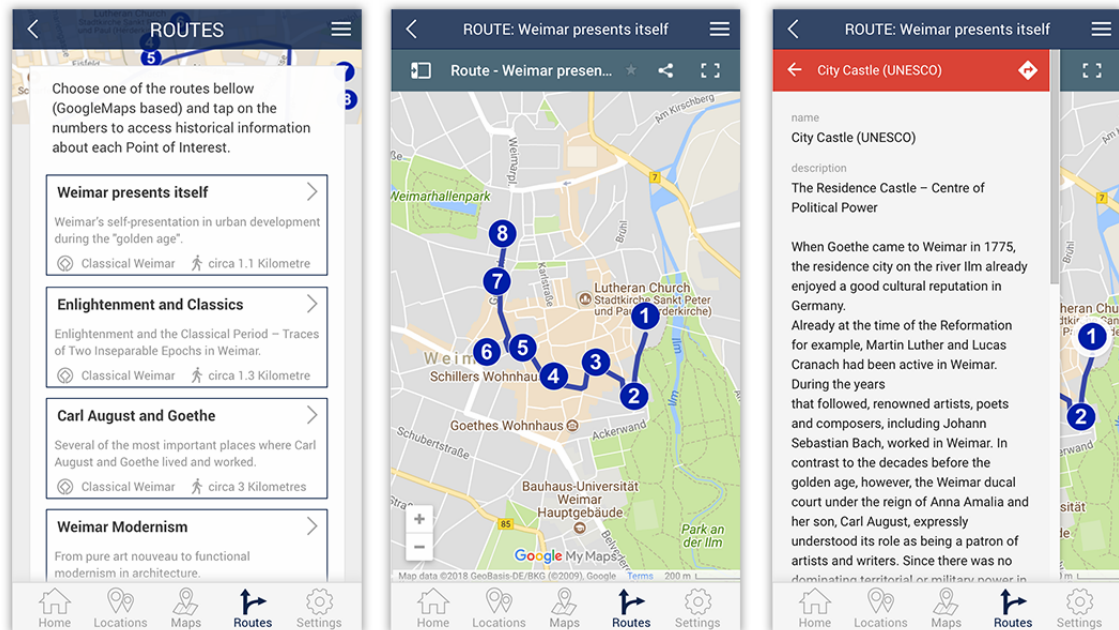
Mark only one oval.

◯ Yes, and I like them

◯ Yes, but I didn't like them

◯ No, I didn't open the routes' page

◯ I opened the routes' page, but I didn't use them

◯ Other:_____

30. [Blue Prototype] Still on the "Routes", can you rate your opinion about this feature? *
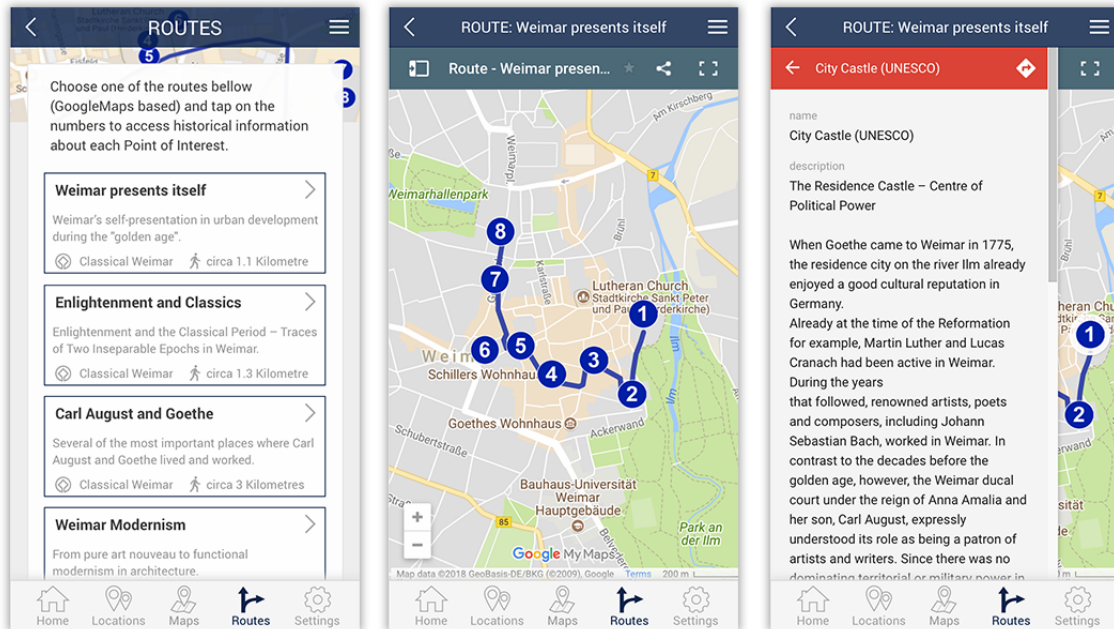
Mark only one oval.

	1	2	3	4	5	
Not useful	O	O	O	O	O	Very useful

31. [Blue Prototype] About the Top-Right Menu content, can you rate your opinion about this feature/page? *
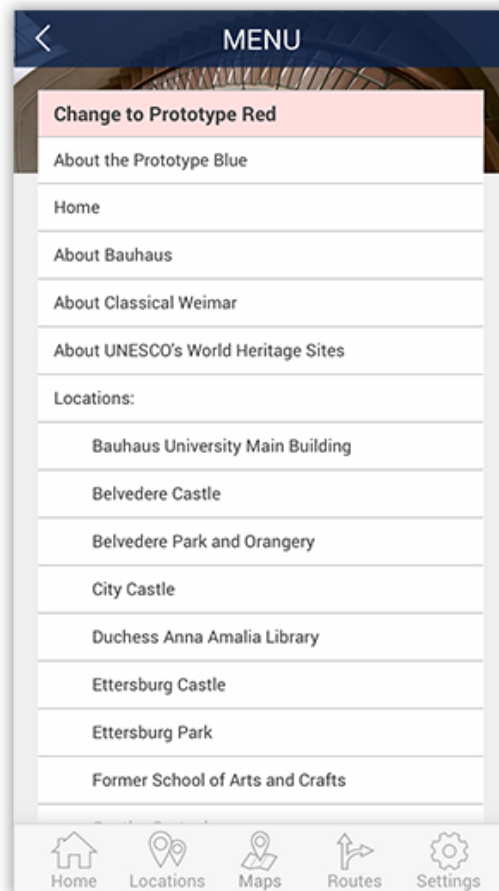
Mark only one oval.

	1	2	3	4	5	
Not useful	O	O	O	O	O	Very useful

32. [Blue Prototype] Can you give your opinion about the features presented in the "Settings"? *
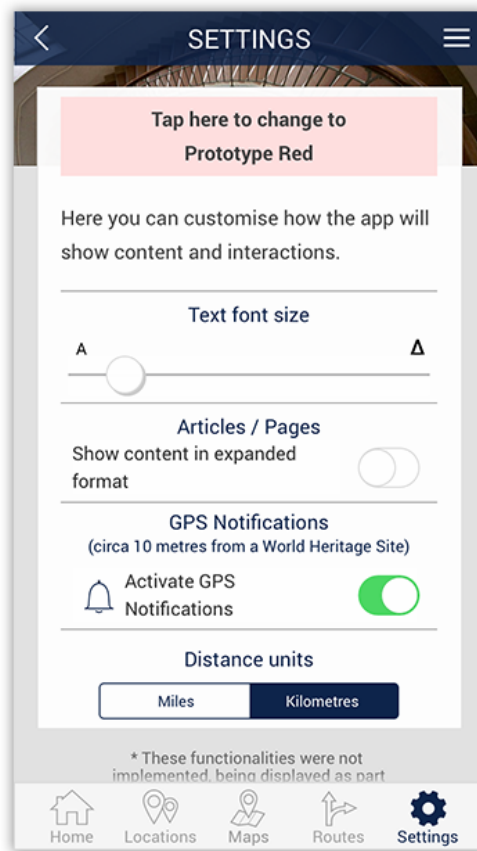
Mark only one oval.

