DESIGN PRINCIPLES IN MOBILE WEB USABILITY

Bachelor’s thesis in Informatics (15 credits)

Elena Pettersson
Tiffany Thai

Fall 2016 KANI17
Title: Design Principles in Mobile Usability

Year: 2017

Authors: Elena Pettersson, Tiffany Thai

Supervisor: Carina Hallqvist

Abstract
As the use of mobile devices is increasing and the use of laptops and computers is decreasing it is becoming more important to design for better web usability across platforms. The established design principles for web design provide guidelines when designing and testing web usability. The principles, however, are not commonly used to evaluate and test the usability of mobile websites. This study seeks to examine how the usability of mobile and desktop websites is affected based on the adaption of established web design principles. The study is built upon an analytical framework where common keywords have been selected from a selection of established web design principles. This study takes on a qualitative approach with experimental features, using a heuristic evaluation, a usability study and an eye-tracking experiment. The study indicates that there is a connection between low adaption of certain keywords of web design principles and the usability of mobile and desktop websites, contributing to a deeper understanding of how adaption of design principles affect web usability across platforms.

Keywords: Usability, Mobile Usability, Design Principles, Heuristics, Responsive Web Design, Mobile Optimised Design, Eye-tracking
**Sammanfattning**

Acknowledgements
We would like to thank our wonderful supervisor Carina Hallqvist for her guidance and patience. We would also like to thank the participants for their contribution, we could not have made it without you!
# Table of Contents

1. **INTRODUCTION** ........................................................................................................... - 1 -
   1.1 DISPOSITION .............................................................................................................. - 4 -

2. **THEORETICAL FRAMEWORK** ...................................................................................... - 6 -
   2.1 DESIGN METHODS ...................................................................................................... - 6 -
   2.2 INTERACTION DESIGN AND USABILITY ................................................................. - 7 -
   2.3 DESIGN PRINCIPLES ................................................................................................. - 8 -
      2.3.1 Common Keywords of Established Design Principles ......................................... - 8 -
      2.3.2 Nielsen’s Design Principles ................................................................................ - 9 -
      2.3.3 Sharp, Preece and Roger’s Five Most Common Design Principles .................... - 10 -
      2.3.4 Government UK’s Ten General Design Principles ............................................. - 11 -

3. **METHODOLOGY** ........................................................................................................... - 13 -
   3.1 RESEARCH DESIGN .................................................................................................... - 13 -
   3.2 DESIGNING THE ANALYTICAL FRAMEWORK: DESIGN PRINCIPLES AND EVALUATION .................................................................................................................................. - 14 -
   3.3 DATA COLLECTION ..................................................................................................... - 16 -
      3.3.1 Content Analysis ................................................................................................. - 16 -
      3.3.2 Using Pre-studies as a Mean and Method to Create Validation for the Main Study ................................................................................................................................. - 17 -
      3.3.3 Usability Testing and Heuristic Evaluation ......................................................... - 18 -
      3.3.4 Eye-Tracking Experiment .................................................................................... - 21 -
   3.4 SAMPLING AND SELECTION ...................................................................................... - 24 -
      3.4.1 The Websites ....................................................................................................... - 24 -
      3.4.2 The Participants ................................................................................................... - 26 -
   3.5 ETHICAL CONSIDERATION ......................................................................................... - 27 -

4. **EVALUATION OF THE CONTENT ANALYSIS** .......................................................... - 29 -
   4.1 CONTENT ANALYSIS OF NELLYS WEBSITE ............................................................ - 29 -
      4.1.1 Visibility .............................................................................................................. - 29 -
      4.1.2 Consistency ......................................................................................................... - 30 -
      4.1.3 Flexibility/Constraints ....................................................................................... - 30 -
      4.1.4 Feedback ........................................................................................................... - 30 -
      4.1.5 Context ............................................................................................................... - 31 -
   4.2 CONTENT ANALYSIS OF ELLOS WEBSITE .............................................................. - 31 -
      4.2.1 Visibility .............................................................................................................. - 31 -
      4.2.2 Consistency ......................................................................................................... - 31 -
      4.2.3 Flexibility/Constraints ....................................................................................... - 32 -
      4.2.4 Feedback ........................................................................................................... - 32 -
      4.2.5 Context ............................................................................................................... - 33 -
   4.3 CONTENT ANALYSIS OF H&MS WEBSITE ............................................................... - 33 -
      4.3.1 Visibility .............................................................................................................. - 33 -
      4.3.2 Consistency ......................................................................................................... - 33 -
      4.3.3 Flexibility/Constraints ....................................................................................... - 34 -
      4.3.4 Feedback ........................................................................................................... - 34 -
      4.3.5 Context ............................................................................................................... - 34 -
   4.4 SUMMARY OF THE CONTENT ANALYSIS ............................................................... - 35 -

5. **RESULTS OF USABILITY TESTING AND EYE-TRACKING EXPERIMENT** ........... - 36 -
   5.1 NELLYS WEBSITE ...................................................................................................... - 36 -
   5.2 ELLOS WEBSITE ....................................................................................................... - 40 -
   5.3 H&MS WEBSITE ....................................................................................................... - 42 -

6. **DISCUSSION** .................................................................................................................. - 45 -
   6.1 Visibility ..................................................................................................................... - 45 -
   6.1.1 Consistency ........................................................................................................... - 47 -
   6.1.2 Flexibility/Constraints ......................................................................................... - 48 -
   6.1.3 Feedback ............................................................................................................... - 48 -
List of Figures
Figure 1.1 Disposition of Thesis................................................................. - 5 -
Figure 2.1 Sections of the Theoretical Framework.................................. - 6 -
Figure 3.1 The Relationship Between Our Selected Design Principles and Their Common Keywords................................................................. - 16 -
Figure 3.2 Nielsens(1995a) graph shows the proportion of usability problems in an interface found by heuristic evaluation using various numbers of participants. The graph represents the average of six case studies of heuristic evaluation........ - 19 -
Figure 3.3 Calibration of the Eye-tracker in Action................................... - 21 -
Figure 3.4 Error in the Eye-tracking Analysis................................. - 24 -
Figure 3.5 Mobile FrontPage of Nelly.com is Seen to the Left and the Desktop Version to the Right......................................................... - 25 -
Figure 3.6 Mobile FrontPage of Ellos is Seen to the Left and the Desktop Version is Seen to the Right......................................................... - 26 -
Figure 3.7 Mobile FrontPage of H&Ms is Seen to the Left and the FrontPage of the Desktop Website is Seen to the Right......................................................... - 26 -
Figure 4.1 Presentation Order of the Analysed Websites........................ - 29 -
Figure 4.2 Selected Keywords and Their Order of Appearance............... - 29 -
Figure 5.1 Heatmap from Nellys checkout, showing the layout of the checkout... - 38 -
Figure 5.2 Illustrates the eye-movements of a participant at the check-out for NLYman ................................................................. - 39 -
Figure 5.3 Heatmap showing the step in the checkout-process where the user is given multiple option of how to proceed......................................................... - 41 -
Figure 5.4 The Mobile Version of the Same Step in the Checkout-process as the one Presented in Figure 5.3................................................................. - 42 -
Figure 5.5 H&M Menu for Desktop Version........................................ - 43 -
Figure 5.6 Placement of Filters, H&Ms Desktop Website and a Gazeplot ....... - 43 -

List of Tables
Table 2.1 Majid, Kamaruddin and Mansors (2016) Summary of the most common keywords................................................................. - 9 -
Table 2.2 Summary of Nielsens Ten General Principles for Heuristic Evaluation . - 9 -
Table 2.3 Summary of Sharp, Preece and Rogers Five Most Common Design Principles ...................................................................................... - 10 -
Table 2.4 Summary of Government UK’s Ten General Design Principles....... - 11 -
Table 3.1 The Selected Design Principles and Their Common Keywords........... - 15 -
Table 4.1 Rating of the Likert Scale ........................................................... - 29 -
Table 4.2 Content Analysis Summary for the Selected Websites, Based on the Selected Keywords ................................................................. - 29 -
Table 4.3 Summary of Established Design Methods for the Selected Websites .... - 35 -
1 Introduction

Ask yourself, how often do you use your smartphone to check something online rather than taking out your laptop or sitting down by your desktop computer. According to a report from Statistiska Centralbyrån (SCB), a statistical institute in Sweden, between 76 to 89 percent of the Swedish private users in the ages 16 to 54 used their smartphone or mobile phone to connect to the internet in the first quarter of 2015 (Carlsson & Fredin 2015). Nielsen (2000) speaks of the importance of designing for better web usability, if a user cannot figure out how a website works fast enough they will leave, the users are growing more impatient and wish to access information in an instant on all units. A Swedish survey from 2015 shows that almost nine out of ten participants answered that they have a smartphone (Wigren 2015). Drubin (2014) predicts that 5.13 Billion people worldwide will use mobile phones by 2017. The number of mobile units is increasing and the number of desktop units is decreasing. The number of so called ultra-mobile units (tablets and hybrids for example) is also increasing according to research published by Gartner Group (Meulen & Rivera 2014). This thesis will however focus on smartphones and desktop computers, although it is important to recognise that there are other mobile units present in the large context. Consequently, there are events and factors that have contributed to shaping the web into how it looks today, a selected few will be presented briefly before presenting some related research which has leads up to the aim, purpose of this thesis.

In 1992 there were approximately 50 websites in the world and five years later there were about a million, the reason for this growth was the web browser (Boulton 2014). Horton and Quesenberry (2014) point out that the web is making the world a smaller and more connected place, but they also explain that there is still much work to be done in order to make the web an inclusive place that everyone can use. The web is not to be confused with the internet. Internet is the global system and infrastructure which carries various services, the web is one of the services carried out by the internet (Boulton 2014).

Innovation in information and communication technology has resulted in the creation of new opportunities for businesses. The use of internet has grown tremendously large within a relatively short period of time according to Furnell (2004) and the growth of the internet has made way for Electronic Commerce, or simply e-commerce as it is also called. E-Commerce can be defined as commercial transactions conducted electronically on the Internet. E-commerce has become almost vital for businesses in the modern society (Furnell 2004). The internet has provided e-commerce, a key for global trade and the use has kept growing over the years (Furnell 2004). As IT has become one of the core elements in our society its importance just keeps increasing (Leu, Lin & Castiglione 2011) but although it is widely used, it is not done so without risks (Furnell 2004). Boulton (2014) explains that e-commerce makes it possible to shop at any time and almost anywhere in the world, the retailers are no longer limited to certain locations or opening hours and they can reach out to more customers to a lower cost. The boundaries between physical shops and the web shops are becoming vaguer, shop-and-collect is increasing in popularity, individual pricing and tailored offers based and much more. E-commerce was the origin of many innovations, such as banner ads, cookies, SSL, Collaborative filtering and responsive design, personalization of ads and unique offers are only a selected few (Boulton 2014). The development and growth of e-commerce and online retail has not been without problems. Boulton (2014) speaks of several events and happenings which have shaped e-commerce and internet into the one we know today, security problems, design problems and other factors have shaped the web. The infamous IT bubble
was an event from which the industry learned, and today a quarter of all purchases are made online in some countries (Boulton 2014).

In 2004 Nokia introduced the first phone that could access and display HTML webpages in the US and Europe (Boulton 2014). Although this was new in Europe and US it was not very new in other places. By that time in Japan the number of people browsing the internet via their phone was exceeding the number of people who used their PC to browse the internet. The new touchscreen interfaces, larger screens and faster connections added a new dimension to the browsing experience, by using for example mobile maps the need of asking for directions was reduced as the location services made it easy to find a specific place. Although this was an event that shaped web design as there was now an increasing demand of browsing the web on much smaller screens. Despite this, Boulton (2014) points out that designers have had to create websites that worked in multiple resolutions as the screen resolutions have always varied, the way he puts it is that websites are just like users, they come in all shapes and sizes and it is the designer’s job to accommodate them in the best possible way.

As the technology has developed over the years, it has become more distinct that web designers do not have control over how the users choose to access a website. Users may choose to access it on various units, with various screen sizes and resolutions stretching from smartphones to high resolutions computer screens or even by using their TVs (Östberg, 2016). In Sweden, the use of mobile phones vary among the age groups, between 76 and 89 percent of the age-group 16-54 use their smartphone outside their home (Carlsson & Fredin 2015). The same study shows that more than three quarters of the Swedish population are using internet daily and the statistics show a broad usage of internet and smartphones. The screens on our phones is increasingly the most important, Boulton (2014) phrases it as “We now work, play, shop, organize and socialize on the move. [...] The mobile web has transformed not only how we browse the web but also how we live our lives.”. Despite the increasing use of smartphones and the importance of the mobile web most websites are still designed and optimised for desktop browsers (Boulton 2014). But the increasing use of mobile and smartphones to access the internet makes it a growing risk to target only a desktop audience as it has the danger of excluding certain groups, making mobile-compatibility an important consideration (Patel et al. 2015).

This thesis will not elaborate the differences between the Internet and the Web further. Interaction design is an important aspect when designing for a user experience. The term user experience (also known as UX) is associated with a wide variety of meanings, from traditional usability to the beauty of a website. The term user experience is an umbrella term used in the field of human computer interaction (HCI) and interaction design (Hassenzahl & Tractinsky 2006). Interaction design is a technique for designing innovative interactive products and services with good user experience. Arvola (2014) explains that good user experience is the overall goal of design work. Cooper, Reimann and Cronin (2007) argue that the essentials in interaction design is the notion of that technology should serve human intelligence and imagination. Sharp, Preece and Rogers (2015) explain that an aim of interaction design in websites is to reduce the negative aspects, such as frustration and annoyance of the user experience while enhancing the positive aspects such as enjoyment and engagement. Looking from a user's perspective it is in essence about developing interactive products that are easy, effective and pleasurable to use (Sharp, Preece and Rogers 2015).

There are various methods to design for better usability, and there are guidelines for interaction design to create better user experiences. Certain design principles are common in
interaction design, and are rules of thumb rather than specific usability guidelines (Nielsen 1995b).

