Universiteit Leiden

ICT in Business and the Public Sector

A comparison of approaches on the analysis of the usability of Leiden University's website

Name: Daniella Bachour Nicolellis
Student-no: S1928945

Date: 14/01/2019

1st supervisor: Prof.dr.ir. F.J. Verbeek
2nd supervisor: Prof.dr. S.W. Pickl

MASTER'S THESIS

Leiden Institute of Advanced Computer Science (LIACS)
Leiden University
Niels Bohrweg 1
2333 CA Leiden

Abstract

A large amount of Websites continues to present its content in a non-usable way to the users that access it. It is still unclear why these Websites are not prepared to receive all types of users, since there are many tools and guides available which helps in the preparation and development of Websites. The purpose of this study is to present usability concepts as well as 2 forms of evaluation to analyze 2 different Leiden University's faculty websites from the usability perspective. During a year and a half of studying at Leiden University, me and my colleagues encountered multiple occasions where finding important information on their website took quite some time and most of the times, we were unable to find what we needed – that is the reason why this motivates me to study Leiden University's websites, as they can benefit from the final thesis project. After encountering the problem with the usability of the website, it was identified that the students are the main users of the website, and that they are the ones that spend more time searching on the website, and therefore the ones that lose more time on it, and that is the reason they were chosen as the stakeholders of the research. Based on the research of usability focused on websites, an attempt was made to develop heuristics to analyze its basic factors: intuitive design, ease of learning, efficiency of use, memorability, error frequency and severity and subjective satisfaction. After this, a questionnaire was developed based on the heuristics so that the users who access those websites can answer in order to understand how they navigate, how long it takes find information and how difficult it is. At the end of the study, there is a comparison of both methods where it shows that both of them relate closely and shows that the website lacks mostly on: Visibility of the system status, User control and freedom, Recognition rather than recall, Help and documentation; and then after that, it provides recommendations based on those heuristics that were shown that are the weakest ones.

Key-words: Usability, Web, Methodologies

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1. Introduction

Since the emergence of the web in 1989, which enabled the construction of a new informational and communicational paradigm, the development of increasingly complex applications has been growing due to the updating of the technologies available for building websites. In this context, the spaces used to store, disseminate and retrieve information on the web, such as websites, must offer users a way to facilitate access and use of information with quality and efficiency. With this evolution, the total of existing websites was increased, as well as the number of users who use them.

Therefore, it is fundamental to reflect on issues related to the development and quality of these products and services that serve the information users, because if the opposite occurs and the system does not meet their expectations, major problems may occur, including disinterest in use the system or even abandon it completely. This way, among other factors, the efficiency of using a system becomes a determining factor to obtain user satisfaction.

The Web has become accessible to all people, and has a wide variety of applications. However, it is noted that such popularity does not necessarily imply satisfied users. Many Websites are visited only once by users. In many cases, this occurs not because the content of the site does not interest them but rather because they were unable to find the information they wanted. The difficulty in finding information on the site is undoubtedly the usability problem most reported by users.

Taking that into consideration, the decision to analyse the websites of Leiden University was due to the fact that those websites are the only way that the students can have access to some information, and therefore cannot switch to a different one once they can’t find the information they need, leading to frustration. Another factor that motivated the topic for this study was the fact that it takes a lot of time to be able to find the information that the user is looking for on the website, and as it is a university website, and the students currently are using it, the information should be easily accessible and

shouldn’t take a lot of time to find everytime the user accesses it. Also, throughout the years of my study at Leiden University, me and my colleagues had a tough time trying to navigate through the website to find crucial information, and most of us had saved the links of the website as bookmarks/favorites to save time, considering we wouldn’t find the information if we would go directly to the website and directly searching. The main motivation is to discover how users interact with the system, and also how can the university improve the website in order to make it more pleasant for the users to use it on a daily basis so that the new students don’t take more time than needed to find what they are searching for.

Usability studies have been carried out for a long time, however they are not always developed in all the projects due to the investment of time necessary and high costs of the classic methodologies. Jakob Nielsen in of of his studies in 1994, demonstrates that from a set of simple and profitable methodologies, it is possible to reach results that meet the expectations of the users, providing a better service without wasting time and money. In fact, simpler methods such as heuristic testing and utilization tests can be better utilized and thus provide more ease and satisfaction in the user's use of the product.

The evaluation of website accessibility can be done in several ways, using various tools. Based on the usability attributes of the researcher Jakob Nielsen, it was developed a group of heuristics order to analyze the usability of the Leiden University websites, which later on were applied as basis to the questionnaire that was developed. This way, it will be possible to compare 2 different analysis to the understanding of the dynamics of efficiency of use of the site and the satisfaction of the users in using it, emphasizing the importance in listening to them, considering them as a fundamental part for the development of this information channel.