	Not useful	Somehow useful	Useful
Changing text font size	O	O	O
Articles / Pages expansion possibility	O	O	O
GPS notifications	O	O	O
Distance units	O	O	O

A.5.4 – Questions comparing the two versions (Red/Blue)

In this session, you are going to compare your experiences with the two apps.

33. Considering the main navigation menu, which version do you like better? *
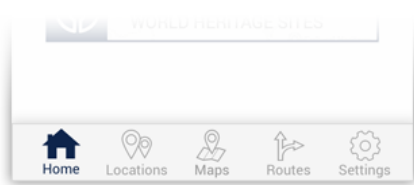
Prototype Blue   **Prototype Red**
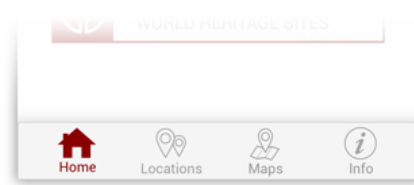
Mark only one oval.

      ○ I liked more the menu from the Prototype Blue   *< Skip to question 34 >*
      ○ I liked more the menu from the Prototype Red   *< Skip to question 35 >*

34. Can you point the reasons why did you like better the menu from the Blue Prototype? (Multiple choice) *
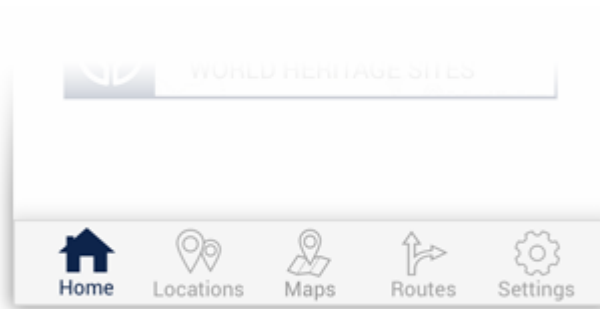
Tick all that apply.

      ○ It has more content options
      ○ It was easy to understand
      ○ It was more appealing for touristic activities
      ○ I liked the icons.
      ○ I liked the "Routes"
      ○ I liked the "Settings"
      ○ Other:_____

< Skip to question 36 >

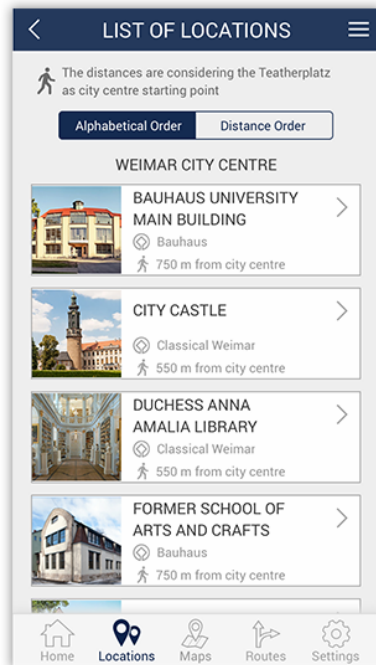**35. Can you point the reasons why did you like better the menu from the Red Prototype? (Multiple choice) ***
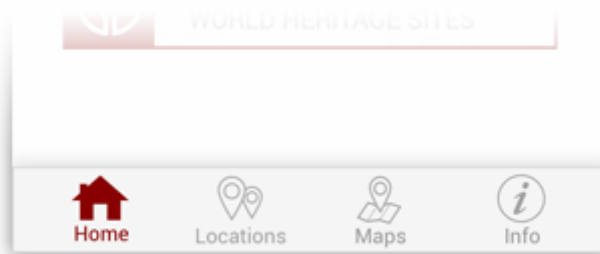
Tick all that apply.

- ○ It has less options
- ○ It was easy to understand
- ○ It was more appealing for touristic activities
- ○ I liked the icons
- ○ It was less complicated
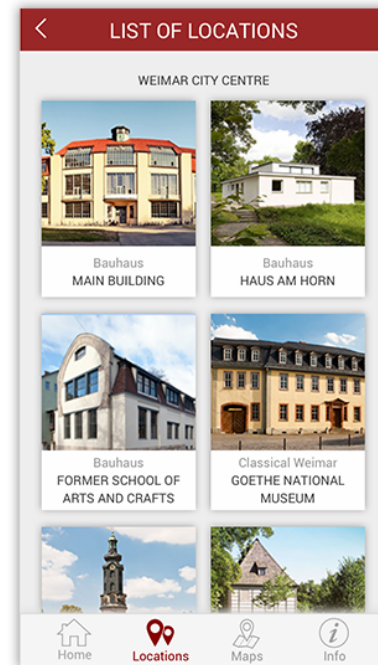- ○ I liked the "Info"
- ○ Other:_____

< Skip to question 36 >

A.5.5 – Questions About the Locations

36. About the list of locations, which version (Red/Blue) did you like better? *
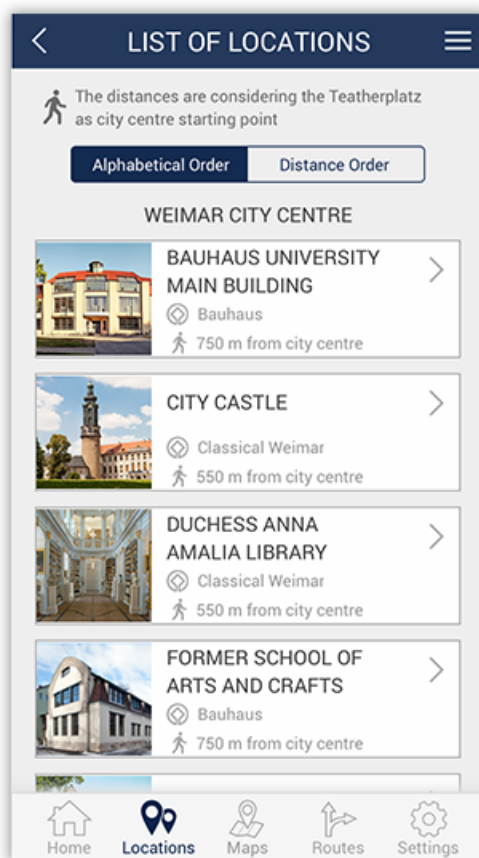

Prototype Blue   Prototype Red

Mark only one oval.

     ○ I liked the Blue version   *< Skip to question 37 >*
     ○ I liked the Red version   *< Skip to question 38 >*

37. Can you point the reasons why did you like better the list of locations from the Blue version? (Multiple choice) *
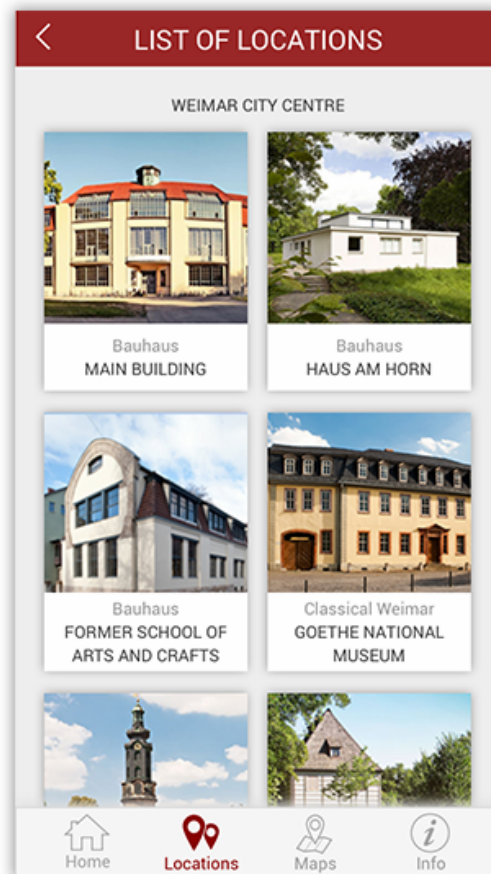

Tick all that apply.