Majid, Kamaruddin and Mansor (2015) establish that there are many studies and theories regarding web usability design principles (Hence forward referred to as simply design principles). Those theories do, however, not always apply for responsive web design (a design method where the content of a website responds to the size of the screen used and adapts the content accordingly (Peterson 2014). Majid, Kamaruddin and Mansor (2015) examined the practice of the design principles in responsive web design for e-commerce websites in their research, in which they pointed out that there is little research regarding the relationship between design principles and responsive design. There have been several usability studies carried out regarding mobile usability by for example Nielsen and Budiu (2013). Patel et al. (2015) conducted a case study comparing two design methods, mobile-optimised design (a design method where separate websites are developed for multiple platforms (Peterson 2014)) and responsive design. There are several studies comparing design methods and usability, trying to establish which method is better. However, little research has been carried out regarding design methods, design principles and mobile web usability. Majid, Kamaruddin and Mansor (2015) studied how various design principles have been adapted to mobile websites, they conclude their research by recommending further research in the area.

Subsequently, this research project, based on the problem presented above, seeks to examine how the usability of mobile and desktop websites is affected by the adaption of usability design principles, in order to obtain a deeper understanding. The investigation seeks to compare existing e-commerce websites against a range of usability principles.

Based on the research problem presented above, the following research question has evolved:

*How can we, by investigating usability and adaption of design principles to mobile and desktop websites, obtain a deeper understanding of the user preferences regarding e-commerce websites across platforms?*

The purpose of this study is to perform a qualitative study with experimental features to obtain more information about the user experiences and preferences regarding mobile and desktop e-commerce websites in relation to the usability design principles. We believe that it is an important and relevant topic to study, as there is little research between the usability design principles and their adaption to various design methods for mobile websites. As such, we hope to contribute with a deeper understanding of the phenomena. Moreover, in a study Majid, Kamaruddin and Mansor (2015) recommend further research to be made regarding design principles and mobile websites. Our thesis seeks to connect areas of research that have previously existed separately, making a connection between. As there is research comparing the two selected design methods (responsive and mobile-optimised design) to one another, the purpose of this thesis is not to determine which approach is better or more suitable. Consequently, our study therefore focuses on investigating the usability of both mobile-optimised design and responsive design in relation to usability design principles. The study compares existing e-commerce platforms, both responsive websites and mobile-optimised websites, against a range of selected usability design principles by performing content analysis and a usability study, with a supplementary eye-tracking experiment. Content analysis is the major element in Majid, Kamaruddin and Mansors (2015) study, where the focus is to identify the usability principles adapted to responsive design. Subsequently, we find it highly relevant to conduct an empirical study, which includes both a content analysis
and an observational usability study that focuses on the users and their experience and preferences. The purpose is not to research whether responsive design or other development methods are better but to provide an understanding of the user preferences when adapting the usability design principles.

Our wish is to provide more in-depth knowledge regarding the relationship between the usability design principles and responsive design based on the user experience and preferences. The study is therefore primarily aimed for researchers studying the usability design principles and methods for website development. The research will also target developers and businesses using mobile platforms and help those to obtain a deeper knowledge of the user preferences when choosing a development method. Furthermore, the research will be of interest for Information Technology and design students to obtain understanding of the correlation between the usability design principles, development methods and the user experience.

The primary task of our investigation is to gather opinions from users experiencing responsive design and mobile websites in order to investigate how the design principles are adapted to responsive design and how large compromises are acceptable from the user perspective. Web Design is based on the design principles, the principles are theoretical guidelines for how to design for better web usability (Nielsen 1995b; Horton & Quesenbery 2014; Peterson 2014; Sharp, Preece & Rogers 2015; Boulton 2014. There are several interpretations and versions of the principles they are all based on the same foundation. Our investigation does not focus on all established Design Principles but on a selected few, Nielsens (1990)” Ten General Principles of User Interface Design for Heuristics Evaluation”, the “Ten Design Principles” listed by the British Government (Österberg 2016) and “The Five Most Common Design Principles Listed by Sharp, Preece and Rogers” (2015). An analytical framework is built to summarise and distinguish common keywords of the selected principles to obtain a better overview. Our research does not focus on mobile applications but on mobile and desktop websites.

Other limitations of this study are that the primary group of participants are young adults and adults who have experience of using internet and smartphones. The group of participants is randomly selected, although the geographic limit is the city of Borås and Gothenburg as the observations will be made at the University of Borås. The result may therefore vary for other groups, such as the elder people or for other geographic areas.

1.1 Disposition

The next chapter presents the theoretical framework upon which the thesis is built, followed by the methodological chapter in which the constructed analytical framework will be presented. The result of the research is presented in two chapters: The Result of the Content Analysis and The Result of the Usability Test and Eye-Tracking Experiment. The results are discussed in Chapter 6 and a conclusion is presented in Chapter 7. The disposition of the thesis is illustrated in Figure 1.1.
Figure 1.1 Disposition of Thesis
2 Theoretical Framework

The theoretical framework upon which this bachelor thesis is founded on is primarily papers and literature work in the related area. The theoretical framework is presented in this section of the thesis in order to provide a background for the method upon which this thesis is based. This chapter begins by a brief presentation of design methods relevant for this thesis. It then proceeds to briefly explain the concepts of interaction design and usability. Further it continues to present a summary of a conceptual framework. Subsequently, the design principles which are of interest for this thesis are presented. The sections of the theoretical framework, and the order in which they are presented is seen in Figure 2.1.

2.1 Design Methods

There are two primary design methods for developing a mobile website, the mobile-optimised approach and responsive web design (Patel et al. 2015). Österberg (2016) mentions that there is a third design method, being adaptive web design which is similar to responsive web design.

Patel et al. (2015) discuss how *mobile-optimised design* has a fixed layout and fixed height and width dimensions of a mobile device. For larger screens the mobile-optimised sites appear in a fixed frame, or are rescaled to fill the whole window. Accordingly, Nielsen and Budiu (2013) propose some basic ideas for designing mobile-optimised websites. One idea is to eliminate functionalities and cut features that are not crucial for the users of the mobile sites. Another idea is to cut the content in order to reduce the word count and place secondary information in secondary pages. The idea is to enlarge the interface elements to make it easier for the users to interact with the touch screens using their fingers. A mobile site should have the same range of products as on the full site although it should have less information than the full site, this is especially important for e-commerce websites as customers who cannot find a product on a mobile website will assume that the company does not sell it.

*Responsive Web Design* (RWD) is the first generic term where one single website is able to handle all visitors, no matter of what device they are using without separate solutions, Östberg (2016). RWD makes no assumptions about width or height, the websites respond smoothly to the device used and images can be repositioned, navigation can be adjusted, content can be re-aligned and font sizes adjusted making it a better experience for both the user and the developer. A responsive website responds elegantly to the device and images can be repositioned, navigation can be adjusted, content can be re-aligned and font sizes adjusted making it a better experience for both the user and the developer Boulton (2014). Nielsen and Budiu (2013) speak of the importance of designing for both screens, understanding that the responsive design is not about just moving around the content to fit the screen but to understand how the content should be moved in the sheets. Nielsen and Budiu (2013) explain how different page elements are placed in a flexible grid that morphs to the dimensions of the screen, using a multi-column layout. With this kind of technology, only one version of website is needed, and the device will automatically rearrange its content according to the screen size of the device. Without making the user zoom in or out to be able to read or navigate throughout the web page on a small screen device (Peterson 2014). RWD was primarily designed to adapt the websites to the users’ needs and to any devices. Östberg mean...
that a website should be able to have a user-friendly interface and be useful in any devices without any special solutions. The new trend in different versions of browsers and various size of devices screen resolution must adopt responsive design in order to provide coherent website layout of all types of devices. According to Patel et al. (2015) RWD is being widely adopted to maintain the usability across a diversity of devices and screen sizes.

The idea behind Adaptive Web Design (AWD) is to tailor every detail of each visitor's experience when visiting a website, according to Österberg (2016). One of the first possibilities of adaptive design was to allow the displaying of websites using more advanced scripts of new web browsers where corners could be rounded off and such, while users who used the older web browsers got an “uglier” display. According to Österberg (2016) it has been argued that many of the features of AWD are already included in good RWD. For the simplicity of things, Österberg (2016) explains AWD as a responsive website where there is room for a customised or tailored experience based on the user conditions. The primary difference between AWD and RWD is that AWD can send different code to different units, with the limitations of knowing the user’s conditions and which device they are using, deciding if they are worth adapting for or not. Examples of conditions which may vary and be of use for the design of an adaptive website are i) does the device have a camera, ii) how is the device navigated or iii) can the device tell a geographic location.

2.2 Interaction Design and Usability

The purpose of interaction design is to create user experience (Sharp, Preece & Rogers 2015) by supporting the communication and interaction between people in their everyday and working lives. A main reason of understanding users in the contexts on how people work and lives to be clear about the primary objective developing a interface. Interaction design is multidisciplinary, involving many inputs from wide ranging disciplines and fields. One of the main aims of interaction design is to reduce the negative aspects such as frustration and annoyance of the user experience, while enhancing the positive ones such as enjoyment, engagement. In essence, it is about developing interactive products that are easy, effective, and pleasurable to use from the user perspective (Sharp, Preece and Rogers 2015). Design principles are useful heuristic for analysing and evaluating aspects of an interaction design. The principles are used by interaction designers to support their creativity and improve the design when designing for user experience (UX). The principles are guidelines which are intended to orient the designers to consider various faces of designing. Nielsen and Budiu (2013) explain how the usability guidelines seldom have a single answer, they are more of qualitative issues that specify the direction of inevitable design trade-offs. They explain that the principles are applicable for the mobile devices, although the judgement of what to include should be harsher as the screen-sizes become smaller. Mobile usability requires a stricter and a more scaled-back design than desktop usability, this is why it is important to separate the two.

Usability is a commonly used concept in interaction design, according to Nielsen (1994) it is important to define the abstract concept of usability. Nielsen (1994) argues that it is important to realise that usability is not a single, one-dimensional property of an interface. Usability has multiple components which are traditionally associated with five attributes: (1) Learnability, (2) Efficiency, (3) Memorability, (4) Errors, and (5) Satisfaction. Nielsen (1994) explains that the usability attributes may be an illuminating exercise to consider how the usability of a system could be made measurable, clarifying that the measurable aspects of usability are better than aiming at a feeling of, what he calls, “user friendliness”. Heuristic Evaluation is an
usability engineering method that uses Design Principles to evaluate the usability. It will be elaborated on further later in this chapter. There are many definitions and views of usability, this research will use Nielsen's definition as the investigation builds upon the Heuristic Evaluation proclaimed by Nielsen and Molich in 1990 (Nielsen 1995b).

2.3 Design Principles

There are many versions and approaches of the Design Principles, to organise the chaos we have chosen to create a conceptual framework. The conceptualised framework is based on a similar one created by Majid, Kamaruddin and Mansor (2015), although some of our keywords and principles differ from theirs. The following sections present the original framework and the design principles selected for our thesis.

2.3.1 Common Keywords of Established Design Principles

Majid, Kamaruddin and Mansor (2015) conducted a similar study, in which they researched adaption of usability principles in responsive web design. The study is also based on established design principles by three different scholars, Nielsen, Galitz and Preece. Majid Kamaruddin and Mansor (2015) argue that their selected design principles have highlighted the same needs to be considered. They have therefore selected the five most identifiable keywords in the works of their selected scholars, and the established design principles and guidelines. In their study, Majid, Kamaruddin and Mansor (2015) have therefore chosen to identify and extract five keywords from their selected design principles to make the analysis of the websites more distinct. The result of the summary, and their selected principles is seen in Table 2.1. The websites are evaluated and analysed based on the five keywords and the results are discussed accordingly. Majid, Kamaruddin and Mansor (2015) argue that the extracted keywords should be included for web developers’ assessment of the effectiveness of the interface design in responsive web design.

Thus, the method of extracting keywords has been of interest in the construction of this study. The Design Principles selected for our study are presented in the next section. The keywords and principles selected by Majid, Kamaruddin and Mansor were considered to be the most suitable for their study, in our study we have chosen to include other scholars and a modified table that suits our aim which is presented in chapter 3. Our framework will be referred to as an analytical framework, as it is an analytical tool developed for the research.
Nielsen’s ten general principles of interaction design, also known as the heuristics, are some of the most recognised design principles. The principles are rules of thumb rather than specific usability guidelines (Nielsen 1995b). Nielsen’s principles have been included as they are recognised and well established in interaction design. A summary of the ten heuristics is displayed in Table 2.2.

Table 2.2 Summary of Nielsen’s Ten General Principles for Heuristic Evaluation

<table>
<thead>
<tr>
<th>Principles Suggested</th>
<th>Common keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Visibility</td>
<td>Consistency</td>
</tr>
<tr>
<td>2. Familiarity</td>
<td>Familiarity</td>
</tr>
<tr>
<td>3. User constraint and freedom</td>
<td></td>
</tr>
<tr>
<td>4. Consistency</td>
<td></td>
</tr>
<tr>
<td>5. Error prevention</td>
<td></td>
</tr>
<tr>
<td>6. Recognition</td>
<td></td>
</tr>
<tr>
<td>7. Flexibility</td>
<td></td>
</tr>
<tr>
<td>8. Aesthetically pleasing</td>
<td></td>
</tr>
<tr>
<td>9. Efficiency Feedback</td>
<td></td>
</tr>
<tr>
<td>10. User Task</td>
<td></td>
</tr>
</tbody>
</table>

2.3.2 Nielsen’s Design Principles

The basic principles of interface design (Nielsen, 1990)

<table>
<thead>
<tr>
<th>Visibility of system status</th>
<th>the system should always keep users informed about what is happening by giving feedback.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Match between system and the real world</td>
<td>the system should speak the user's language using words, phrases and concepts that are familiar to the user rather than technical terms. The information should appear in natural and logical order.</td>
</tr>
<tr>
<td>User control and freedom</td>
<td>Users make mistakes, often by choosing the wrong system function. Therefore, there is a need to have a clearly marked &quot;emergency exit&quot; for the users to leave the function or to change their choices without having to go through an extended dialogue. The support of undo and redo is important.</td>
</tr>
<tr>
<td>Consistency and standards</td>
<td>The Users should not have to be confused about if different words, situations, or actions have the same meaning, it is important to follow the platform conventions.</td>
</tr>
</tbody>
</table>
Error prevention

Even better than good error messages is a careful design that prevents a problem from occurring in the first place. Either by eliminating error-prone conditions or checking for them and presenting the users with a confirmation option before they commit to the action.

Recognition rather than recall

The user’s memory load should be minimised by making objects, actions and options visible. The users should not have to remember information from different parts of the dialogue. The instructions for using of the system should be visible or easily retrievable when appropriate.