In this way, this research contributes to the understanding of the dynamics of efficiency of use of the Leiden University’s websites and the satisfaction of its users in using it, considering them as a fundamental part for the development of this information channel.

It is important to point out that this analysis will be made on the main website of Leiden University, and does not include third party websites that are also used by students, like USiS and Blackboard Leiden, which is also part of the websites that the students use on their daily basis. The decision on focusing on the main website was because that is the main entry point of all other websites related to the university, and also the website that the students will reach whenever they need to find whatever information.

1.1. Research Questions

Based on the studies of web usability, specifically in the studies of usability of websites, some questions have arisen regarding the efficiency of websites, specifically Leiden University's one. Considering this study is focused solemnly on the main website of the university, it was chosen to take only the perspective of the students (which are the main users of the website) that are searching for information. Below are the questions that the study will be centered:

- Is the interaction with the user effective, allowing it to achieve its goals on finding information fast and complete?
- What about the efficiency of the system, can the user accomplish the proposed tasks?
- How satisfied are these users with the system they use?
- How can Leiden University improve their websites?

1.2. Structure of the Thesis

With the purpose of making known the theme developed in this work, the paper is structured in different parts, being organized according to eight chapters. Initially we present an introduction to all the research carried out, identifying the necessary context

for its follow-up, the problem, some questions, as well as the motivation and its objectives.

Based on the study of usability, the 2nd Chapter tries to define its concept and how it is approached according to some authors. It also contains the quality components considered by Jakob Nielsen, which will serve as a basis for the methodologies used in the practical study

As the theoretical basis of the thesis analyzes the methodologies of the evaluation of usability, the 3rd Chapter presents the methodologies used throughout the work. Thus, it is explained each method, as well as the objective of the 2 applied techniques: Heuristic Assessment and Usage Tests.

Chapter 4 presents the practical part of this dissertation. After the research carried out in previous chapters, this chapter presents the case study, explaining the context of the usability study in the website of Leiden University. In this chapter, it is possible to see how both methodologies were implemented and get some considerations that are possible solutions to be developed in the next chapter of the paper.

After application of the practical study, Chapter 5 presents the results from both methodologies and also a comparison between them to show if the Leiden University website is according to the usability heuristics. This chapter also contains recommendations that should be applied to the website in order to make it more user-friendly according to the heuristics.

The 6th Chapter presents the conclusions drawn from the work developed, from theoretical and practical considerations.

The last 2 Chapters present the references of all the content used on the research as well as an appendix containing documents relevant to the paper.

2. Usability

When we talk about usability, we refer to a term that defines what is functional and usable. Usability takes into account the needs of the user and the context in which it is inserted, orienting it to perform a task in the best possible way. This chapter will discuss the concept of usability in general, as well as web usability.

2.1. Usability Concept

The concern with the relationship between man and machine, arose at the time of World War II and it has its roots in the study of ergonomics during the early 20th century. In this period, scientists from the British Air Force realized that the failures occurred during the operation of military equipment were not only caused by human failure, but due to the adequacy of equipment, the physical, psychic and cognitive characteristics of humans (Nascimento, et al 2010). After the wars, the benefits and study of ergonomics slowly penetrated into the corporate world and eventually reached into most industries.

According to International Ergonomics Association, Ergonomics is a "scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance". Ergonomics is at the origin of usability, as it aims to provide effectiveness and efficiency, through the adaptation of work.

The User Interface (UI) is a fundamental part of a software; is the part of the system visible to the user, through which he communicates to accomplish his tasks. It can become a source of motivation and even, depending on its characteristics, a great tool for the user, or if it is poorly designed, it can become an addictive point in rejecting a system.

One of the main goals in UI design is to obtain user-friendly interfaces, that is, interfaces that the user is comfortable with and encouraged to use. When some aspects, such as

human factors and domain factors (understanding the problem) are considered, a natural dialogue is obtained; if ignored, the result is an unfriendly system. The usability comes in with the focus of aiming to facilitate the use of a user interface without losing the interaction of its functionalities with the system.

The term usability began to be used in the 1980s, replacing the term user friendly by having subjective connotations. According to Dias (2003) a system can be considered friendly for one user and not as friendly for another, since the needs differ from one user to another. It is understood that rarely the same interface of a system will be seen in the same way by different users.