- ○ I like more the "list" format
- ○ The "list" format shows more information per screen space
- ○ The distance to the locations is available
- ○ Every location is identified as Bauhaus or Classical Weimar sites
- ○ It offered Alphabetical and Distance order
- ○ Other:_____

< Skip to question 39 >

38. Can you point the reasons why did you like better the list of locations from the Red version? (Multiple choice) *


Tick all that apply.

- ○ I like more the "grid" format
- ○ It shows bigger pictures
- ○ It shows more options on the screen at the same time
- ○ Every location is identified as Bauhaus or Classical Weimar sites
- ○ I like the design centred on visuals and with less text
- ○ Other:_____

< Skip to question 39 >

39. Comparing the prototypes (Blue/Red), after accessing a location, which version of content display did you like better? *
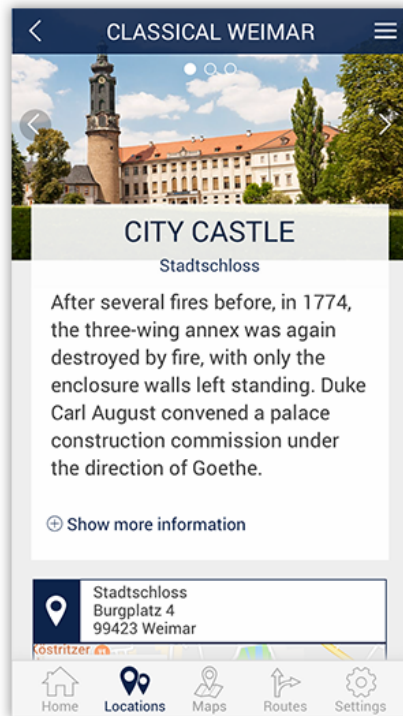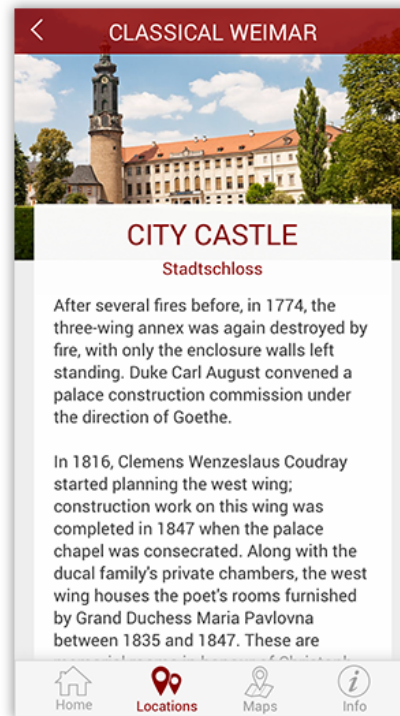
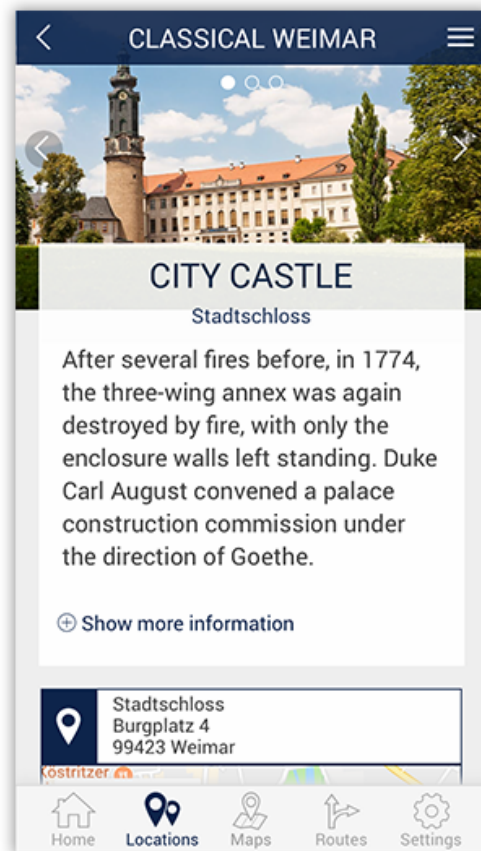*Mark only one oval.*

     ⭘ I liked the Blue version   *< Skip to question 40 >*
     ⭘ I liked the Red version   *< Skip to question 41 >*

40. Please, select the options that reflect the reasons why do you prefer the way the content is being displayed in the Blue Prototype? *
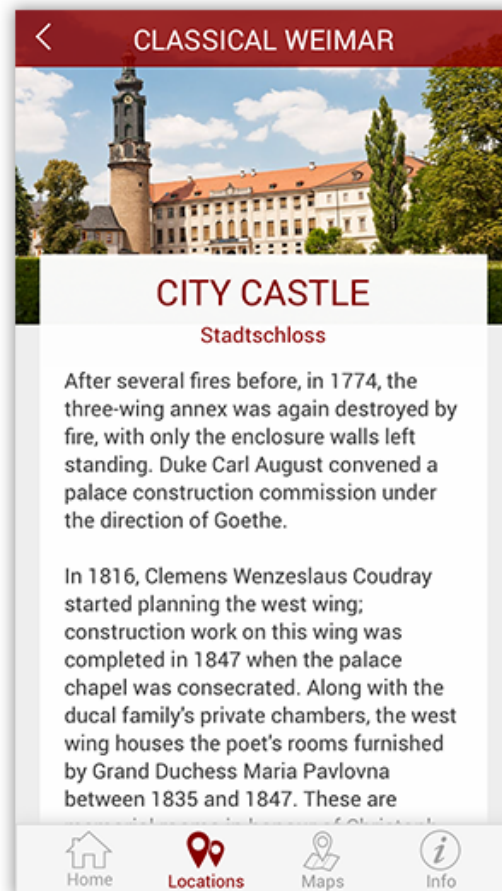

Tick all that apply.

- ◯ The text was shorter, going directly to the point
- ◯ It offered the "show more information", in case I wanted to read more
- ◯ I liked the photo-gallery on the top
- ◯ I liked more this font type
- ◯ I liked more this font size
- ◯ Other:_____

< Skip to question 42 >

41. Please, select the options that reflect the reasons why do you prefer the way the content is being displayed in the Red Prototype? *
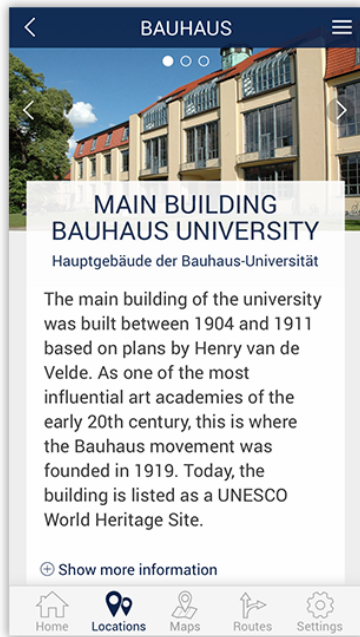

Tick all that apply.