Flexibility and efficiency of use

Accelerators are unseen by the novice user, they may often speed up the interaction for the expert user, such that the system can cater to both inexperienced and experienced users. The accelerators allow users to tailor frequent actions.

Aesthetic and minimalist design

Dialogues should not contain information that is irrelevant or not needed. For every extra unit of information in a dialogue it competes with the relevant units of information and diminishes their relative visibility.

Help users recognize, diagnose, and recover from errors

Error messages should be expressed in “normal” language and not in codes. The error messages should precisely indicate the problem, and constructively suggest a solution.

Help and documentation

It may be necessary to provide help and documentation, although it is better if the system can be used without documentation. The information should be easy to search for and it should focus on the user's task, list the concrete steps to be carried out, and not be too large.

2.3.3 Sharp, Preece and Roger’s Five Most Common Design Principles

Sharp, Preece and Rogers (2015) propose five of the most common design principles of interface design which are visibility, feedback, constraints, consistency and affordance. A summary of the five principles is seen in Table 2.3. The principles have been chosen as they have been published and established. Preece published Six design principles in 1994, those are used in a study by Majid Kamaruddin and Mansor (2015). The five common principles are included in the study as they are a summary of many established principles and as they are reviewed and edited for each publication of the book Interaction Design.

Table 2.3 Summary of Sharp, Preece and Rogers Five Most Common Design Principles

<table>
<thead>
<tr>
<th>Common Design Principles:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility</td>
</tr>
<tr>
<td>Feedback</td>
</tr>
</tbody>
</table>

Visibility defines how noticeable the controls for different functions are, including indicators, headlights, horn and warning lights etc. The more visibility functions are appearing, the easier it will be for users to know what to do next.

Feedback is related to the concept of visibility, it involves sending back information about actions and what has been accomplished by the action, allowing the user to continue with the activity. There are various kinds of feedback available for interaction design, the selection of which combinations that are appropriate for various activities is central in interaction design.
### Constraints
The concept of constraining refers to restricting the kinds of interaction that can take place at the given moment. The benefit of constraints is that it reduces and prevents the user of making mistakes and selecting incorrect options by for example shading them in another colour or making them unclickable.

### Consistency
Consistency refers to designing interfaces to have similar operations and use similar elements for similar tasks. A consistent interface is, in particular, one that follows rules, inconsistent interfaces allows exceptions in the rules. One of the benefits of consistent interfaces is that it is easier to learn how to use.

### Affordance
Refers to how obvious something is to use or how inviting it is to use it. Graphical elements It is suggested that there are two kinds of affordance, real and perceived, physical objects are said to have real affordance. Perceived affordances are essentially learned conventions, interaction design falls under this category.

### 2.3.4 Government UK’s Ten General Design Principles
The Government of the United Kingdom have constructed their own design principles, (from now on referred to as GOV UKs Design Principles). Although the design principles are primarily aimed at the public sector they are still useful for all web designers. The principles are published recently and Österberg (2016) argues them as highly relevant in the interaction design field. A summary of the principles is seen in Table 2.4.

**Table 2.4 Summary of Government UK’s Ten General Design Principles**

<table>
<thead>
<tr>
<th>Government UK’s Design Principles</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start with the user needs</strong></td>
<td>Designing a service starts with identifying the user needs, what they ask for is not always what they need. It is therefore important to do research and analyse data.</td>
</tr>
<tr>
<td><strong>Do Less</strong></td>
<td>The governmental aspect is clear in this principle: the government should only do what the government can do, although it is applicable for most designs. If there is already a way to something there is no point in reinventing the wheel each time. By providing or using resources such as APIs there is an opportunity to focus on the core rather than designing everything from scratch. This principle is also applicable for how to present information and how much to present at once, the content should be clear and have a consistent theme.</td>
</tr>
<tr>
<td><strong>Design with Data</strong></td>
<td>The data should drive the decision-making, in most cases the service is not designed without experience. By looking at existing services and learning from real world behaviour it is possible to gather inspiration and information. Iteration and prototyping are important tools, A/B-testing is a suitable method to test the designs among users.</td>
</tr>
<tr>
<td><strong>Do the hard work to make it simple</strong></td>
<td>Making something simple to use is harder than making something that looks simple. If a service is complicated to use it will affect the users, not the designers and the user needs are in focus!</td>
</tr>
<tr>
<td><strong>Iterate. Then iterate again</strong></td>
<td>Iteration reduces the risk, testing with real users and moving from different stages of testing, adding and deleting features based on the feedback.</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>This is for everyone</strong></td>
<td>An accessible design is a good design, no matter how the user chooses to access the service it should work. The service should be as inclusive, legible and readable as possible; it should be built for needs and not for audiences.</td>
</tr>
<tr>
<td><strong>Understand Context</strong></td>
<td>It is not about designing for a screen or building just a website, it is about designing for the people. It is important to understand the context in which the service will be used.</td>
</tr>
<tr>
<td><strong>Build Digital services, not websites</strong></td>
<td>The digital world needs to connect with the real world, it is therefore important to consider all aspects of the service and make sure that they meet the user needs. Not all services need to be started and concluded on a website, sometimes all the user need is information of where to find the local service, this should be included in the design process even though some aspects may be out of the designers control.</td>
</tr>
<tr>
<td><strong>Be Consistent, not uniform</strong></td>
<td>Being consistent does not mean that a website should look identical on a mobile phone and a desktop computer, although they should have a recognisable design where the user can relate one to the other. It is also important to use the same language and design patterns wherever it is possible, it helps the users obtain a familiarity ant it is therefore important to make the approaches consistent. Although, the consistency aspect should not keep designers from changing and improving the designs in the future.</td>
</tr>
<tr>
<td><strong>Make things open: it makes things better</strong></td>
<td>The more eyes there are on a service, the better it gets. Sharing code, designs and ideas whenever it is possible helps improving it, better alternatives can be pointed out and mistakes can be discovered sooner.</td>
</tr>
</tbody>
</table>

This chapter has presented the theoretical framework upon which this thesis is founded. In the following chapter, methodological choices and concerns are presented and discussed. The following chapter will also present the analytical framework which is built upon the design principles and the common keywords presented in this chapter.
3 Methodology

The purpose of our research is to obtain more information about the users experiences and preferences, regarding the usability of mobile and full websites in relation to selected design principles. Qualitative methods often consist of interpretive research as it seeks to reveal or learn the meaning of opinions, behaviours or views of the participants (Bryman & Bell 2015; Recker 2015). The qualitative approach has been considered to be the most suitable approach for this study. The research strategy chosen to achieve the purpose of this study is therefore a qualitative approach with experimental features, containing interviews, think-out-loud studies, observations and an eye-tracking experiment to supplement the observations.

The choice of strategy is what distinguishes the researcher’s method of collecting, processing and analysing information and data. Recker (2015) argues that there are three main strategies of inquiry, although in his book he has chosen to add a fourth strategy. The most common strategies are the Quantitative and Qualitative strategies. The first has a focus on numbers and large amounts of data while the second emphasises words rather than numbers. The second strategy has been primarily adapted for this study, although features of quantitative nature are present. There is also a third strategy, Mixed Method, where the characteristics of the qualitative and quantitative strategies are combined (Recker 2015). Our study could be argued to have an approach of mixed method as there are features of quantitative methods involved. The primary argument for not qualifying into the category of mixed method is that the analysis of the data collected in the experiment is analysed in a qualitative way to suit the purpose of this thesis. Recker (2015) also describes a fourth, additional strategy, which is the Design Science method. This strategy is not relevant for our research as we are not developing any IT-artefacts, which this strategy is aimed for.

3.1 Research Design

Qualitative methods emphasise words rather than numbers as the methods are designed with intention of assisting researchers to study and understand phenomena in context (Recker 2015). A primarily qualitative approach has been taken on for this study to fit the purpose, which is to understand behaviour and actions in order to explain how the adaption of design principles affect the usability in certain websites. As qualitative methods were developed in social sciences to study social and cultural phenomena (Recker 2015). Qualitative methods are often used to for example study the behaviour of people in the social and cultural context, as people's way of making decisions is often contextual. Considering those features it is believed to be the more suitable approach for our thesis as it seeks to examine behaviour in a certain context. As the focus of measurement in quantitative methods tends to isolate certain aspects of a phenomena (Recker 2015) it is considered to narrow the perspective of the wider setting of our research if it is fully applied. There are however quantitative features present in the research for our study. The quantitative method used for the research is of experimental nature, however, the numerical data generated is not of interest for our research and the results of the experiments are analysed in a qualitative way. Examples of qualitative research methods include Case study research, action research, and grounded theory to mention a few, ethnography, or participant observation, are other examples of a qualitative methods (Recker 2015). The primary qualitative method used in our research is however observation. Bryman and Bell (2015) explain that by using observation, the researcher can get a picture of the culture of the social group studied in a certain environment. As the observation research strives to interpret the understanding of a phenomenon in its context and the correlation between other phenomena. This means, researchers interpreting the data collected to
understand it (Recker 2015) this is considered a suitable method to collect the information required to achieve the purpose of our thesis. Our study includes a mixture of action research, content analysis and observational research, with focus on qualitative aspects.

Qualitative methods are strategies of empirical inquiry that study phenomenon in a real-life context, the researchers collect the data and information themselves rather than using objective instruments (Recker 2015). The empiricist epistemology reckons that knowledge is obtained by experience mediated through the senses, therefore the observation and experience of empirical facts are the foundation of knowledge. Almost all data collected for this study has been collected by us through content analysis, observations and interviews, rather than using instruments. Although the eye-tracking experiment is the exception as the data is collected with help of instruments. The participants have also been asked to complete a questionnaire providing background information relevant for the tests. The quantitative methods have been included as a supplement to the qualitative approach in order to increase the validity of the study. Inductive reasoning is used to formulate and develop general conclusions or theories without them being based on already established theories by using the empirical data collection. With the results of an empirical study, induction can create theories based on the conclusions that can be drawn from the empirical data. Deduction is therefore quite the opposite of induction, as it uses reasoning based on one or more existing theories. Recker (2015) argues that a good research design should include the three themes of Observation, Induction and Deduction. We would like to claim that we fulfil those requirements as the foundation of our research is built upon previously established theories and principles, making it deductive, the collection of data is observational and the analysis of the data being deductive.

The supplemental quantitative approach has been taken on to increase the validity of our study. Bryman and Bell (2015) explain how a quantitative approach allows one to gather larger amounts of data compared to a qualitative approach. The higher amount of data can increase the validity and validate that the observational study by using numerical data. As the time frame is limited there is not enough time to perform a full quantitative study to supplement the qualitative approach chosen for this research, but the eye-tracking experiment has been included to increase the validity and reliability of the study. The selection of strategy and methods has been made to fulfil the purpose and obtain a deeper understanding of what users think about the specific web pages based on the design principles. The selection of Design Principles to be evaluated and analysed is based on Nielsens (1990) Ten general principles of user interface design for heuristics evaluation, the Ten Design Principles listed by the British Government Österberg (2016) and the five most common design principles listed by Sharp, Preece and Rogers (2015).

3.2 Designing the Analytical Framework: Design Principles and Evaluation

The design principles listed in Chapter 2 have been interpreted and summarised into five key words. Much like Majid, Kamaruddin and Mansor (2015) summarise their selected principles, which are seen in Table 2.1. We have chosen to summariser our selected principles in a similar way. Nielsen's Ten Design Principles have been included in our study as well as the study by Majid, Kamaruddin and Mansor (2015). The difference between our study and Majid, Kamaruddin and Mansors (2015) is the replacement of two scholars and their design principles. In our study we have chosen to include Ten Design Principles by GOV UK and Five Common Design Principles by Sharp, Preece and Rogers, excluding the design...
principles of Galitz and Preece which were used in the study conducted by Majid, Kamaruddin and Mansor (2015). A summary of design principles selected for this study are seen in Table 2.2, Table 2.3 and Table 2.4.

A summary of our selected design principle and the most common keyword for those is seen in Table 3.1. The relation between the keywords and the selected design principles is visualised Figure 3.1. The purpose of the categorisation is to establish a shorter list of our selected design principles to be analysed in the content analysis and to be included in the usability testing and eye-tracking experiments.

The establishment of the common keywords was based on the interpretation of the definitions of each selected principle. The connection between each principle and common key-word is seen in Figure 3.1. As the principles are interpretable it has been difficult to connect them to one single keyword, the presented connections are an overview and the presentation and discussion of the keywords may therefore overlap in the sections.

Table 3.1 The Selected Design Principles and Their Common Keywords

<table>
<thead>
<tr>
<th>Authors</th>
<th>Principles</th>
<th>Common Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nielsen’s ten general principles of user interface design for heuristics evaluation (Nielsen, 1990)</td>
<td>1. Visibility of system status</td>
<td>Visibility</td>
</tr>
<tr>
<td></td>
<td>2. Match between system and the real world</td>
<td>Consistency</td>
</tr>
<tr>
<td></td>
<td>3. User control and freedom</td>
<td>Flexibility/Constraints</td>
</tr>
<tr>
<td></td>
<td>4. Consistency and standards</td>
<td>Feedback</td>
</tr>
<tr>
<td></td>
<td>5. Error prevention</td>
<td>Context</td>
</tr>
<tr>
<td></td>
<td>6. Recognitions rather than recall</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Flexibility and efficiency of use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Aesthetic and minimalist design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Help users recognize, diagnose and recover from errors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Help and documentation</td>
<td></td>
</tr>
<tr>
<td>GOV UKs Design Principles (Österberg, 2016)</td>
<td>1. Start with the</td>
<td>Visibility</td>
</tr>
<tr>
<td></td>
<td>2. Do less</td>
<td>Consistency</td>
</tr>
<tr>
<td></td>
<td>3. Design with Data</td>
<td>Flexibility/Constraints</td>
</tr>
<tr>
<td></td>
<td>4. Do the hard work to make it simple</td>
<td>Feedback</td>
</tr>
<tr>
<td></td>
<td>5. Iterate. Then iterate again</td>
<td>Context</td>
</tr>
<tr>
<td></td>
<td>6. This is for everyone</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Understand Context</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Build Digital services, Not websites</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Be Consistent, not uniform</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Make things open: it makes things better</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Feedback</td>
<td>Consistency</td>
</tr>
<tr>
<td></td>
<td>3. Constraints</td>
<td>Flexibility/Constraints</td>
</tr>
<tr>
<td></td>
<td>4. Consistency</td>
<td>Feedback</td>
</tr>
<tr>
<td></td>
<td>5. Affordance</td>
<td>Context</td>
</tr>
</tbody>
</table>
3.3 Data Collection

The data collection was made in several steps, the first step was the content analysis, followed by a usability study which was then supplemented by an eye-tracking experiment. All steps are described in this chapter in this order.