Below, are some definitions of usability, from the literature review:

Author	**Definition cited from the authors**
ISO 9241-11	*The extent to which a product can be used by specified users to achieve specific goals with effectiveness, efficiency and satisfaction in a specified context of use.*
Jakob Nielsen (2012)	*Usability is a quality attribute that assesses how easy user interfaces are to use. The word "usability" also refers to methods for improving ease-of-use during the design process*
Dumas & Redish (1999)	*Usability means that the people who use the product can do so quickly and easily to accomplish their own tasks.*

Table 1 - Definitions of usability

By the definitions above, it is clear that usability is used to describe the quality of use of product. This is a quality assessment for product with an increasing number of users, decreasing the appearance and errors, and is not important, contributing to user satisfaction. The indicator is an important but not unique measure for the determination of the overall quality of applications. Overall, this is a final criterion for the user to purchase software or visit a website.

Jakob Nielsen, a renowned researcher in the area, describes these 5 quality components related to usability in his book Usability Engineering (Nielsen, J. 1993).

1. **Learnability**: It is the first user experience with the system. Dialogue should be simple and natural. The messages must be clear and the system must continually inform about what the user is doing. The system should be easy to learn so that users can quickly begin to interact with the system and develop their activities.
2. **Memorability**: Memorability and learnability are 100% tied. If the previous concept is applied successfully, the ease of remembering will be an easy task for the user. The system should be easy to remember, so that a user is able to return to the system after some period of time without having used it, without having to learn everything again. Care must be taken not to focus on the interaction of the novice user. Sometimes in an attempt to help, the interface is very explanatory for first access, but then it can become tiring for later accesses.
3. **Efficiency**: When Nielsen cites efficiency, it is already understood that effectiveness is embedded. Efficiency is linked to experienced users. Often, these users find other ways to interact with your system differently than you have designed. The system should be efficient to use, so that once the user has learned to interact with the system, he can achieve a high level of productivity in the development of their activities.
4. **Errors**: It is logical that every system is susceptible to errors, but trying to minimize them help in this process. The system should have a low error rate, error messages should be user friendly and if users make mistakes while using the system, they can easily recover them.
5. **Satisfaction**: The system should be pleasant to use, so users feel subjectively satisfied when using it. The content is easy to understand and as said before, language should be simple and easy. The customer should feel pleasure in reading or interpreting the system.

Therefore, we can understand that the quality and usability of a system depend on a set of factors such as the interface, the task to be performed, the equipment used and

especially the relationship between the user and the system itself. The quality components are also mentioned by Shackle in one of his books (Human Factors for Informatics Usability) where he states all those components, with a different name, and says that for a system to be usable, it should follow those components. These are used in order to understand better the concept of usability and therefore will not be measured specifically on those terms, but they are applied to the heuristics used later.

These quality components can be measured by implementing them in the different types evaluations available (that will be mentioned later on), in a way that they will be rated and detailed, so this way, the evaluation is deeper than only 5 topics.

2.2. Usability Specifications

Usability engineering is a process through which usability characteristics are specified, in advance and quantitatively in the development process, and measured throughout the process (Good et al., 1986). Without measurable specifications, it is impossible to determine usability goals and tell whether the end product achieves those goals. In the background, if you can not take action on an activity, you probably can not manage it.

Usability specifications defines quantitative usability goals that are used as reference to evaluate the quality of the user interface. The specifications should be established as early as possible in the development process, and the goals are levels of performance in tasks typical of the various roles of users. By establishing the Usability Specification as early as possible in the development process, and monitoring each iteration, one can determine when the interface is actually moving toward improvements.

Considering this study evaluates the website post development, there is no basis to do a usability specification study, as the website is fully done. So, some of the specifications that are considered when developing a website are considered in the format of heuristics in the analysis of the website, and therefore are measured in a different format (Likert scale - explained later on).

2.3. Web Usability

The Cambridge Dictionary describes a website as a set of pages of information on the internet about a particular subject, published and administered by an entity, that is, by a person, a company, an organization or a provider. Pages contain specific virtual addresses that enable access to content from any computer, anywhere, connected to the network.

Netcraft (2018) is a company that provides internet security services and analyses many aspects of the internet, such the market share of web servers, operating systems, among others. They released an article in 2018 saying that there are over 1.8 billion websites on the world wide web today, of different types, different goals, styles and functionalities such as news, entertainment, university, organizational (profitable or unprofitable) websites, information and personal pages. Even though there is a large number of websites on the web today, only less than 200 million are active.

When computers were used by a small number of people who performed highly specialized tasks, it had been expected high levels of knowledge and competence from users. Nowadays that the access to computers has popularized it is important that the interfaces are of the understanding and handling of users with little experience as well. The quality of systems is related to effectiveness, ease of learning, efficiency and use, ease of storage, low error rate, satisfaction and consistency - as mentioned before. The most effective sites in getting people to the right place are those that match users' expectations. Allocating adequate resources to design the best information architecture possible for your site ensures that customers find the answers they need in the places they expect.