     ◯ It shows more content about the location
     ◯ There was no "show more information" option, making one less tap/click to access all the information
     ◯ I liked the picture on the top
     ◯ I liked more this font type
     ◯ I liked more this font size
     ◯ Other:_____

< Skip to question 42 >

42. Considering the font used in the text, which version did you like better? *

Prototype Blue   **Prototype Red**
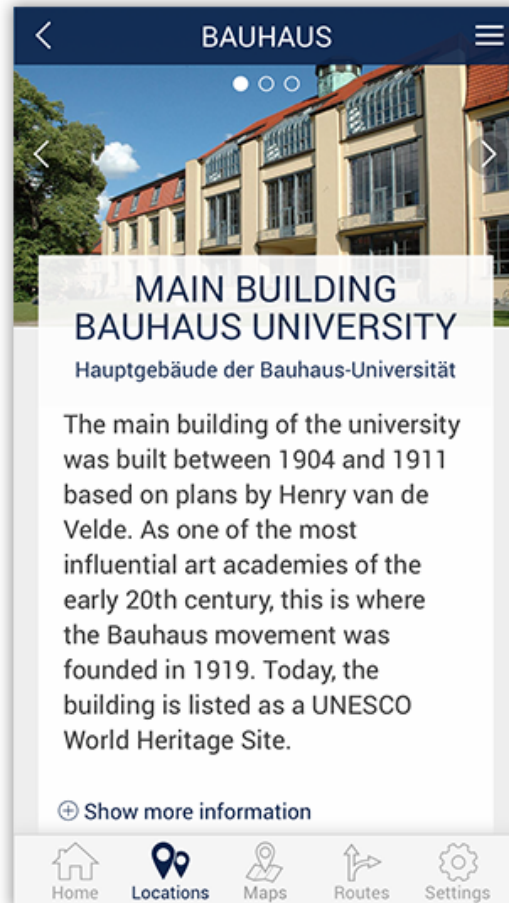
Mark only one oval.

○ I liked the font on Blue version   < Skip to question 43 >
○ I liked the font on Red version   < Skip to question 44 >

43. Can you point the reason why do you liked more the font displayed on the Blue version? (Multiple choice) *

Tick all that apply.

    ○ It was bigger
    ○ It was easier to read
    ○ I liked more this font style
    ○ Other:_____

< Skip to question 45 >

44. Can you point the reason why do you like better the font displayed on the Red version? (Multiple choice) *
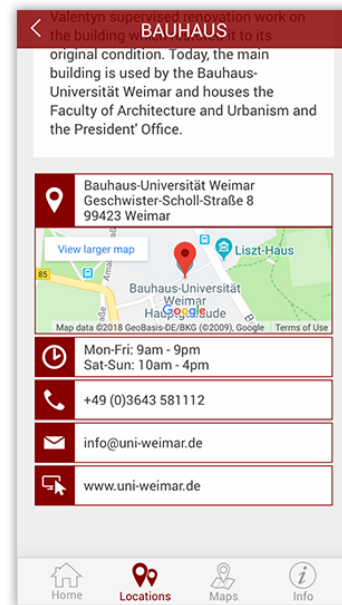

Tick all that apply.

    ○ It is smaller, showing more content before scrolling the page
    ○ It was easier to read
    ○ I liked more this font style.
    ○ Other:_____

< Skip to question 45 >

45. About the layout used to offer additional content and further information options at the bottom of each location page, which version did you like the most? *

Prototype Blue   **Prototype Red**

Mark only one oval.

     ⭘   I liked the Blue version   *< Skip to question 46 >*
     ⭘   I liked the Red version   *< Skip to question 47 >*

46. Can you point the reasons why did you like better the additional content and further information layout in the Blue version? (Multiple choice) *

Tick all that apply.

- ○ It shows more space between the content
- ○ It is easier to tap/click in the content
- ○ I just liked this one more, no special reason
- ○ It shows the UNESCO's World Heritage Sites logo
- ○ Other:_____

< Skip to question 48 >

47. Can you point the reasons why did you like better the Additional content and further information layout in the Red version? (Multiple choice) *
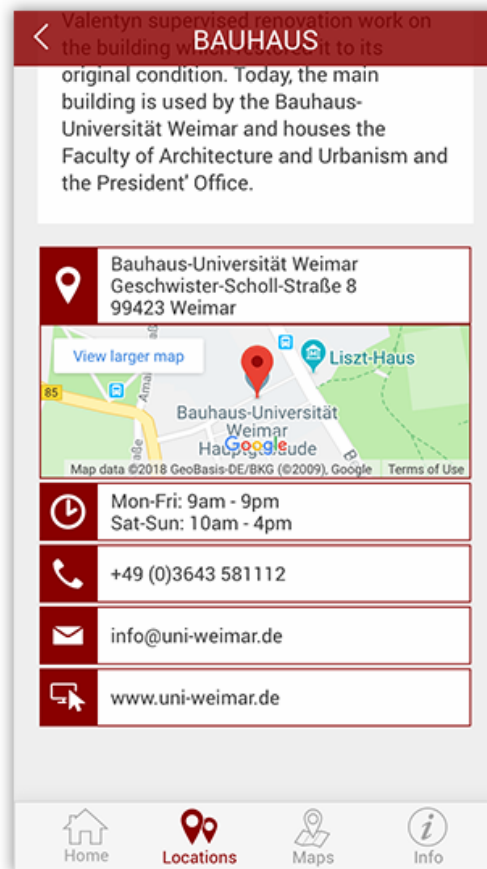

Tick all that apply.

- ○ compact, using less screen space
- ○ It is easier to see all the options.
- ○ I just liked this one more, no special reason
- ○ It was simpler than the Blue one, without extra images on bottom
- ○ Other:_____

< Skip to question 48 >

48. From the home screen, when you accessed an "About" page (Bauhaus, Classical Weimar, UNESCO's World Heritage Sites), which is your preference between the two models? *
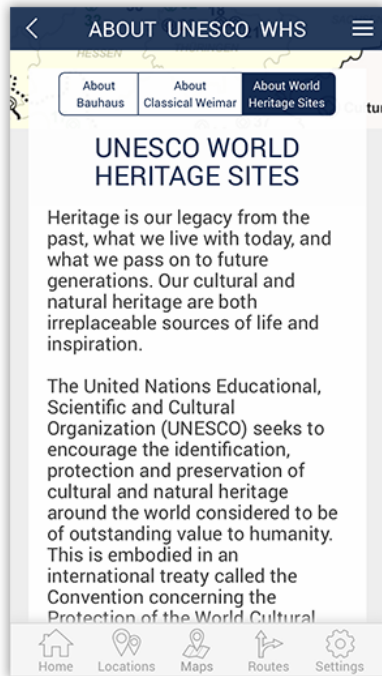
Prototype Blue   Prototype Red
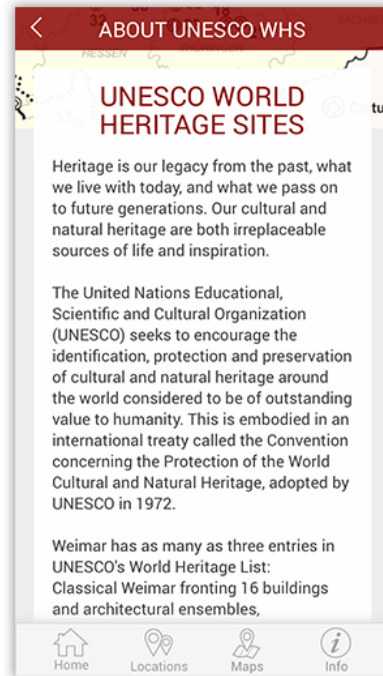
Mark only one oval.