The primary method of collecting data was the think-out-loud method and observation, those were present both in the usability tests and in the eye-tracking experiment. The results of the eye-tracking were merely a validation of what the participants said. The participants have been asked to complete questionnaires with questions of background and experience of online shopping. The tests were held in Swedish and the websites used were of Swedish origin.

3.3.1 Content Analysis

Content analysis, also known as textual data analysis, is used to assess and review the websites of interest in this thesis. The analysis can be conducted manually or by computer to determine generalities and patterns within a specific sample (Majid, Kamaruddin & Mansor 2015). The content analysis of the websites has been based on Nielsen's heuristic evaluation which was presented in the theoretical framework. The evaluation has been based on the Five keywords, presented above in Figure 3.1 and Table 3.1 in a similarity to Majid, Kamaruddin and Mansors (2015) study.

The analysis in our work has been conducted manually to determine the adaption of design principles from our selected websites. The analysis has also been conducted in order to determine which websites that are suitable for this research and to determine which category they fall into (RWD, AWD or mobile-optimised). The selection of the websites used for the study were based on a smaller content study of seven websites. The seven websites were
narrowed down to three and the adaption of design principles on those were analysed more in depth. The analysis was, as mentioned, based on Nielsen's heuristic evaluation.

The principles of interest were, Nielsen’s (1990) Ten general principles of user interface design for heuristics evaluation, secondly the Ten Design Principles listed by the British Government (Österberg 2016), and thirdly the most common interface design principles stated by Sharp, Preece and Rogers (2015). A summary of the used design principles can be found in Table 2.2, Table 2.3 and Table 2.4. The selected principles were compressed into five common keywords that have been described in the previous section. The adaption of all the selected usability principles was evaluated for each website, and graded according to a likert scale. The results of the tables are presented in the appendix as those were compressed into the five common keywords upon which the analysis and full evaluation was built upon. Tablets were excluded from the evaluation, although they were checked briefly when selecting the final three websites in order to establish whether they were mobile-optimised, responsive or adaptive.

The websites adaption of the design principles was graded according to a Likert Scale. Likert scale or rating systems are designed to measure subjects attitude, opinions or perceptions. (Knapp & Powers 2010). Likert scale method is for assigning numerical scores in a hierarchal sequence to a scale which respondents indicate their attitude towards how much respondents agree or disagree against a statement. The most common grading scale of the statements is five, but more or less categories can be used according to Bryman and Bell (2015). The scale used in this analysis was a five-grade scale. The scale was graded Good to Bad, an option of not evaluated was included but only used when it was not possible to assess the principle and is therefore not considered to be a part of the grading. The assessment was based on the opinions of the researchers, Good meant that the website was considered to have adapted the principle well, and the Bad meant that there was a lot of room for improvement. The grading of Acceptable meant that the adaption of the principles was distinguishable and that it was usable, but with room for improvements.

3.3.2 Using Pre-studies as a Mean and Method to Create Validation for the Main Study

In order to increase the validity and reliability in our study, we decided to perform two pre-studies, one for the usability study and one for the eye-tracking experiment. Each one of the pre-studies had two participants. The pre-studies were performed to improve the validity of the research. They have been performed in the same environmental setting as the real studies, in order to increase the efficiency of the real tests. The purpose of conducting the pre-studies was not only to increase validity, it was also to ensure that the timeframe for each test was accurate and that the tasks were relevant and performable. Additionally, the pre-studies were performed to investigate if the method used was appropriate for the real testing. Subsequently, the results of the pre-studies were evaluated and analysed before conducting the real studies and experiments.

The number of participants of the pre-studies were based on Nielsen’s (2000) recommendations, those are presented in the following section and visualised in Figure 3.2. Given the circumstances it did not seem necessary to have more than two participants for each pre-study as the timeframe was limited.

When performing the pre-study of the usability test the participant was given instructions upon arrival, the instructions were written on a whiteboard and explained more in depth
before starting the test. The participant was asked to pretend to purchase a pair of formal shoes to wear to a dinner on each website. During the test, it was realised that pretending to purchase a pair of shoes six times was exhausting and boring for both the participant and for the observers. The task was redesigned for the upcoming tests, but the structure and the way of giving the instructions was successful and kept for the remaining tests. It was also revealed that it was not possible for the observers to simply observe the actions without interfering. One of the participants of the pre-study did not find the category he needed to complete the task for one of the websites, and as the search function was not efficiently used the test was cut short. Subsequently making the upcoming tests more of a Heuristic Evaluation rather than a traditional usability testing, based on Nielsens (1995a) description.

The pre-study for the eye-tracking experiment was performed on one of the researcher of this thesis and one of the coordinators of SIIRs Retail Lab. The purpose of the pre-study was to familiarise with the environment and equipment used. The task given to the participant was the same as the for the final usability test, excluding the mobile testing. The structure of the test remained the same as for the usability test. The instructions were given on the screen and were verbally explained to participant upon arrival. The eye-tracking experiment was revealed to be more of a Heuristic Evaluation, with observations and thinking-out-loud where the observers communicated with the participants throughout the experiment.

3.3.3 Usability Testing and Heuristic Evaluation

Heuristic Evaluation is a usability engineering method, proclaimed by Nielsen and Molich in 1990 (Nielsen 1995a). The method is designed for finding usability problems in a user interface design in order to use the results as a part of an iterative design process. Heuristic evaluation involves having a small set of evaluators examine the interface and judge its compliance against recognised usability principles. Nielsen (1995a) suggests that his ten general principles for Heuristic Evaluation (also known as the heuristics) are suitable for this purpose (Nielsen 1995a). A summary of the Heuristics is presented in Table 2.2.

The usability tests performed were a combination of the traditional usability tests (Nielsen 1995a) and Nielsens Heuristic Evaluation, for the simplicity the testing will henceforth be referred to as Usability Testing, as the purpose is to study usability. One major difference between the two methods is how the observer of the study interacts with the participants during the test (Nielsen 1995a).

Nielsen (1995a) elaborates further on the differences between the heuristic evaluation sessions and traditional user testing. The first is the willingness of the observer to answer questions from the participants during the session and the extent to which the participants can be provided with hints on using the interface. In traditional usability testing, it is normally wanted to disclose the mistakes made by users while using the interface. The observers are therefore hesitant to provide more help than absolutely necessary. During the sessions, the observers in this study interacted with the participants, assisting them when it was required. Another difference between the methods which is pointed out by Nielsen (1995a) is that the participants in a usability test are requested to discover the answers to their questions by using the system rather than by being assisted by the observers. Nielsen (1995a) further explains that when performing a heuristic evaluation of a domain-specific application, it would be unreasonable to refuse to answer the participant’s questions about the domain, especially if the participants are inexperienced with the domain. For the participants it was considered better to assist them if problems or questions came up. Nielsen (1995a) argues that answering
the participant’s questions will enable them to better assess the usability of the user interface, with respect to the characteristics of the domain. In addition, he points out that when the participants have problems using the interface, they can be given hints on how to proceed in order to not waste time struggling with the mechanics of an interface. Although, it is important to note, that the participants should not be given help until they are clearly in need of it and comment on the usability problem in question.

Nielsen (1995a) describes how a heuristic evaluation is performed by having each individual evaluator inspect the interface alone. The individual evaluation is important in order ensure independent and unbiased evaluations from each participant. There are multiple ways to record the results of the evaluation. Nielsen (1995a) further describes methods of how results can be recorded. Researcher may use written reports by the participants themselves or by having the participants explaining their findings as they perform the evaluation. The written reports have the advantage of presenting a formal record of the evaluation, although they require an additional effort from the evaluators and the need to be read and assembled by an evaluation manager. Nielsen (1995a) argues that using an observer to monitor each evaluation session reduces the workload of the participants. Furthermore, the observer can assist the participants in case of problems during the sessions and help if the participants have limited knowledge of the interface to be evaluated. According to Nielsen (1995a) observers have the responsibility of interpreting the user's actions in order to interpret how those actions relate to usability issues in the interface design. Nielsen (1995a) points out that this method makes it possible to conduct usability testing even if the participants of the study are not familiar with interface design or the researched domain in particular. In our study we have chosen to record the sessions with a recording device, as the participants have been asked to think-out-loud during the test.

![Graph showing proportion of usability problems found](image)

*Figure 3.2 Nielsen (1995a) graph shows the proportion of usability problems in an interface found by heuristic evaluation using various numbers of participants. The graph represents the average of six case studies of heuristic evaluation.*

The usability tests were performed on three occasions, the first session on the thirtieth of November and three people participated. The second session was on the December second and one person participated. The last session for usability testing was a combined session of eye-tracking and mobile usability testing, where some of the participants performed the mobile usability test after completing the eye-tracking experiment. The session was held on December eight and three people participated in the usability testing after completing the eye-tracking experiment, the mobile usability testing was not eye-tracked in the session. The total number of participants was based on Nielsens recommendation of five usability tests, Figure 3.2 shows the relationship of number of tests performed and their efficiency. Six tests were
performed, as the first test was considered to be a pre-study it has not been included in the count. Although some of the participants comments are included in the result as they were considered to be of value for the research. The question design and tasks were refined and changed after the pre-study, but the comments of the participant are considered to be general enough to be included in the result.

The first and second study took place at the University of Borås, in a study room at the library. The room was equipped with a 24” desktop computer, running Windows 7 and using Mozilla Firefox as browser for the tests. Information of the tests was distributed online and the participants signed up in an online-form scheduling a suitable time. The participants received instructions on site and were offered coffee and cinnamon buns as compensation. The test took around thirty minutes in total, fifteen per device. The participants were instructed to first perform a task on a website on the computer and then on the mobile device, to then continue to the next website and repeating the procedure for all three. The instructions were written on the whiteboard and were also explained briefly to participant when they arrived.

The participants were asked to pretend to make a purchase on each website. It did not have to be the same product on all sites but the scenario was to find something to wear for a formal dinner. The instructions were to first perform the task on the computer and then on phone before switching to the next website. The participants were asked to think-out-loud during the process and to pay attention to the websites interface, design and functions rather than the range of products. The websites had been selected and opened in tabs before the arrival of the participants. The sessions were recorded on an external device and the participants were observed during the process. All the participants performed the test on the provided iPhone 6, running iOS 9.1.2, using Safari Web Browser. The results and opinions may therefore vary if an Android device or a different browser is used in the mobile usability test, as the design of the mobile websites varies depending on those factors.

The interviews were made alongside the observational study and were semi-structured, giving all participants will the opportunity to express their opinions. The interviews were supplements to the think-out-loud test in case of the participants not answering all questions or giving insufficient answers during the test. The purpose of the interviews was to ensure that the responses could be compiled and compared in an equitable way. All interviews and think-out-loud tests were recorded and the participants were informed of it. The questions in the interviews were based on the users experience of the websites in correlation to the design principles. If the participants did not express their thoughts and experiences in a way that was of use they were encouraged and guided to speak up about certain features or problems they encountered in the process. The questions also focused on the user experience of the designs for the two platforms and the user preferences regarding those. If the participant did not mention anything about the design and layout they were asked direct questions about it. The questions were phrased in an everyday language and adapted to be understandable for the participants who were not familiar with advanced terminology.

In order to increase the validity and reliability of the usability study a quantitative element was included in the control study. The eye-tracking experiment was, as the name suggests, an experiment. Raw data may be gathered from the results of an eye-tracking experiment, although it was not the purpose of this research and the results were analysed in a qualitative way. But it was still a quantitative method that was used for the experiment. The participants of both the eye-tracking experiment and the usability test were asked to complete a
questionnaire regarding their experience of Online shopping and some background details about themselves. The approach of using a survey may be argued to be a quantitative method, although the number of participants and the purpose of the questionnaire suggests that it was rather qualitative in this research.

### 3.3.4 Eye-Tracking Experiment

The eye-tracking experiment was conducted in collaboration with Swedish Institute for Innovative Retailing (SIIR) in their Retail Lab. The Retail lab is a research environment at the University of Borås. The location is known for conducting research in retail and innovation and offers several research possibilities and several collaborations with well-known companies have taken place here. The environmental setup was designed as a showroom displaying products from companies that the University has worked with. The room was equipped with chairs, tables, several displays, virtual reality glasses and more. The equipment used for this research was a 24” computer monitor with an eye-tracking device (Tobii Pro X2-60) with a keyboard and mouse connected for the participants to use. The monitor was connected to a laptop which was controlled by the researchers, screening the same view as the participants saw. Both the researcher and the participant controlled the computer, the participants received instructions of what their task was and what equipment to use, the researchers controlled the Tobii software starting the test, switching between websites and finalising the test. The environmental setting is seen in Figure 3.3.

![Figure 3.3 Calibration of the Eye-tracker in Action](image)

---

The participants received instructions regarding the eye-tracker as they arrived. The instructions were that they should sit approximately 60 centimeters from the screen and try to be still holding eye-contact with the screen during the test. The Tobii Pro X2-60 is a screen based eye tracking device capturing every single movement of what people are looking at, with a sampling rate of 60Hz and according to the Tobii website the subjects can move along without losing vital data. Although it was discovered in the pre-study that if the participants looked away from the screen too often the results were affected. The participants were recommended to only use the mouse and the space-key during the experiment as looking down on the keyboard could disturb the eye-tracker and result in a loss of data. The eye-tracker was calibrated for each participant and they were asked to think-out-loud during the session. The process of the calibration was explained to the participants, the process can be seen in Figure 3.3. The white spots on the screen are the eyes of the participant and they should be in the middle of the black box, making the bar at the bottom green. The red-and-green bar to the right of the black box is a scale of how close to the screen the participant is located, the optimal distance is around 60 centimetres away. Once the participants were all set on how and where they should sit they proceeded to the next step of the calibration which was following the movements of a red dot across the screen. It was very important for the participants not to move the head while watching the dot move as moving the head disturbed the calibration. Once the calibration was completed the experiment started. In the first step the participants were asked to complete a short survey with questions regarding their background and experience. The instructions for the test were displayed on the screen and a reminder to think-out-loud and not break eye-contact was also included, they were also instructed to only use the space-key and the mouse to minimise the risk of looking down. The first website was opened as the participant pressed the space-key. The participants were asked to focus on the website’s functions, interfaces and designs rather than the products themselves. The participants were asked to behave in the same way as the participants of the usability test, with the addition of the eye-tracking instructions of how to sit and where to look. As the purpose of the experiment was to supplement the participants comments and opinions with heatmaps and gazeplots, the sessions were evaluated and analysed in the same way as the Usability Tests. The participants were observed and the eye-tracker recorded the sessions, supplementary recordings were also made on an external device.