○ I liked more the Blue version   *< Skip to question 49 >*
○ I liked more the Red version   *< Skip to question 50 >*

49. Can you point the reasons do why did you like better the "About" pages from the Blue version? (you can choose more than one answer) *
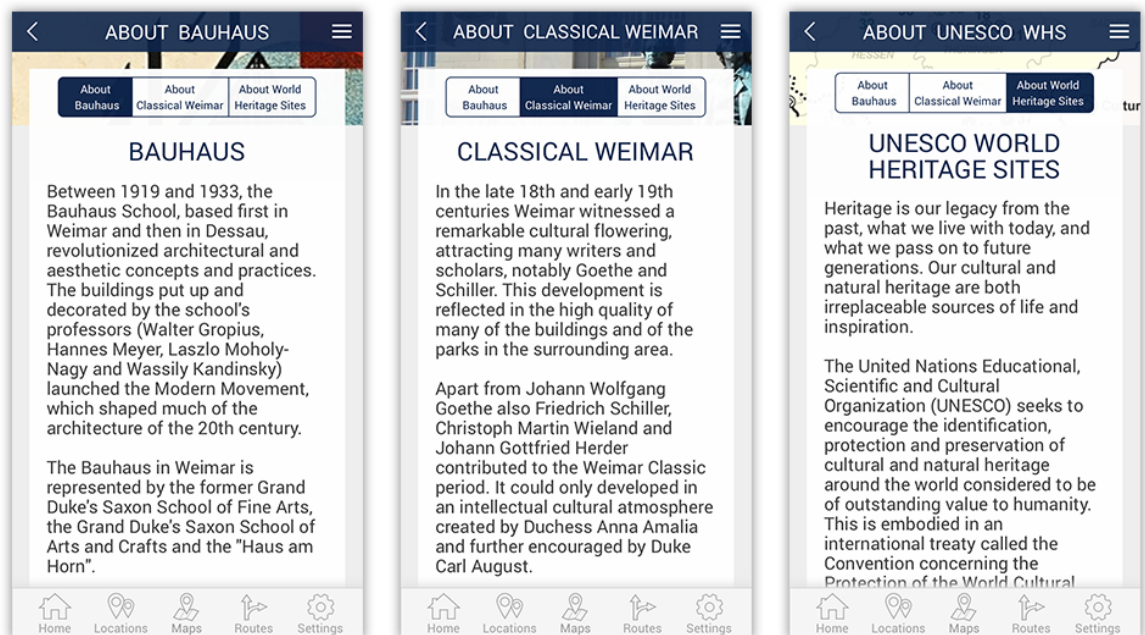
Tick all that apply.

○ I liked the font style
○ I liked the top navigation between the pages
○ I liked the way the locations were placed
○ It does look better in general, the layout is more appealing.
○ Other:_____

50. Can you point the reasons why did you like better the "About" pages from the Red version? (you can choose more than one answer) *
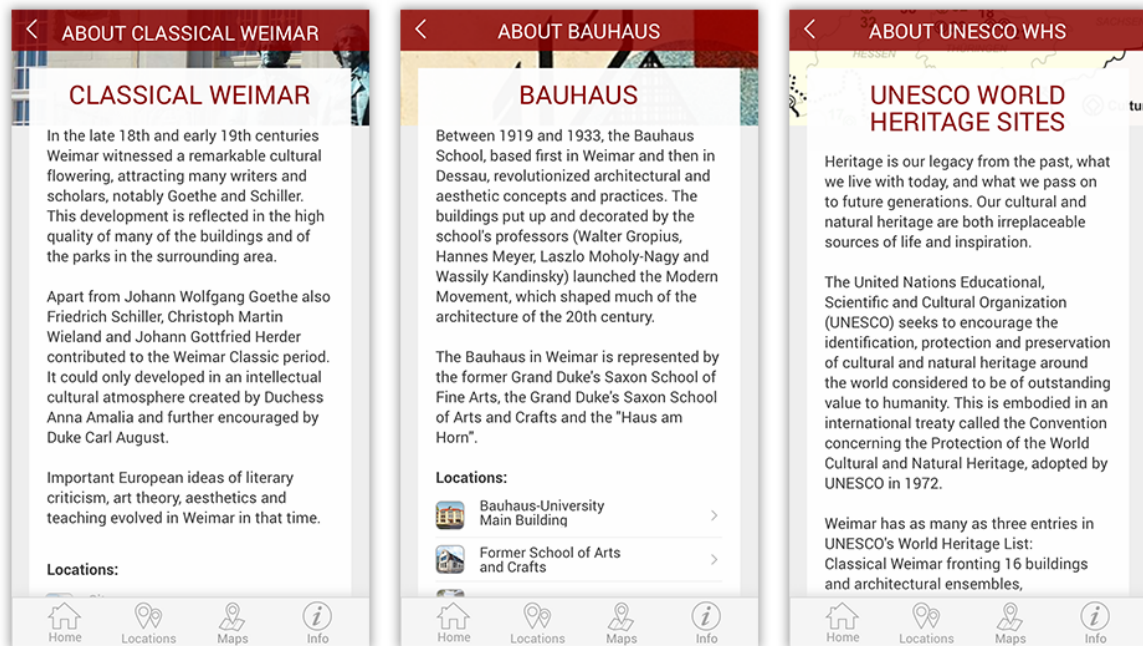
Tick all that apply.

- ○ I liked the font style
- ○ It is more compact
- ○ I liked the way the locations were placed
- ○ It does look better in general, the layout is more appealing.
- ○ Other:_____

< Skip to question 51 >

51. Considering the different ways of presenting and exploring the photo/image at the head of the attraction's description page, which version did you like the most? *

Mark only one oval.

     O   I liked the Red one   *< Skip to question 53 >*
     O   I liked the Blue one   *< Skip to question 52 >*
     O   I didn't see any difference between them   *< Skip to question 54 >*

52. Can you point the reason(s) why did you like better the way the image is presented at the Blue version? *

Tick all that apply.

- ○ The image gives a better preview about what I am looking for
- ○ The photo-gallery was helpful in giving a preview of the location
- ○ I like more the photo-gallery than the static image
- ○ I don't think the image is necessary
- ○ Other:_____

< Skip to question 54 >

53. Can you point the reason(s) why did you like better the way the image is presented at the Red version? *

Tick all that apply.

    ○ The image gives a better preview about what I am looking for
    ○ Just one image is enough to have an idea about the location
    ○ I don't like photo-gallery, such as presented in the Blue version
    ○ I don't think the image is necessary
    ○ Other:_____

< Skip to question 54 >

54. Considering the way the locations are presented inside the maps (Blue/Red), which one did you like better? *
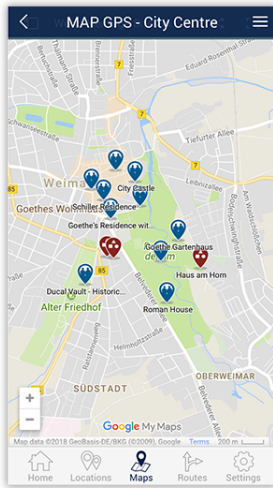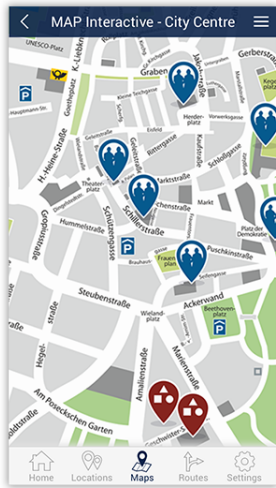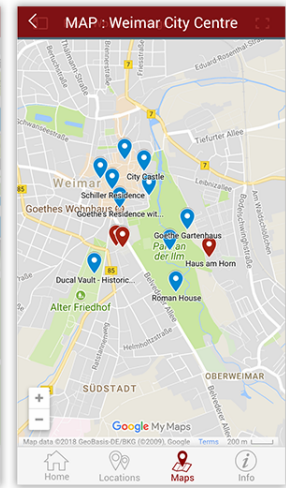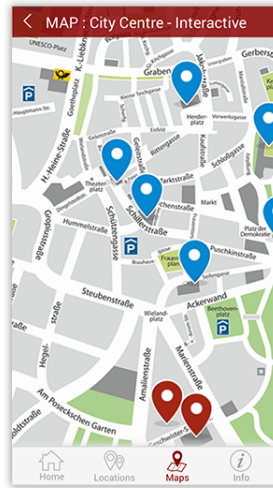
Prototype Blue   **Prototype Red**

Mark only one oval.