The experiment was performed on three occasions, the first time may be called a pre-study to become familiar with the equipment and the setting. Two subjects participated in the pre-study, the first participant was one of the authors of this thesis and the other one was an employee at the University of Borås. The results of the pre-study are not included in the results of this thesis but were used as a foundation for the real experiments.

The second session took place in SIIRs Retail Lab on the eighth of December 2016 having ten participants. Another session was planned to take place on the ninth but was rescheduled to the twelfth instead because of unforeseen events. Fifteen people participated in the session on the twelfth, making it a total of twenty-five participants in the eye-tracking experiment.

In the first session on the eighth of December, some of the participants were asked to participate in both the eye-tracking experiment and the mobile usability test. Although the mobile test was not tracked with help of the eye-tracker, it was performed in the Retail Lab after completing the eye-tracking experiment. The mobile usability tests were not included in the eye-tracking experiment, or tracked with help of an eye-tracker as the equipment provided could not catch the eye-movements on the smaller screen of a mobile phone. The sessions
took maximum thirty minutes, fifteen minutes per part. The participants were given instructions about their task on site, beforehand they only knew that they were participating in an eye-tracking experiment for a bachelor thesis. In the cases where the usability study was performed it was done so after the eye-tracking was finished. The procedure of the mobile usability test was the same as in the other experiments, described above. Three of people participated in the usability study in connection to the eye-tracking experiment.

The results of the eye-tracking experiment were evaluated based on the observational think-out-loud test and the data generated by the eye-tracker. The experiments were combined usability studies and think-out-loud tests and the evaluation has been based on the participant’s words, the gazeplots and heatmaps produced are used to support the observations and comments.

Gazeplots are a very valuable analysis tool according to Pernice and Nielsen (n.d). The gazeplots compile the eye gaze of one user on one page, it does not combine more than one page or user in the representation. The dots on the page show several important data items, the number of dots and their location determines where the user’s fixations were. The numbers in the dots shows in which order the users looked at the items and the size of the dots determines for how long the users looked at the item (the larger the dot is, the longer the user looked at the spot) (Pernice & Nielsen n.d).

Heatmaps are another valuable analysis tool in the eye-tracking environment, they display the areas where the users looked on a webpage. Heatmaps can be created with one or many users, it is better to create heatmaps using the length of fixation rather than the number of fixations as it would count all fixations equally, missing out the intensity of the fixations (Pernice & Nielsen n.d).

The gazeplots and heatmaps included in our thesis are meant to support the observational think-out-loud tests. Some of the heatmaps are combinations of the results of several users, and some are individual heatmaps, all gazeplots included are individual results as the combination of several results are too cluttered. There have been problems with the gazeplots and heatmaps as the URLs of the websites change as the participant’s open products in quick-view mode without the eye-tracker recognising it and resulting in white or half-loaded pages with the eye-tracking data visible, the issue is illustrated in Figure 3.4.
3.4 Sampling and Selection

The websites used in the study were not randomly selected, the selection-process is presented in this section together with a presentation of the selection of participants for the study.

Mobile Applications are not a part of our research as it has a focus of web design and using websites rather than specially built applications. This bachelor thesis is focused on the understanding of the user's perspective of website usability for desktop computers and mobile phones based on design principles.

3.4.1 The Websites

The selection of the websites was based on a content analysis which was conducted manually. The content analysis was used to review the websites and the selected principles. The establishment of whether the websites were responsive, adaptive or mobile optimised was determined by the content analysis. The similarities between the Adaptive Web Design (AWD) and Responsive Web Design (RWD) made it difficult to distinguish which approach the site were using. Two mobile-optimised websites and one responsive were included in the study. The list of websites of interest was longer in the beginning of the process, but was narrowed down based on a quick content analysis. The selection of the three websites to be included in the study was subsequently based on a brief evaluation of the adaption of design principles and the establishment of the design approach used. The mobile and desktop start

Nelly.com (hence forward referred to as Nelly) is a relatively new company and was founded in 2003. Nelly’s target is to sell clothes, shoes, and beauty-products to young fashionable
Women and Men in the ages 18-35. Nelly is a company that has a primary website, which is nelly.com, although this page only targets women. Rather than combining the content into male and female options in the menu they have chosen to have a separate website for the male version, being NLYman.com (hence forward refered to as NLYman). The menus contain links to the other website, although it opens in a separate window when selected. The two versions of the website have different layouts, but the same purpose. Nelly has been included in the study as they are a rather new company that are successful (Nelly n.d). The FrontPage for the two platforms of Nellys female website as it looked during the tests is seen in Figure 3.5.

![Mobile FrontPage of Nelly.com is Seen to the Left and the Desktop Version to the Right.](image)

Ellos was originally a factory and a trading company that was founded in 1947 focusing on mail order and distance trade. The company is famous for the catalogue-shopping that has been developed into a successful e-commerce business, the first ellos-website was launched in 1996. Ellos has a unique and long experience of distance trading in fashion and interior and they claim to develop new technological solutions to improve the customer's shopping experience. The selection of Ellos as one of the three websites to be included in the study was formed on their long experience and development of distance trading and their transition into being one of the most successful e-commerce businesses in Sweden. Ellos has been included in the study as they are a successful e-commerce business with a long history of distance trading (Ellos n.d). The FrontPage for the two platforms as it was displayed during the tests is seen in Figure 3.6.

![FrontPage of Ellos.com](image)
Hennes & Mauritz (H&M), is a Swedish fashion company that opened its first store in Sweden 1947, it has grown rapidly and now has stores in 61 countries. In the year of 1980, H&M introduced mail ordering by catalogue in some of the markets, the concept was successful and expanded rapidly over a few years. By 1998 H&M introduced online shopping, which became a successful e-commerce business. H&M was included in the study as they are a successful e-commerce business, with a history of distance trading (H&M n.d). The FrontPage of H&M mobile and desktop website as they were during the tests are displayed in Figure 3.7.

3.4.2 The Participants

The study was performed at the University of Borås in Sweden, and the goal was to have participants of mixed genders in the ages 20-75. The participants were voluntaries who had chosen to attend the sessions that have been marketed through social media or by being asked to participate if they have been nearby. The tests were held in Swedish as the websites were of Swedish origin and it was therefore required that the participants spoke Swedish. The participants were given an option if they wanted to attend the eye-tracking sessions or the usability test sessions. They were informed that the tests would take approximately 15-30 minutes and that they would be observed while shopping online. The participants received further instructions upon arrival and it was not a requirement to have experience of online shopping in order to participate.
The number of participants was based on Nielsen´s (2012) efficiency and costs recommendations for conducting a usability study (see Figure 3.2). According to Nielsen (1995a), it is difficult to rely on single participant finding all usability problems. It is therefore valuable to include multiple participants when conducting a heuristic evaluation, or usability study, to obtain additional information and achieve better result. Nielsen (1995a) suggests that the optimal number of participants is three to five people as including more people will not provide any additional information. Figure 3.2 illustrates the graph of how the efficiency levels out after six participants. Nielsen (2000) argues that elaborate testing is a waste of resources and that the best results come from no more than five users. Our usability study included six participants, based on those recommendations. Although the first test is considered to be a pre-study and the results from that session are excluded from the results.

According to Nielsens (2012) recommendations for the number of participants in eye-tracking experiments is 39 to get stable heatmaps. The number of participants in our study is 25, which is less than the recommendation. Although as the heatmaps used in this study are not combined heatmaps of all participants but of specific individuals it is not necessary to have a higher amount. As different URLs were visited by each participant it was not possible to combine the results into a gathered heatmap, this does not affect the results of the study as it has a qualitative approach and the analysis has been manual. The number of participants was affected by the time-frame, the results of future research in the subject may therefore vary depending on the selection of participants.

The setting of the observation was two separate environments. The main study's setup was performed in a session room at the University of Borås where the respondent performed a usability test where they got to think-out-loud and guide us through their thoughts and actions, on both desktop and mobile websites. The eye-tracking experiment took place in SIIR´s Retail Lab at the University of Borås, which will be elaborated on later in this chapter. The participants eye-movements were tracked while they were asked to think-out-loud. The studies were performed on a set location, at the university of Borås primarily because of the eye-tracking equipment which could not be moved. The fixed location has affected the distribution of participants as they were selected based on their ability of attending the sessions. The main group of participants are in the age-group 20-25, and primarily students at the university, the results may therefore vary if the study is carried out among other age-groups or other locations.

### 3.5 Ethical Consideration

Informed consent is the logical and legal cornerstone to protect the research participants (Waters, Carswell, Stephens, & Selwitz 2001). The participants of the usability test and the eye-tracking experiment for this study gave their consent verbally as they volunteered to participate and received information about the study. According to Waters et al. (2001) there are compelling ethical reasons to use consent forms and the participants have a right to know what they will be asked to do, in order to decide if they wish to stay or go. This research has not used a physical form where the participants give their consent, although the instructions of the tasks have been clearly presented both in written form and explained out loud. All participants were informed of that the sessions would be recorded and that the eye-tracking data could be used for future studies, they were also informed of the eye-tracking camera recording them. None of the participants had any problems with those aspects, and they all decided to stay. Recker (2015) explain how the anonymity and confidentiality principles are important in social science research and how confidentiality is vital when the principle of
anonymity is running against the purpose of the study. The participants of this study have been informed of that they will not be completely anonymous as they are participants of an observational study. The participants have been guaranteed confidentiality and the data collected has not been distributed in inappropriate ways, the participants have also been guaranteed that they will not be mentioned by name in the thesis. The participants have been informed that the data collected during the eye-tracking experiment may be used in future studies, although it is believed not to compromise the confidentiality or integrity of the participants as the research conducted at SIIR is professional. The recording of the observational think-out-loud tests will be stored for a longer time, accordingly to Reckers (2015) recommendation.

We have now presented the choices and motivations regarding the setting for our study. The following chapters will, in detail, present the result of the methods described in this chapter. Firstly Chapter 4 will present the result of the content analysis of the selected e-commerce websites. Secondly the Result of the Usability Test and Eye-Tracking Experiment will be presented in chapter 5. The Discussion of the two results will follow in chapter 6.
4 Evaluation of the Content Analysis

This chapter presents the first part of the results of our research. This chapter begins with a presentation of the evaluation of the selected websites and the adaption of the common keywords established in chapter 3. The chapter is concluded with a summary of the analysis and an evaluation of which design method that has been used for each website. The order in which the websites are presented is consequent throughout the thesis and is seen in Figure 4.1.

The grading of the content analysis was based on a likert scale where the websites were rated from good to bad based on how they were considered to fulfil the design principles. The analysis results are based on the selected keywords, which are seen Figure 4.2. The results of the analysis are displayed in Table 4.2 and the rating of the likert scale used for grading is visualised in Table 4.1. The grading of each website and keyword will be accounted for in the next section. Detailed grading of all selected design principles (Nielsen, GOV UK and Sharp, Preece and Rogers) is seen in Table Table I, Table II and Table III in the appendix. The order in which the websites were analysed is seen in Figure 4.1.

Figure 4.1 Presentation Order of the Analysed Websites

The first website to be evaluated in the content analysis was Nelly, the results of the evaluation are displayed in Table 4.3. The adaption of Design Principles was evaluated according to the five common keywords established in chapter 3 and the order in which they are presented is seen in Figure 4.2.

4.1 Content Analysis of Nellys Website

The first website to be evaluated in the content analysis was Nelly, the results of the evaluation are displayed in Table 4.3. The adaption of Design Principles was evaluated according to the five common keywords established in chapter 3 and the order in which they are presented is seen in Figure 4.2.

4.1.1 Visibility

The Visibility principle was graded as acceptable for both the mobile website and the desktop website. Nelly was considered to have a bit too much commercial, offers and bright colours which distracted the user. NLYman had a cleaner, more minimalist, layout, although it was still filled with advertisement and commercials. The categorisation considered good for both
websites, and platforms and the menus were easy to navigate. Nelly was considered as fairly easy to navigate, despite the bright advertisement, and there were filters that were easy to distinguish both in the mobile website and in the desktop version. For NLYman it was also easy to navigate, although the filters were more hidden in both the desktop and mobile website. The desktop filters were expandable, and when expanded it was discovered that the colour-filters were small coloured boxes without any explanation of which colour they represented (it was difficult to distinguish as there were three white boxes representing different shades such as silver, white and patterned). The checkout process was more minimalist for both Nelly and NLYman, reducing the rooms for errors. Although in Nellys checkout there were advertisement saying “you haven’t missed this?” placed directly below the products in the shopping-bag, it was possible to believe that the products had been added to the bag which was considered confusing.

4.1.2 Consistency
The consistency was graded as Pretty Good for both websites, across the two platforms. Although the consistency between the male and female websites was less significant in the layout. The consistency between the platforms was considered as pretty good, the responsive design made the transitions between platforms smooth and elegant. Some pictures on the first page of Nelly could not be seen in full in the desktop website, while the “longer” screen of the mobile phone showed a taller version of the same picture, displaying more of it. The NLYman was considered to be neat and neutral, the white, grey and light blue design was quite the opposite of the Nelly, which used dark and bright pink colours. The websites were similar in the layout, the placement of features and the design overall. Although the placement of filters in the mobile website of NLYman was considered as confusing. The filters were placed at the bottom of the screen, and displayed as a small white box which made them easy to overlook. The filters were the opposite in Nelly, the feature was placed at the top of the page for the mobile website and coloured bright pink.

The consistency towards other, similar, e-commerce websites was considered to be pretty good. The placement of features appeared as logical for experienced users and also for newcomers.

4.1.3 Flexibility/Constraints
The Flexibility/Constraints was graded as acceptable, the website was believed to be responsive and it had removed the users option of choosing how to visit the website in the mobile device. It was slightly difficult to shift between the two sites, Nelly and NLYman. It was also considered difficult to purchase products for both men and women in the same order as it was troublesome to swap between the sites, even though the shopping baskets were synchronised. Special features such as quick-buy or quick-view were present and distinguishable for users. There were also features for saving a product for later, or informing the user by e-mail when the product got back in stock, increasing the flexibility and efficiency.

4.1.4 Feedback
The Feedback was graded as Pretty good for both platforms and websites. Although, Nelly was considered to integrate a bit too much with offers, and products suggestions at all times during the shopping process. NLYman was considered as more minimalist, but it also had suggestions of products during the process. The “add to basket” feature had a smaller window opening in the main window as confirmation, both for Nelly and NLYman. The confirmation was clear but had product suggestions which were said to be related to the
wanted item, although they did not appear to be relevant at all. The error-messages were clear and understandable, in an everyday language. The website integrated with the users with help of user-submitted reviews and intractable product images, for instance offering a 360 degree view of some products and videos of other. The features were present in the mobile version of the websites as well as in the desktop versions.

4.1.5 Context
The context was graded as pretty good, for both the mobile and desktop versions of Nelly and NLYman. The websites were considered to use an everyday language and have clear messages for the users to avoid errors. The context and the users seemed to be understood as special features such as “inform me when my size is back in stock” and extended visuals of the products were presents, at least in Nelly. NLYman was rather simple in that matter, the features of many images and videos of products had been scaled down. The target group of Nelly and NLYman is a younger audience, which the website mediates through the design and layout.

4.2 Content Analysis of Ellos Website
The second website to be evaluated in the content analysis was Ellos, the result is seen in Table 4.2. The adaption of Design Principles was evaluated according to the five common keywords, in the same order as the one presented in Figure 4.2.

4.2.1 Visibility
The Visibility has been graded as acceptable for the desktop website, and as poor for the mobile version. The grading of the desktop website was based on the clear menu, even though it had double-categories that were placed both in the header of the website and as subcategories when opening the full menu. As for the mobile website, the menu was easy to find but the naming of some subcategories was slightly confusing. The visibility of the product pages was less pleasant, there were advertisement in the margins and a “read more” function that sent the user to the bottom of the page rather than expanding as it suggested to do. For the mobile website, the product pages were cleaner, although the zoom option for the products opened in a new window which was considered slightly annoying. The “read more” function and information about the product was hidden in the mobile version. Other features were excluded from the mobile website and will be elaborated on further in the upcoming keywords. The website had a lot of advertisement and bright colours when entering, it also targeted the first ad to a female audience, this regarded both the desktop and mobile website. There was also a symbol present in the product pages, which meant that the product was excluded from offers or discounts. The symbol was explained by a label that showed when the cursor was held over it, although the symbol was not explained at all for the mobile website even though it was present. The shopping-bag was slightly confusing in the desktop website, as the remove-option was written in line with other options, making it easy to overlook. The checkout-process was kept minimalist and clean and considered as clear for both mobile and desktop website.

4.2.2 Consistency
The consistency was graded as poor for both the desktop website and the mobile website. The grading of the desktop website was considered better than the mobile website as it was easy to
see and had reasonable categorisation. Although some of the categories were doubles and appeared in both in the main heading menu and as subcategories in the selected theme. The consistency between the two platforms was considered bad. The primary difference between the two was that many features had been removed from the mobile version. There also the different categories, many of them were the same as the ones in the desktop website, and there were double categories in both versions. Although the content of the subcategories in the mobile website and the categories in the main menu differed even if they had the same label. As for the removed features, there was the lack of a size-guide in the mobile website and a lack of shipping information on the product page. There was also the lack of explanation of symbols and signs that appeared. The main difference, and reason for the grading was the lack of a function where the users could place an order without registering. In the desktop website there were three options of how to proceed to the checkout, although in the mobile website there was only two. Therefore, it was considered that the consistency between the two platforms as poor.

Regarding the consistency between Ellos and similar websites, the consistency was considered acceptable. The double categorisation that was mentioned was considered to be slightly disturbing in this matter as well. Although the design of the website and the features with established symbols, such as the three lines representing a menu in the mobile website, was considered as good.

4.2.3 Flexibility/Constraints

Evaluation of Flexibility/Constraints resulted in a grade of acceptable for the desktop website and as poor for the mobile version. The users were, when entering the website from their mobile-phones given an option to choose to proceed to the mobile version or the full version of the website. It was also possible to swap between the different sites when the choice had been made, if necessary. The option to swap between the versions was considered as good, since the constraints on the mobile website were harsh and the flexibility considered as low compared to the desktop website. The removal of certain features constrained the users options, for instance when selecting how to proceed to the checkout (which was mentioned in the previous keyword. The users were only given two options in the mobile website, while given three in the desktop version. Other functions that restrained the users was the filters in the mobile version, the filters were considered as good for the desktop version as it was easy for the user to remove a filter in order to return to the previous selection. In the mobile website, the user was sent back to the main category when removing a filter, even if it was the last filter to be applied that was removed, forcing them to restart the process of applying filters. Apart from the lack of certain features in the mobile website, it was considered difficult to make mistakes in both websites. There was a lack of option to change colour or size in the shopping basket for both websites, constraining the users and lowering the flexibility as they were forced to go to the product page to add another product and then removing the faulty one, rather than just updating the information in the shopping-bag.

4.2.4 Feedback

The adaption of the keyword Feedback was graded as acceptable for both the desktop website and the mobile website. The websites integrated with the users by clear error-messages, and sometimes a live chat-option with customer service was seen in the desktop website. Although the chat function could not be found on several occasions and there was no information about the function to be found on the website. The website did not use cookies, or did at least it does not tell the users that it does, making it more difficult to have a
personalised experience. The error-messages were written in an understandable language and were clear to prevent mistakes. The website also integrated with the users by having an option to review the products after a purchase, providing feedback from other users.

4.2.5 Context
The Context was graded as acceptable for both the mobile website and the desktop version. The grading was based on the use of everyday language, which was understandable for most users. The order in which to perform tasks and how was logical, and considered good. The overall feeling of the website had a feminine touch, which was considered as something that may have a negative effect on the male users. The website also mediated a “catalogue feeling” and had a feature where the users could browse the latest catalogue online with links to the products included. Although, unknown symbols were used in both platforms, and even if they were partly explained in the desktop website, they confuse the new users even if previous users may be familiar with them. Ellos was considered to not take all users into account and disregarding needs and wants of users as they removed essential features from the mobile website.

4.3 Content Analysis of H&Ms Website
The final website to be evaluated was H&M, the evaluation was based on the selected keywords and the grading is seen in Table 4.2.

4.3.1 Visibility
The Visibility was considered to be acceptable for both the desktop website and the mobile website. The clean, minimalist design was one of the main reasons for the grading. Another reason was the distinguishable timeline which was seen in the checkout-process, where the user could see in which step they were at the given moment. One of the reasons for the lowered grading was the cluttered menu, with a lack of subheadings and a mixture of categories and concepts that were not separated. The lower grading also depended on that the design could appear as being too minimalist, making it easier for the users to overlook and miss out on information, the mobile website appeared to have better visibility from this aspect as all the information was gathered in a smaller display rather than being expanded over a large monitor. The mobile websites visibility was graded lower because of the struggle to find some of the features. The removal of products from the shopping basket was a difficult process, and it was troublesome to distinguish concepts and brands in the menus as they were included in the common categories.

4.3.2 Consistency
Consistency, was graded to Acceptable for both platforms. The consistency of the design between the platforms was considered to be pretty good, although the consistency to other websites in the category of fashion and apparel is considered to be poor. The consistency between the platforms was considered as good as the smooth transition between the platforms could be mistaken for being responsive, only when looking closely it was distinguished to be a mobile-optimised website. The placement of features and the layout of the mobile website the is consistent to the desktop version. The design of the websites is also consistent to the physical stores, and the brand image is distinguishable through the atmosphere. The feature of removing products in the mobile-website was different from the desktop website, and it was difficult to distinguish, contributing to the grading.
The consistency between similar e-commerce websites was graded as poor, the primary reason for the grading was the placement of features and the categorisation. The placement of filters was at the top of the page, in other e-commerce websites the location is often in the left-hand margin. The layout of the filter is an expandable header, in white and grey, which is easy to overlook for the users who are used to look to the left of the screen or looking for a more distinguishable layout. The categorisation was also considered to be slightly confusing as it was not divided into concepts or brands, but those were included in the “normal” categories of clothing and accessories.

4.3.3 Flexibility/Constraints
Flexibility/Constraints was considered as acceptable for both the mobile website and the desktop version. There were constraints on the mobile website which made it difficult to decide whether the website was responsive or mobile-optimised, the lack of an option to see a full version of the website in the mobile may affect the usability for some users, affecting the usability. The function of changing language or location was fairly easy on the desktop website, but difficult to find for the mobile website and no symbols were used for the function, making it difficult for the users to select another market if they accidentally chose the wrong one in the first step. The keyword of flexibility/constraints includes the error prevention principles, which were considered to not be fully adapted. Products that went out of stock during the session were not removed from the product count or the price, making the users believe that they can make errors. Although, error messages are clear and it is not possible to add any products into the shopping bag if they are out of stock. Also, the requirement of registering as a new customer or signing in as an old one is restraining the users from making a purchase as guests. The instruction of which personal information and address details that are necessary to enter in order to make a purchase are clear, and if there are any details missing the users receives an error message, both for the mobile and the desktop website.

4.3.4 Feedback
Feedback was considered as pretty good for both the mobile website and the desktop website. Some aspects of feedback and error-preventions have been mentioned in previous section, flexibility/constraints, and one of the reasons for the grading is the clear error-messages that are written in an everyday language and where clear instructions are given to the user. There are several features that help the users to interact and get help such as a size-guide and an option where frequently asked questions are seen and a contact-details to customer service. There are also some features where the users get suggestions about similar and related products, although there is no option where the user can trace their own steps and see what products that they have recently viewed, lowering the grade slightly. The users get feedback from the warehouse as they can see if the product is in stock or not, although they cannot see if the product of interest will get back in stock or not.

4.3.5 Context
The grading was partly based on the lack of connection between the physical stores and the websites, the feeling and brand image was mediated through the website, but it was difficult to find information about the physical stores. Also, there was no feature where the users could check the stocks in stores which could improve the usability if a product was out of stock in the webshop. The service feeling was somewhat lost as users’ needs and wants to find a
physical connection was disregarded. Apart from the lack of connection to the physical store, the context was regarded to be pretty good, the language was understandable without technical terms or non-recognisable error messages. The context overall seemed to be understood, and the users in focus.

4.4 Summary of the Content Analysis

The first website to be evaluated was Nelly. The website was determined to be a RWD website. This conclusion was based on the smooth transitions across the two devices and the lack of option to see a desktop version of the website. It was considered to fit the definitions of RWD, the lack of an option to go to a full website in the mobile phone and the lack of m.XX.com in the URL field. The result of the evaluation was rather confirmed when the open-position of a web-designer established that the applicants should be experienced with responsive design. The conclusion of the website being responsive, rather than adaptive has been based on the observation and interpretation of the website.

The second website to be evaluated was Ellos. The website was believed to be mobile-optimised, primarily based on the first page that is visible when entering the standard address http://www.ellos.se on a mobile device. Upon entering the site the user is asked to select if they want to visit the mobile version or the full website. When entering the mobile version, it is visible that certain functions have been removed from the mobile site, compared to the full website.

The last website to be evaluated was H&M. The website could at first be categorised as a Responsive design or as Adaptive design, as it integrated with the user by asking if it could use the location of the mobile device and suggesting “Sweden” as the marker if the user agreed. The behaviour matched the definition of AWD, although when observing it closer one could determine that it was really a mobile-optimised design. H&M has not only two, but three versions of their website, a desktop or full website, a mobile website and a tablet website. The three websites have the same content and similar layout, they behave as responsive when looking at them separately and together, the main clue to them being separate is in the browser's URL field where the m.XX.com or tablet.XX.com are visible. The function of viewing the full website in the tablet and mobile phones has been removed.

The result of the evaluation and the establishment of which design approach that was considered to have been used for respective website is seen in Table 4.3.

<table>
<thead>
<tr>
<th>Website</th>
<th>Design Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nelly</td>
<td>Responsive</td>
</tr>
<tr>
<td>Ellos</td>
<td>Mobile-Optimised</td>
</tr>
<tr>
<td>H&amp;M</td>
<td>Mobile-Optimised</td>
</tr>
</tbody>
</table>

*Table 4.3 Summary of Established Design Methods for the Selected Websites*
5 Results of Usability Testing and Eye-tracking Experiment

The recommended number of participants for an eye-tracking experiment is according to SIIR² 30, although Nielsen claims that 39 is the best number in order to achieve the best result possible. The slightly lower number achieved in the experiment conducted for this research was acceptable as the purpose of this part was to be a control-study and not the primary focus of the research. The heatmaps generated were different for each website and participant as the tracking was based on the URLs of the websites, although a few of the pages had a combined result based on the hour and day of the experiment.

Regarding the structure of the websites, the participants considered that the three evaluated websites had a logical structure from a user perspective. All the participants had experience of online shopping before the test, but not all were familiar with the websites that were used in the tests. Many of the participants spoke about the similarities between the sites as e-commerce websites usually have similar features and design. It was therefore fairly easy for the them to navigate the websites. When asked, the participants explained that they expected to find the same products on the mobile website of a store as on the desktop version.

5.1 Nellys Website

The first website that was tested in the usability test was Nelly. Some of the male participants had difficulties finding the male website as they first assumed that there would be a separate category for it in the menu although there was a link in the menu it was not clearly marked. All the participants found the male website after being encouraged to look either at the top, left corner of the webpage or at the bottom of the menu. They were happily surprised that it was a separate website and later on reflected on that it was a better solution to avoid the “female”-label or atmosphere of a website. Some of them admitted that they were not aware of that Nelly had male clothing until they participated in the session.

The male participants, using the NLYman website remarked on the filter-options, for both the mobile and the desktop. The first problem that was encountered with the filters was the colour-options on the desktop website. The Colour-options were small, coloured squares representing the colours in which they were filled. Three of the boxes appeared to be white, there were no labels displayed or any explanations of which one that was which colour, but they were all different and only one was truly white. The participants remarked on the difficulty to understand which colour that was which in the cases of when the boxes were coloured in similar shades. The participants did not have further negative comments on the filtering options but believed that they were reasonable.