    ○ I liked the Blue version   *< Skip to question 55 >*
    ○ I liked the Red version   *< Skip to question 56 >*

55. Can you provide the reason(s) why did you like better the maps from the Blue version? *
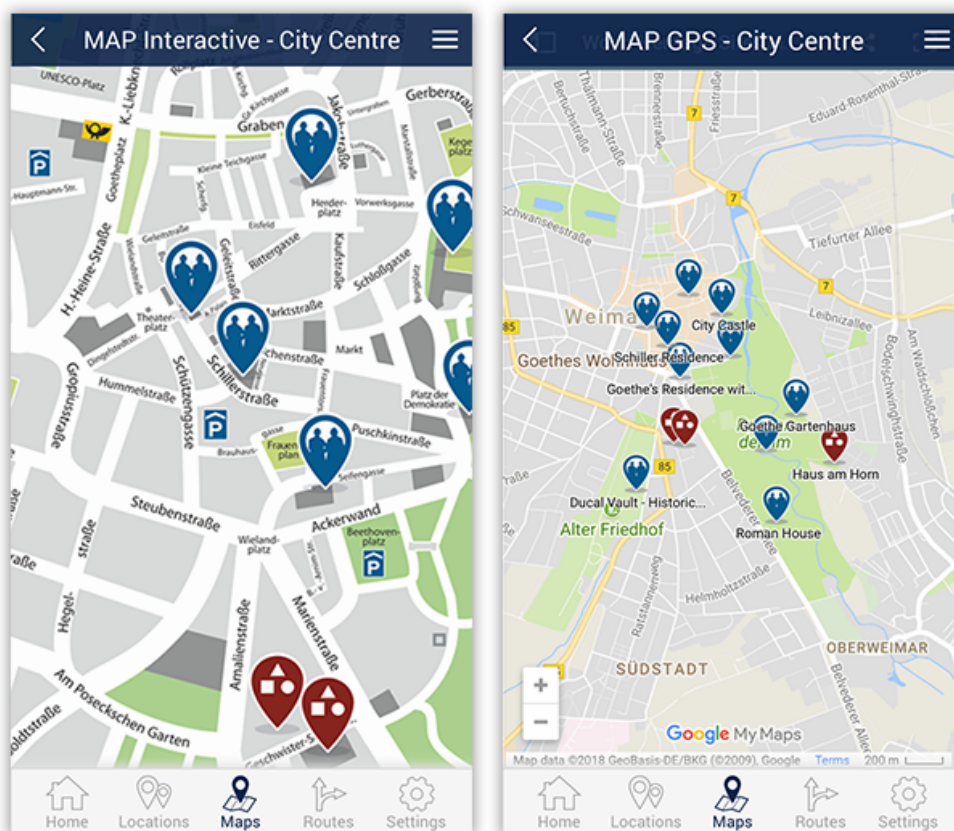
Tick all that apply.

- ○ The icons are better and make easier to distinguish the locations
- ○ The colours were helpful to distinguish the locations
- ○ I recognised the icons from the home screen
- ○ I didn't understand the differences on colours and icons
- ○ I recognised the colour scheme from the main-screen of the maps' page
- ○ Other:_____

< Skip to question 57 >

56. Can you provide the reasons why did you like better the maps from the Red version? *
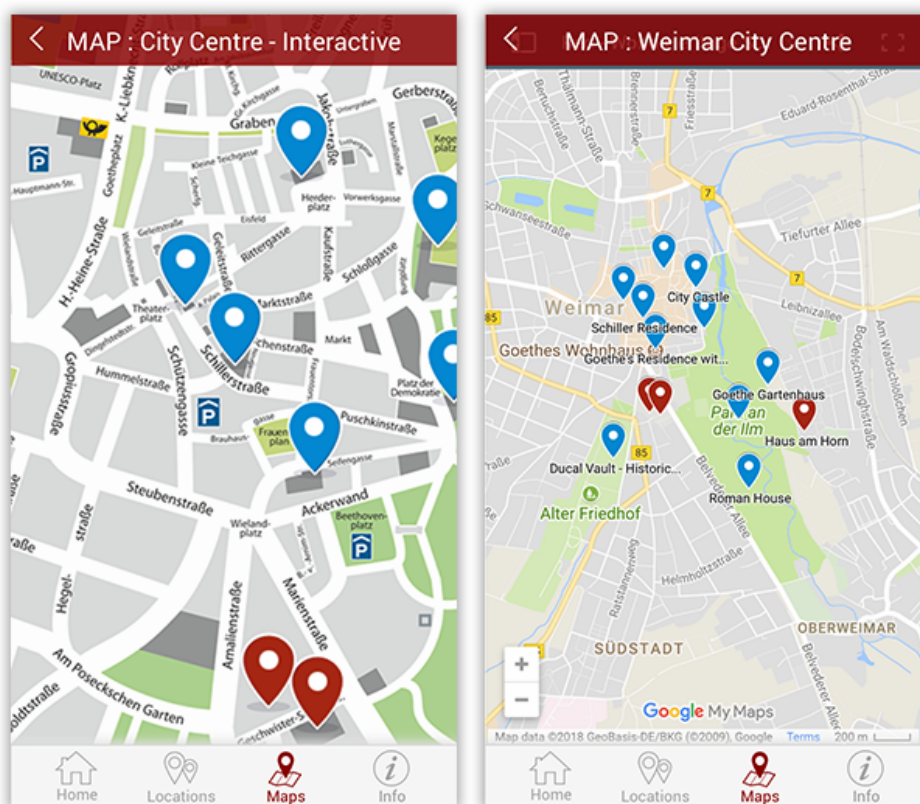
Tick all that apply.

○ It is more likely to standard google-maps icons
○ The colours were helpful to distinguish the locations
○ I didn't understand the differences in colours and icons
○ I recognised the colours from the main screen of the maps' page
○ It would be nicer if it uses the icons presented at the home page (on "About" pages)
○ Other:_____

57. Considering only the Interactive Map on both prototypes, after you tapped/clicked in a location, which version do you like the most? *
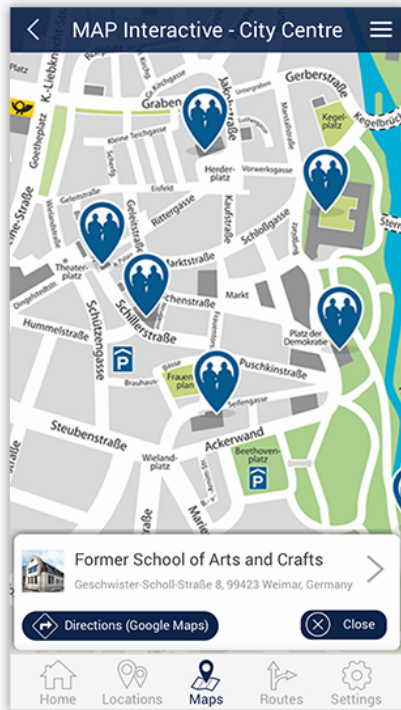
Prototype Blue
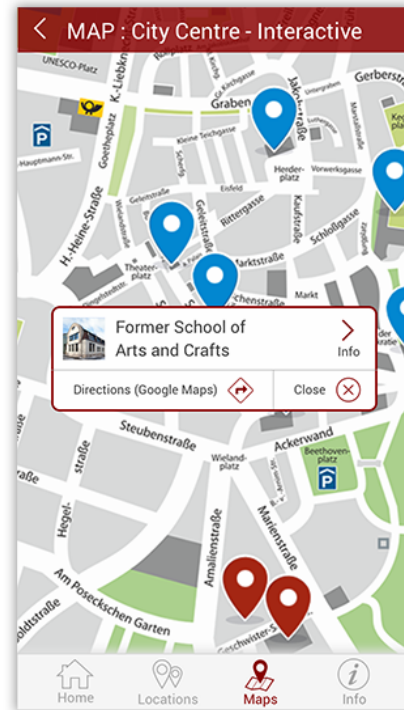
Prototype Red

Mark only one oval.