As for the mobile website, some of the participants had problems applying the filters, swapping between the filters and closing the options to return to the product-pages. Some of the participants also remarked on the location of the filter-options for the mobile website, where the filters were located at the bottom of the screen. As for the female participants of the test, using Nelly, the comments on functions of the website were not as many as for the male website. The majority of the females thought that the filters were clear and visible, and the filter-options good. The location of the filters in the mobile website was at the top of the screen and coloured bright pink making it difficult to overlook. The females did although

---
² The experiments took place in collaboration with the Swedish Institute for Innovative Retailing (SIIR) in their studio at the University of Borás.
remark on the design and layout of the website was described as being a bit too much in colours and advertisement making it difficult to focus on the task.

A feature that all female participants remarked on was the product-suggestions which were displayed in the confirmation pop-up window when adding something to the shopping bag. One of the participants explained that the feature could had been more attractive if it suggested products relevant to the item that was placed in the bag. Similar comments were made by the male participants regarding the same feature.

A feature that was highly disliked by the female participants was that the same product suggestions recurred at the checkout, once again suggesting products irrelevant to the products about to be purchased. Figure 5.1 shows the layout of the checkout. The primary reason for the dislike was that it was confusing why there were other products placed in the bag than the ones placed by the users. The second opinion was that it took the focus away from the purpose of the check-out, one of the participants explained that when she reached the checkout she just wanted to pay and be done with it, if she wanted the suggested products she would have looked at them in the confirmation step or in the basket - not at the checkout. The feature of suggested products was not remarked upon by the male participants, although the product-suggestions in the confirmation window were remarked on by some. The comments were similar to the females, the feature could have been more attractive if the suggested products were of relevance to the product added to the shopping bag, now it was simply overlooked or when seen causing an annoyance among the users.
Figure 5.1 Heatmap from Nelly’s checkout, showing the layout of the checkout

The feature of product suggestion was present in the mobile website as well. It was also remarked upon there too, although as it was not as visible on the mobile screen - the product added was in focus and the suggestions were below, requiring the user to scroll down in order to look at the products. The feature of the suggestions at the checkout was remarked on more, it was seen as unnecessary for the same reasons as for the desktop version. Other than that, the checkout was considered to be neat, clean, and logically structured, but most of the participants said that they would have preferred to complete the purchase on a computer.
website. Several of the participants mentioned that the focus was more targeted on the screen of the smartphone, but they said that the overview was better on a desktop website. One of the participants noticed that the placement of the button “complete purchase” was below the order summary, following the actions as the user scrolled down the page. The participant commented on that the button was enabled before he had submitted the personal information necessary to place the order, when he clicked the button an error message was displayed at each field that needed to be completed. The participant commented on the placement as he believed it would have been more suitable to place it at the bottom of the page, or at least disable the button until all information had been submitted by the user. The eye-movements of the participant who remarked on the event are displayed in Figure 5.2.

![Figure 5.2 Illustrates the eye-movements of a participant at the check-out for NLYman](image)

In the mobile usability testing, none of the participants had problems finding the menu. When asked if it was easy to understand where to find the menu all of the participants answered Yes. The motivation for most was that the menu is usually located in the top, left corner of a mobile website and marked with the symbol of horizontal lines.
5.2 Ellos Website

The second website of the usability test and eye-tracking experiment was Ellos. Most of the participants of the usability test chose the mobile-optimised website, considering that such a large company should have enough resources to build a good mobile platform. One of the participants did although chose the desktop website when given the option as she believed that the content might be reduced for the mobile website and considered the overview to be better when using the full website. A few of the male participants, of both the usability test and the eye-tracking experiment remarked on the terminology used for some of the categories as they considered the naming be too feminine or too broad for a male website. According to them they would have preferred that all sub-categories such as sweaters, shirts, blazers and such should be spelled out rather than using the term “överdelar”, translated “tops”. A few of the participants mentioned that they would not have entered the Ellos website to make a real purchase as they did not know that the website had male clothing. They also remarked on that the layout and atmosphere of the website had a feminine feeling, making them hesitant to make a purchase. Some of the participants of the usability test remarked on that the categorisation on the desktop website did not match the mobile-version, confusing them. Some also remarked on the double-categorisation, the opinions were although mixed for the desktop website but caused more reactions for the mobile as some participants needed to return to the main menu in order to see all subcategories, causing remarks on the categorisation and layout.

A feature that many of the participants remarked on and used was the filters. The filter-options on Ellos website were considered good according to the participants. Many remarked on how easy it was to see which filters one had applied and that it was easy to remove the applied filter and return to the previous selections without using the return-feature of the browser. Some of the participants remarked on the placement of the filters, which were located at the left-hand side in the desktop website and at the top of the mobile website, making them easy to locate.

Some of the participants had remarked on the product-pictures, the inconsistent sizes of pictures when browsing the desktop website was, according to some disturbing, although some participants like the layout as it made the products more visible. A few of the participants commented on the different settings of the product-pictures, as some of them were “in actions”-photos in nature or in other settings. Some of the participants found the inconsistent theme of pictures disturbing as it took focus away from the products. A few of the participants said that the layout and design gave them a “catalogue-feeling”. Other comments that many of the participants had regarded the lack of more than one product-picture, many of them claimed that it would make them hesitant to purchase clothing unless they could see what the product looks like on a model. The usability test participants also remarked on the zoom-feature in the mobile-website, where the photo was opened in a new tab if the zoom-label was clicked. The feature of a new tab or window was not much appreciated as it was disturbing and confusing to be sent to another page.

Some of the participant had experience of the Ellos website, they commented on a small symbol being visible in some product-pages. They explained how the small symbol was confusing as it meant that the specific product was excluded from discounts and offer but was barely explained or visible. Some of them also remarked on that the symbol was not explained at all in the mobile website, one of the participants had especially strong opinions in the matter claiming that it was false advertising to hide such information from the users. Participants also commented on that it was slightly annoying that when they clicked “read
more” about the product they were sent down to the bottom of the page, rather than expanding the text further. They also remarked on that there was a lot of information about delivery costs and options on the product pages but not specific pricing or information summary about the shipping of the products in the shopping basket or at the checkout.

At the shopping-basket summary, some participants had problems finding how to remove a product that they did not want to order. The confusion was caused by the symmetrical grid where all information appeared in the same format, most participants commented that they would have preferred the use of a symbol rather than words or a different layout of the text as they overlooked it several times before finding it. Other comments on the summary referred to the lack of delivery information and the lack of the ability to change colour or size in the basket. The participants commented on that they would have like to change at least the size of the selected product, rather than the quantity which was the only changeable feature in the shopping basket.

When choosing to proceed to the checkout from the shopping basket many of the participants were happy to see that it was possible to complete the purchase without registering as a new customer. Although the option was not included in the mobile version of the website, causing confusion and annoyance among the participants. The heatmap of the process, in the desktop version, shows how the option is the one that is looked upon the most, claiming that the feature is popular and desirable, Figure 5.3 and Figure 5.4 show the step on both mobile and desktop platforms.

![Figure 5.3 Heatmap showing the step in the checkout-process where the user is given multiple option of how to proceed](image)
5.3 H&Ms Website

H&Ms website was the final website to be evaluated in the usability test and the eye-tracking experiment. Many of the participants remarked on the neutral design, which they liked, although some of them believed the text to be too small in some cases. There were also several remarks about the categories, which were said to have a lack of headings or division. Some of the participants commented on that a few of the objects under the category-heading were concepts or brands rather than categories. The excessive menu is seen in Figure 5.5. As for the mobile website, it was observed that the subcategories in the menus were less organised than in the desktop website. The participants argued that the concepts were not usual categories, and that they should be differentiated in the menu, as the current layout was confusing.
The placement of the filters in H&M’s desktop website was slightly confusing, participants commented on that they did not see the filter options at first. They explained that they were used to having the filter on the left-hand side of the website, rather than at the top of the products. Furthermore, the participants commented on the minimalist design, arguing that the filter option could have been made more distinct. Figure 5.6 shows the placement of the filters and a gazeplot of how one of the participants looked at it.

A feature that the participants appreciated was the “go to the top” short-cut at the bottom of the website. The explained that they appreciated the feature as it was timesaving and making it easier to navigate the website.
The participants explained that the website is very neutral and got the same feeling as in-store. The brand image is transmitted through the website and the feeling of consistency between and the real world and the physical stores. Many of the participants described H&M’s website as good, neutral and centralised, providing a good overview. The feature of animated product-images that changed when holding the cursor over the image without clicking was also appreciated, the participants explained that they liked that they could see more images of the product without opening the product page. Another feature that was appreciated for the same reason was the quick-view that allowed the user to see the product and information in the same window without leaving the page they were on. The feature was remarked on being slightly hidden under the misleading label “Shop Now”, but much appreciated when discovered.

The result of the studies showed that many of the participants, both those who are familiar with the website and those who have not experienced H&M website before, easily overlooked around the website without noticing the discount code.

Many of the participants said that it was easier to get a better overview of the website and the products on the computer rather than the smartphone. Although they explained that it was easier to miss out on specific offers when the content was extended on the large screen compared to the narrowed view of the mobile website. Many of the participants overlooked the free delivery offer on the desktop website, they looked at it but did not register that it was there. When the observers enlightened them about the offer they noticed it but said that they would not have noticed it on their own as the minimalist design made it disappear into the page. The participants of the mobile usability study all saw the free delivery offer. Despite this, most of the participants said that they would prefer to make the purchase on the computer rather than the phone.

During the mobile usability test, one of the participants accidentally chose the wrong country and the entire website was displayed in Polish. The participant struggled with changing the language and eventually gave up without succeeding. As the observers, could not solve the problem either the test was cancelled as it was the last stage of the test.
6 Discussion

This chapter will evaluate, analyse, compare and discuss the results from chapter 4 and 5, to obtain a deeper understanding of the relationship between design principles and user preferences. The chapter will begin with an overall discussion of the result and the method before going into a further discussion of the results based on the selected keywords regarding design principles in relation to the theoretical framework.

The analysis of the websites was based on the interpretation of five selected keywords (visibility, consistency, flexibility/constraints, feedback and context) accounted for in our method. The analysis of the results further explains the connection between the selected keywords and the adaption of them to the selected platforms and websites. It may be argued that design principles are not designed to be used when designing for a mobile screen but Nielsen and Budiu (2013) argues the opposite. Nielsen and Budiu (2013) propose that the design principles should be evaluated harsher for the mobile platforms as it is more difficult to design for a smaller screen. The summary of the results is, shortly, that the design principles are important to adapt when designing websites, no matter for what platforms. Although it is important to not over-adapt the principles and exclude wanted or needed functions.

In the evaluation of the websites it was seen that many of the design principles were covering the same features and aspects. Despite having different names and being established by different scholars the meaning was similar among the chosen principles. Five common keywords were extracted and the result has been built on those. Many of the other principles build on Nielsen's 10 heuristics as they were among the first ones to be published as guidelines. The results of some of the observations have therefore been recurring throughout the analysis. The decision of extracting five common keywords was inspired by the study conducted by Majid, Kamaruddin and Mansor (2015) to avoid the repetition. The selected keywords are closely related and it is rather difficult to distinguish to which some features belong. Consequently, there will be overlaps in the discussion as it is separated into sections based on the keywords.

The results of the usability tests were based on the content analysis and supported by the gazeplots and heatmaps produced in the eye-tracking experiment. The results of the usability tests and the eye-tracking experiment will be discussed based on the Five Keywords.

The eye-tracking test was similar to a usability study as the participants were asked to think-out-loud in the process. The eye-tracker was used as more of a confirmation of that what the participant said was what they did. The results of the studies show that many of the participants were divided about many of the websites, some preferred Ellos and other could not stand it, a few mentioned that they did not like Nelly as they did not belong to the seemingly intended target group. H&M was often described as a very neutral, clean and minimalistic website, suitable for most audiences, although some of the participants thought of it as a boring and plain site.

6.1.1 Visibility

A visibility aspect that many participants remarked on was the layout and the colours of the websites. Many participants commented on the bright colours and animations on Nellys, NLYmans and Ellos website as being confusing and distracting. A majority of the participants remarked on Nellys extra “you haven’t missed this…” advertisement at the checkout which
they considered being irrelevant and providing useless information and taking focus of the primary task. The participants expressed that when they reach the checkout they do so with one purpose: making the purchase, it was therefore annoying to have extra products taking focus. The principle of Do Less (Österberg 2016) would be appropriate to consider in situations such as this as Nielsens (1990) Visibility of system status was affected. It was discussed how the feature could have been more suitable for the shopping cart but the checkout should have been kept clean. Those comments combined with the content analysis may be interpreted into the conclusion that the checkout of a website should be kept clean and minimalist. It can also be seen that the excessive advertisement may annoy and distract users from completing their task. Ellos received similar comments regarding their somewhat colourful and over-advertised website, although as they kept the checkout process neat and clean it did not affect the participants in the same way as Nelly. On the other hand, H&Ms website was described as very minimalist and neutral, which made the participants overlook offers that could have been of interest. As several participants saw the offers in the mobile website but missed out on them in the desktop version. Visibility (Sharp, Preece & Rogers 2015) was lost and the principle of Aesthetic and Minimalist (Nielsen 1990) was considered as a bit over adapted. The eye-tracking experiment showed that participants had looked at the offer but did not see it or react to it. It could be argued that the visibility was slightly better on the mobile website where the layout was more compressed and the information more gathered. This could be interpreted as a situation where the Do Less (Österberg 2016), Visibility (Sharp, Preece & Rogers 2015) and Nielsens (1990) Aesthetic and Minimalist principles had been over-adapted. Subsequently, it is important to find a balance of the level of adaption.

Another case where the visibility could be interpreted as being over-adapted, or the consistency could be argued to not be adapted enough, was Ellos website and the removal of features. This aspect will be elaborated upon further in the next section together with the placement of certain features which could be argued to affect both the visibility (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) and the consistency (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016).

The line-up of actions is, apart from the advertisement, clear at the checkout for the female website (both mobile and desktop). An order summary is displayed at the right-hand side of the screen and follows the user as they scroll down the page, the logical order of events makes it easy to follow. The male website on the other hand, has a “Complete Purchase” button directly under the order summary which was remarked upon both by the participants and in the content analysis. The purchase button has not been disabled and is clickable before submitting the personal information, although the order cannot be placed and error messages are displayed, explaining which fields the user needs to complete before being able to place the order. As the order, cannot be placed without the information being completed the logical placement of the button would have been at the bottom, this is considered to oppose the Affordance principle (Sharp, Preece & Rogers 2015) and the Error Prevention Principle (Nielsen 1990). It is although believed to meet the Help the Users to Recover from Errors Principle (Nielsen 1990), although the errors that are caused are not technically the users.

The placement of the filters for the mobile platform varied between the sites. The filters were located at the top of the site for Nellys female mobile-website and coloured bright pink, making them easy to distinguish according to the participants. Nellys female mobile website may therefore be argued to meet the Visibility Principle (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016), and the Recognition Rather than Recall principle (Nielsen
As for the NLYmans mobile site, the placement and layout of the filters was not as visible. The filters were placed at the bottom of the screen which some of the participants remarked on. The location of the filters for the male website is therefore argued to not meet some of the principles analysed. It is considered not to meet the affordance principle (Sharp, Preece & Rogers 2015), the visibility of system status principle, recognition rather than recall, consistency and standards, and flexibility and efficiency of use (Nielsen 1990). It may also be argued not to follow a few of the Governent UK principles such as designing with data principle, the do less principle and the understanding context principles (Österberg 2016). It is not necessary to follow the principles but as some of the participants said, they are used to look from the top to bottom of a page and it is therefore easy to overlook the filters on NLYman mobile website. Nellys female website on the other hand is argued to not be following the aesthetic and minimalist principle, the visibility of system status (Nielsen 1990), the visibility principle (Sharp, Preece & Rogers 2015), the do less and design with data principles (Österberg 2016) which affects the usability according to the participants.

6.1.2 Consistency

Apart from the advertisement at the checkout of Nellys website, there were few negative comments regarding the checkouts for all evaluated websites and platforms. Most of the participants simply remarked that all the checkouts looked like ordinary webshop checkout and that it felt safe and secure to order. Those comments, along with the content analysis could be interpreted as there was good consistency (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) across the platforms and between other webshops. There was only one participant who remarked on the placement of the “complete purchase”-button in NLYmans checkout. The inconsistent placement and the non-disabling of the button confused him as it was inviting to press the button before entering the required information to place the order, affecting the Error Prevention (Nielsen 1990), the Constraints (Sharp, Preece & Rogers 2015) and the Understanding of Context (Österberg 2016). It was not possible to place the order before completing the information required, error messages showed at the boxes that needed to be completed, but the option to press the button invited the users to make errors according to him and affected the Consistency (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) and Affordance (Sharp, Preece & Rogers 2015).

The major differences of the sites were the filters, the female version had more options which were explained in detail. A few of the participants remarked on that the filters on the male website were closed and sometimes difficult to distinguish. Although, the participants claimed that the placement was logical in the left-hand margin and therefore easy to find. The placement may be argued to meet the affordance principle (Sharp, Preece & Rogers 2015) and the Recognition Rather Than Recall principle (Nielsen 1990). Although, the Visibility principle (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) could have been further adapted. The principle of This is For Everyone (Österberg 2016) was not met for either of Nellys websites, primarily because of the clear target group, that made the users who did not fit into it feel excluded.

Many of the participants mentioned the categorisation in the H&M website, the lack of headings was also observed in the content analysis and it is seen in Figure 5.5 how the participants looked at the categories. Most of the comments were regarding the reasonable naming of categories and a semi-logical order, although many also mentioned that there should have been another heading for the concepts, or brands as they were referred to as. The participants claimed that
the concepts were not usual categories, making it irrelevant and confusing to mix them into those. This is another example of where the Do Less principle (Österberg 2016) has been overadapted, but also how the Do the Hard Work to Make It Simple (Österberg 2016) has been overlooked. It may also be argued that it is not following the affordance and visibility principles and the Consistency and Standards Principle (Nielsen 1990). As for the loyal customers and the users who are familiar with H&M it may also be argued to oppose the Recognition Rather Than Recall Principle (Nielsen 1990). As for the mobile website, it was not remarked upon that the concepts and other subcategories were mixed into the same menu. There were also remarks regarding the lack of connection between the physical stores and the website, some of the participants would have liked to be able to see whether the physical stores stocked the products or not. This affected the principle of Match Between System and the Real World (Nielsen 1990) and the Building Digital Services, Not Websites principle as well as the principle of Understanding Context (Österberg 2016).

6.1.3 Flexibility/Constraints
As the keywords of the Flexibility/Constraints overlap with the discussion of the Visibility and Consistency keywords it has been quite difficult to distinguish where one starts and the others. There are important aspects which many of the participants remarked on which may be interpreted to fit into almost all the established keywords, the discussions therefore overlap across keywords.

Regarding the participants’ opinions, it was observed that if they could not find a feature, or product where they expected it to be, they gave up. Nielsen and Baidu (2013) point this out in their works and argue for the importance of Consistency. The problem was particularly distinguishable for H&Ms desktop website. The participants expected the discount code to be more visible, they did not see the small minimalistic plain the sign, this was also seen in the eye-tracking results. The filter in H&Ms desktop website had the same problem, the participants did not see it at the first gaze and had to actively search for it. Participants remarked on the lack of familiarity when they did not see features where they expected them to be. There were also issues in Ellos website where participants could not find categories they were looking for as the options were placed in multiple locations, which may be argued to be an effect of a lower adaption of the Do Less principle (2016). Many participants also remarked on the labelling of categories across the websites, the inconsistent naming confused many and was considered to affect the usability. It was visible throughout the tests that when the placement of features or naming of categories was different from the users expectations or experiences they began to struggle. It was important for the users to have flexibility, but they also required Consistency (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) across the websites and platforms. The issue of the lack of constraints in NLYmans checkout (mentioned above) was annoying for one participant in particular as he claimed that it opened up for errors. It is therefore seen that certain users require a higher level of Constraints (Sharp, Preece & Rogers 2015) and User Control (Nielsen 1990) while others prefer a higher level of Flexibility and Freedom (Nielsen 1990).

6.1.4 Feedback
Features that could be interpreted into the feedback (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) keyword were for example a live chat function, clear error messages and interaction with the users, such as 360view and catwalk videos of the product. Other features that could be interpreted into the Feedback (Sharp, Preece & Rogers 2015) were customer submitted reviews of products which were accessible for the users.
The interaction-features such as catwalk videos and 360 view were appreciated among the participants but only appeared in the Nelly website. As the aim of interaction design, according to Sharp, Preece and Rogers (2015) is to reduce negative aspects and frustration for the users, the enhancement of positive and pleasurable experiences is of importance and the positive user experience is visible when encountered during the tests.

6.1.5 Context

Some of the participants remarked on the lack of connection between H&Ms websites and their physical stores. The participants argued that they would like to be able to see available products in stock in the physical stores. Despite missing this feature, the participants considered that the H&M-feeling was mediated through the mobile and desktop websites. The Understanding of Context (Österberg 2016) was considered as acceptable as the Consistency (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) between the designs in stores and online were so good. The Match Between System and the Real World (Nielsen 1990) could have been improved but the overall layout and language was considered good by both users and observers. The clean neutral and minimalist design using black, white, grey and red is the same as the colour theme used in the physical stores. Overall, the understanding of the context was considered good by both the participants and the observers.

Ellos was considered to partly understand the context. The history of Ellos was considered to have been taken into account when designing the website. The catalogue-feeling was mediated through the websites and there was an option where the users could browse catalogue online. The catalogue feeling was slightly confusing according to many of the participants. Although, the participants who were familiar with Ellos history appreciate the familiarity of the design and the Consistency (Nielsen 1990; Sharp, Preece & Rogers 2015; Österberg 2016) across time. Some of the male participants remarked on a female feeling which was mediated through the design and the history of Ellos which made them feel excluded, which affected the principle of This is for Everyone (Österberg 2016) and the Understanding Context (Österberg 2016) principle.

It would seem as Nelly have a lot of work to do regarding the awareness of the existence of their male website, and NLYman, as many of the male participants were not aware of its existence. This seemingly makes us to interpret that Nelly and NLYman did not adapt or understand the keyword-context. Another aspect of the keyword-context regard the target group of Nelly and NLYman which is clearly seen in the design making users of the non-targeted groups feel excluded. As Nelly is a relatively young company targeting a younger audience they succeed mediating the feeling through their websites and design. The bright colour of Nelly which have been discussed before may seem as excessive and excluding towards some audiences, it may be consider as acceptable in this purpose as the target group is made very clear and making us interpret that they Understand their Context (Österberg 2016).

6.1.6 Summary

Österberg (2016) argues that a website is never finished, which has been visible throughout the analysis. Arvola (2014) argues that good user experience is the overall goal of design work although that the usability has been argued to be good for the websites in this study there are still ways to improve the overall experience. It was seen in the results that features that were appreciated in the desktop websites had been removed in the mobile websites, despite the urge of Nielsen and Budiu (2013) who stressed the importance of being consistent across platforms.
It was argued to be bad for the usability and for the customers experience if the users could not find the same features or products on the mobile websites as in the desktop versions of e-commerce websites (Nielsen & Budiu, 2013). It has been visible in both the usability tests and the eye-tracking experiments that the participants gave up on finding features or products if they were not placed where they were expected to be. It has been visible that the adaption of design principles affect usability across platforms, it is therefore important for designers to remember to use Design Principles as guidelines when designing mobile websites as the usability may be affected when there is a lack of adaption.
7 Conclusion

By conducting empirical research, and by that providing empirical and theoretical evidence our study contributes to obtaining a deeper understanding regarding user preferences and adaption of design principles on mobile and desktop websites. The result of the study suggests that there is a visible effect on the usability based on the adaption of common design principles to mobile and desktop websites. These findings assist an understanding of how the adaption of design principles affects the web usability for mobile and desktop websites. The study also provides an analytical framework of keywords, identified in the design principles established by three separate scholars. Our research further provides understanding of the importance of finding a balance in adapting design principles in web design. This study provides a continuation of researching adaption of design principles to responsive web design and mobile-optimised design. As this study focuses on Swedish websites and is conducted at a fixed location with a limited amount of time and resources we would like to recommend further research in the subject to obtain a more general understanding.

The chosen methodology was considered suitable the purpose of this study, although the many features and steps were slightly excessive for a study of this proportion. For future research, we would like to suggest selecting one of the approaches, either eye-tracking or usability study, as there was room for misunderstandings when the two were combined as separate methods but analysed as one result. Subsequently, we would also suggest an eye-tracking experiment of the mobile websites for future studies, to obtain richer data and more distinguishable results. The data collected in SIIR’s Retail Lab, at the University of Borås, by using the eye-tracker may also be used for other research if relevant in the future.

The analytical framework upon which this study was built is considered to have been of importance to structure the results, analysis and collection of data. Without the selected keywords of the analytical framework, the analysis would have been excessive and disordered. Consequently, we would suggest further research regarding the mobile web usability in relation to established design principles.
8 References


Rempel, H.G. & Bridges, L. (2013). That Was Then, This Is Now: Replacing the Mobile-Optimized Site with Responsive Design. Information Technology and Libraries (Online),


Appendix

Table I - Content Analysis Summary for the selected websites, based on Nielsen’s Heuristics

<table>
<thead>
<tr>
<th>Nielsen's Principles</th>
<th>H&amp;M</th>
<th>H&amp;Mm</th>
<th>Elois</th>
<th>Elois m</th>
<th>Nelly</th>
<th>Nelly m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility of System Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Match Between System and the real world</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User Control and Freedom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency and Standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error Prevention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognition rather than recall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback and Efficiency of Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic and Minimalist Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help users recognize, diagnose, and recover from errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help and documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table II - Content Analysis Summary for the selected websites, based on the Government UK’s principles

<table>
<thead>
<tr>
<th>GOV’ UK Principles</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Start with user needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do Less</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design with data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do the hard work to make it simple</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test. Then iterate again.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This is for everyone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand Context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Build digital services, not websites</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Be consistent, not uniform</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make things open: it makes things better</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table III - Content Analysis Summary for the selected websites, based on Sharp, Preece and Rogers Most Common Design Principles

<table>
<thead>
<tr>
<th>Interaction Design</th>
<th>H&amp;M</th>
<th>H&amp;Mm</th>
<th>Elois</th>
<th>Elois m</th>
<th>Nelly</th>
<th>Nelly m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constraints</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consistency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affordance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table IV - Rating of the Likert Scale

<table>
<thead>
<tr>
<th>Rating</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Pretty Good</td>
<td></td>
</tr>
<tr>
<td>Acceptable</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Bad</td>
<td></td>
</tr>
<tr>
<td>Not Evaluated</td>
<td></td>
</tr>
</tbody>
</table>
University of Borås is a modern university in the city center. We give education programs and courses in business administration and informatics, library and information science, fashion and textiles, behavioral sciences and teacher education, engineering and health sciences.

At the Department of Information Technology, we have focused on the students' future needs. Therefore, we have created programs in which employability is a key word. Subject integration, wholeness and contextualization are other important concepts. The department has a closeness, both between students and teachers as well as between industry and education.

Our courses and programs with a major in informatics are centered around basic concepts as system development and business development. In our wide range of specializations there is everything from programming advanced systems, analyze the needs and requirements of businesses, to conduct integrated IT and business development, with the common purpose of promoting good use of IT in enterprises and organizations.

The department is carrying out IT-related research within the university’s research area called Business and IT. In terms of field, the research activities are mainly within computer and systems science. Particular areas of focus are data science and information systems science. Both scientifically and professionally-oriented research are performed, which among other things is manifested through that research is often conducted based on domain specific needs of business and government organizations at local, national and international arena. The professionally-oriented research is also often manifested through our participation in the Swedish Institute for Innovative Retailing (SIIR), which is a research center at the University with the aim of contributing to commerce and society with the development of innovative and sustainable trade.

VISITING ADDRESS: JÄRNVÄSGATAN 5 · POSTAL ADDRESS: ALLEGATAN 1, SE-501 90 BORÅS
PHONE: +46 33 435 40 00 · E-MAIL: INST.HIT@HB.SE · WEB: WWW.HB.SE/HIT