      ○   The Blue version   *< Skip to question 58 >*
      ○   The Red version   *< Skip to question 59 >*

58. Can you tell the reason(s) why did you like better the interactive map from the Blue version? *
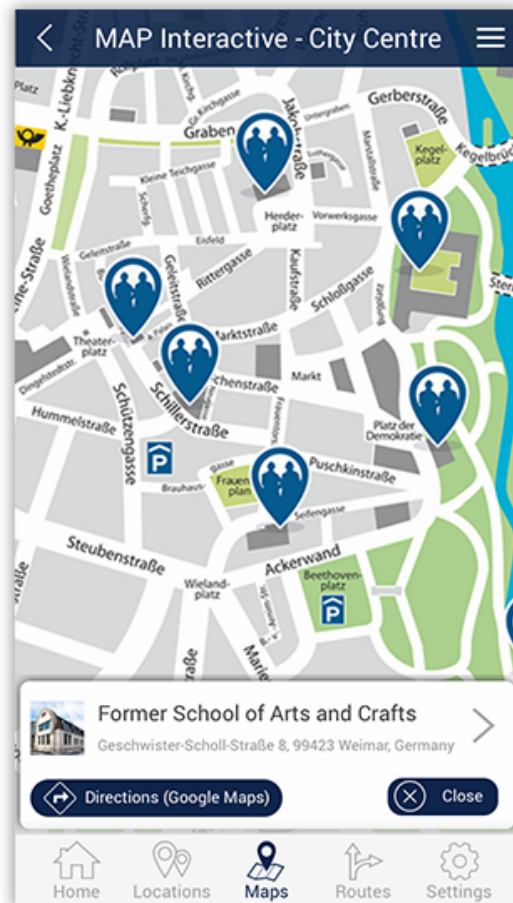
Tick all that apply.

- ○ I prefer when the information about the location is displayed at the bottom of the screen
- ○ It shows more information about the location, such as the address.
- ○ Other:_____

< Skip to question 60 >

59. Can you tell the reason(s) why did you like better the interactive map from the Red version? *
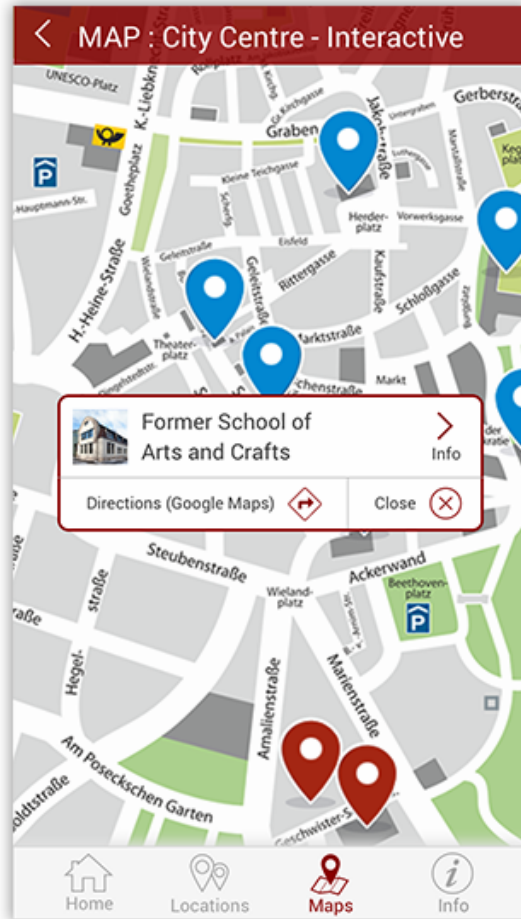
Tick all that apply.

- ○ I like the floating-centred information box
- ○ The coloured border creates a better contrast in relation to the map
- ○ Other:_____

< Skip to question 60 >

60. After using the two prototypes (Red and Blue) and reviewing some screenshots in this evaluation, which version did you like better? *

Prototype Blue   **Prototype Red**

Mark only one oval.

     ○   I liked more the Blue Prototype   *< Skip to question 61 >*
     ○   I liked more the Red Prototype   *< Skip to question 62 >*

61. Can you point the reason(s) why did you like better the Blue Prototype? (Multiple choice) *

Tick all that apply.

- O Blue colour better than the Red one
- O It offered more options on the menu
- O The menu on top-corner was helpful to find information
- O It looked more professional than the Red version.
- O I liked the design in general
- O Other:_____

< Skip to question 63 >

62. Can you point the reason(s) why did you like better the Red Prototype? (Multiple choice) *

Tick all that apply.

- ○ I like the Red colour better than the Blue one.
- ○ It offered less options in the menu
- ○ The content structure is more direct, there is no need to search for the content
- ○ It looked more professional than the Blue version.
- ○ I liked the design in general
- ○ Other:_____

63. Based on the version of your preference, would you consider using a similar App for another location on a future trip? *

Mark only one oval.

- ○ Yes
- ○ No
- ○ Maybe
- ○ Other:_____

64. How did you access the prototypes? *

Mark only one oval.

    ○ Via Junstinmind App (mobile version)
    ○ Via web browser (desktop version)
    ○ Both (app and web versions)

A.5.6 – Questions about Weimar

65. Have you been to or visited Weimar? *

Mark only one oval.

    ○ Yes   *< Skip to question 66 >*
    ○ No   *< Skip to question 67 >*

66. In your opinion, which version (Red/Blue) covered better the information about the selected locations in Weimar? *

Prototype Blue   **Prototype Red**
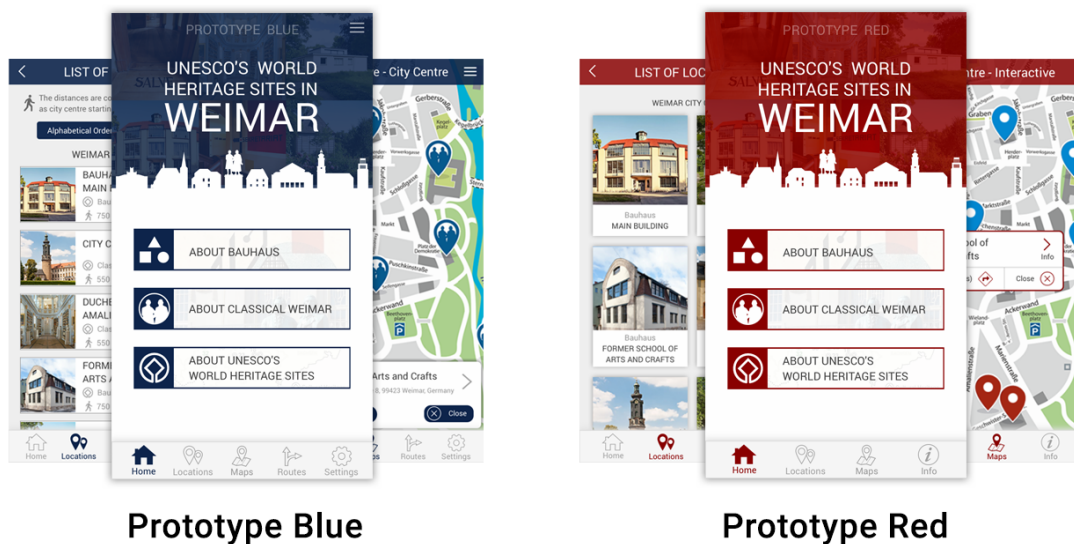
Mark only one oval.

    ○ The Blue version covered better Weimar and it's locations
    ○ The Red version covered better Weimar and it's locations
    ○ Both were the same, in terms of showing Weimar and it's locations

< Skip to question 68 >

67. After using the prototype(s), would you consider in visiting Weimar to see the selected locations in person? *

Mark only one oval.

- ⭘ Yes
- ⭘ No
- ⭘ Maybe

< Skip to question 68 >

A.5.6 – Final open answer

68. After reviewing some screenshots on both versions, would you like to add or suggest something? (optional)

(long-answer text field)

A.5.7 Question about the questionnaire

69. Thank you so much for participating in this evaluation. Before you go, can you tell how easy was to fill out this questionnaire? *

Mark only one oval.

	1	2	3	4	5	
Very hard	⭘	⭘	⭘	⭘	⭘	Very easy

Declaration / Ehrenwörtliche Erklärung

Ich erkläre hiermit ehrenwörtlich, dass ich die vorliegende Arbeit ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus anderen Quellen direkt oder indirekt übernommenen Daten und Konzepte sind unter Angabe der Quelle gekennzeichnet.

Es waren keine weiteren Personen an der inhaltlich-materiellen Erstellung der vorliegenden Arbeit beteiligt. Insbesondere habe ich hierfür nicht die entgeltliche Hilfe von Vermittlung- bzw. Beratungsdiensten (Promotionsberater oder anderer Personen) in Anspruch genommen.

Die Arbeit wurde bisher weder im In- noch im Ausland in gleicher oder ähnlicher Form einer anderen Prüfungsbehörde vorgelegt.

Ich versichere, dass ich nach bestem Wissen die reine Wahrheit gesagt und nichts verschwiegen habe.

Derby, den 25. Januar 2021

Unterschrift

Curriculum Vitae / Lebenslauf

Personal Data

Name: Joatan Preis Dutra

Birth Date and Place: 12th July 1974, Florianópolis / Brazil

Citizenship: Brazilian and Italian

Academic Formation

Since April 2012   Doctoral Candidate at the Faculty of Media

                              Bauhaus-University Weimar

                              Weimar / Germany

Oct. 2008 – Oct. 2011   MSc in Digital Media

                              An inter-university programme from University of Bremen, Bremen University of Applied Sciences, University of the Arts Bremen, and Bremerhaven University of Applied Sciences

                              Bremen / Germany

Oct. 2003 – Feb. 2006   MSc in Multimedia Production

                              Kiel University of Applied Sciences

                              Kiel / Germany

Mar. 1995 – Aug. 2002   BA in History and Teaching

                              UFSC – Universidade Federal de Santa Catarina

                              Florianópolis / Brazil

Further Academic Training / Workshops

Sep. 2019   History Takes Place – Dynamics of Urban Change /
                             Centennial of Bauhaus

                             ZEIT – Stiftung Ebelin und Gerd Bucerius
                             & The White City Center

                             Tel Aviv – Jaffa / Israel

Apr. 2019   Future Friends Speculative Design Conference & Workshop

                             ITD Institute for Transmedia Design & University of Split

                             Maribor / Slovenia

Oct.-Nov. 2017   Hybrid Heritagescapes as Urban Commons in Mediterranean
                             Cities: accessing the deep-rooted spatial interfaces of cities

                             The Cyprus Institute

                             Nicosia / Cyprus

Feb. 2017   Co-Creating of Inclusive and Digital Mediated Public Spaces

                             CeiED – Universidade Lusófona

                             Lisbon / Portugal

Oct. 2016   Games for Cities: Cities, Public Space, Play, Circular Economy

                             Lectorate of Play & Civic Media – Amsterdam University of
                             Applied Sciences

                             Amsterdam / Netherlands

Aug.-Sep. 2015   ICTs to Promote Sustainable Tourism. Tangible and Intangible
                             Heritage between Cultural, Leisure, and Gastronomic Tourism

                             UNESCO Chair of ICT to develop and promote sustainable
                             tourism in World Heritage Sites
                             USI – Università della Svizzera Italiana & Millano Biccoca

                             Milan / Italy

Sep. 2015	1st INCONET-GCC2: Collective awareness platforms for Smart Cities development
	University of Thessaly
	Volos / Greece
Apr. 2015	Interculturalism in Historical Education
	POLIN Museum of the History of Polish Jews
	Warsaw / Poland
Jul. 2014	3rd EINS Summer School: From Smart Cities to Engaged Citizens
	University of Thessaly
	Volos / Greece
Jun. 2014	Connecting Cities – Urban Media Lab
	iMal – center for digital cultures and technology
	Brussels / Belgium
Aug.-Sep. 2013	UrbanIxD (Urban Interaction Design) Summer School
	University of Split
	Split / Croatia
May 2013	MediaCity 4 – Digital Media and Urban Spaces
	University at Buffalo
	Buffalo / USA
Sep. 2009	IPCity Summer School – Digital Storytelling
	Vienna University of Technology
	Vienna / Austria

Academic Career

Since Aug. 2018   Senior Lecturer in Media Production

                         Leicester Media School
                         De Montfort University Leicester

                         Leicester / United Kingdom

Nov. 2017 – Jul. 2018   Assistant Lecturer

                         College of Arts, Humanities and Education
                         University of Derby

                         Derby / United Kingdom

Sep. 2012 – May 2016   Lecturer

                         Chair of Interface Design
                         Bauhaus University-Weimar

                         Weimar / Germany

Industry Career

Jul. 2001 – Sep. 2011   Art Director

                         mutação - arte digital

                         Florianópolis / Brazil

Feb. 2005 – Sep. 2006   Art Director / Visual Programmer

                         Imprint Digital Foto GmbH

                         Kiel / Germany

Sep. 2004 – Jan. 2005   Visual Designer and Programmer

                         Macio GmbH

                         Kiel / Germany

Aug. 1998 – Jul. 2002   Visual Designer and Programmer

Teclan – Engenharia de Software Ltda

Florianópolis / Brazil

Mar. 1995 – Jun. 1998   Visual Production Assistant

SENAI's (National Industrial Training Service)
CTAI (Automation and Computing Technology Center)

Florianópolis / Brazil

Publications

Nov. 2020   "Building Guidelines for UNESCO World Heritage Sites' Apps"

Joatan Preis Dutra

Conference Paper

ISSN: 2308-4138

ISBN: 978-1-61208-761-0

ACHI 2020 - The Thirteenth International Conference on Advances in Computer-Human Interactions

Valencia / Spain

Jul. 2018   "INTA MOAT: a tool for governing the urban commons"

Dutra et al.

Proceedings Paper

Book: ISBN 978-1981237173

Nicosia / Cyprus

Mar. 2018   "Informing, banning and protesting: an international journey through icons and pictograms" (Originally in Portuguese)

Joatan Preis Dutra, Ivana Ebel

Magazine Article

ANER – Special Design

São Paulo / Brazil

Dec. 2017	"Design Principles for Co-Creating Inclusive and Digitally Mediated Public Spaces"
	Dutra et al.
	Proceedings Paper
	Book: ISBN 978-989-757-059-9
	Lisbon / Portugal
Dec. 2014	"Cultural hARitage: Augmented Reality applied on Cultural Heritage"
	Joatan Preis Dutra, Ivana Ebel
	Conference Paper: EuroVR 2014
	DOI: 10.2312/eurovr.20141349
	Bremen / Germany
Feb. 2012	"HCI/GUI Design Applied for Adaptable Context-Aware Mobile Game"
	Joatan Preis Dutra
	Conference Paper: CLAP Conference (HfK Bremen)
	Bremen / Germany
Feb. 2012	"The Hand in Digital Culture: Marcel Duchamp, Salvador Dalí and the "Immaterial" Connection"
	Joaran Preis Dutra, Ivana Ebel
	Conference Paper: CLAP Conference (HfK Bremen)
	Bremen / Germany

Languages

Portuguese	Mother Language
English	Proficient
German	Intermediate
Spanish	Intermediate
Italian	Intermediate

Bauhaus-Universität Weimar

Cultural Heritage on Mobile Devices:

Building guidelines for UNESCO world heritage sites' apps

DOCTORAL THESIS DEVELOPED BY

JOATAN PREIS DUTRA

MMXXI