When applied this to market reality, we must think about the importance of getting the customer to get what they are looking for on their website in the easiest way possible. If a user cannot use a website, then the company loses a customer, and therefore, money. The big question behind any usability is finding balance in the need for

elements, that is, many elements leave the person confused, few elements make it difficult for them to find what they are looking for quickly.

According to Nielsen (2007), nowadays, theoretically, most web projects take into account the user experience, and it is rare to find managers who do not list usability as the main purpose of their site, but, unfortunately, in practice, websites continue to violate many of the usability guidelines. Usability fits into any type of interface design, having different amplitude according to the criticality of the project, ie, the more critical the system, the greater the losses if it is not user friendly and provides satisfaction.

When usability is taken into account during the process of developing Web interfaces, several problems can be eliminated, for example, one can reduce the time of access to information, make information easily available to users and avoid the frustration of not finding information on the site. If the goal is, for example, distance learning, students may feel frustrated, unmotivated and underperforming due to frequent occurrence of usability problems.

The structure of a website should value and encourage the availability of information to users, so it is important that website owners always update it with services and news of interest to their target audience.

The maintenance and constant updating of a website is of vital importance, since this is the showcase for the external public. In order for a site to maintain the quality standard and meet user demand, re-evaluations of the site should always occur. (Matera, M. 2006)

Steve Krug's book "Do Not Make Me Think: A Common Sense Approach to Web Usability" can be considered the usability bible "for dummies," for its simple and objective way of explaining everything that is essential for good web usability. Below are some lessons that he considers determinant to guarantee the quality of use of a site:

1. Usability means doing something that works well, and that a person not very experienced can use it for its proper purpose, without any frustration during this process.
2. Web applications should be as much self explanatory as possible. When a user looks at a web page, all navigation or interface operation should be evident, obvious and self explanatory.
3. Users do not like puzzles when it comes to getting things done. If people who design interfaces do not care enough about creating obvious things, they can directly shake users' confidence about the site.
4. For the most part, our web use is motivated by the desire to save time. With competition being just a click away, users tend to be in constant motion. A second lost unnecessarily can result in a competitive jump.
5. Even with good usability, it is not difficult to see users wandering their way from time to time while browsing because of just a wrong click in a hurry. Therefore, the "back" button is still the most used feature of browsers.
6. When a user finds something that works, he will use it, even if it malfunctions. It is almost certain that users will use interface elements that they know will work, and will hardly look for something that works best.
7. Most users do not have the time for small talk, and they always want to get right to the point. So therefore the site needs to be objective and eliminate small talk as much as possible.
8. A substantial part of users, upon entering a website, will immediately search for a search field. Often, doing a search is much more practical than searching for content via navigation.
9. When the user goes back to some part of a site, instead of looking for information through established navigation (like the first time), they try to remember the

conceptual hierarchy to redo our previous steps. This way, the site has to have the same structure all over it.

10. Keeping a link to the home page always in sight is a guarantee that no matter how lost the user may be, he can always start over.

3. Methodologies

The study identifies and describes the characteristics of the object of study in question, the usability of the Leiden University website. To do so, it was used the quantitative and qualitative methodology in the research.

The quantitative method is characterized by the use of quantification, both in the form of data collection via questionnaire and in the analysis of the results and their subsequent presentation to arrive at a new situation where the website has more usability.

Qualitative methodology works with values, beliefs, representations, habits, attitudes and opinions and is adapted to deepen the complexity of phenomena, facts and specific processes of delimited in extension and capable of being intensively covered.

The combination of such methods is adequate for the organization, interpretation, understanding and enrichment of the data to be analyzed.

There are several methods that can be used in order to evaluate the usability of a website, and some of them have their origins in psychology, such as incident diaries, interviews, controlled experiments and other methods, such as the focus group and user workshops, are adaptations of other disciplines, such as marketing, for example. There are also methods that were developed especially for the evaluation of usability in digital graphical interfaces, such as co-discovery, heuristic evaluation, cognitive walkthroughs and logging use.

The methods chosen were the heuristics, and questionnaires, which will be described in the next session, containing an explanation on why they were chosen for this study. And, considering that the purpose of this study is to analyse the website and point out ways it can improve, there is also a comparison of both methodologies in order to understand better what the website is lacking on, so that there is a clear way to show recommendations related to the methodology studies.

3.1. Heuristics

Heuristics are a set of principles recognized as good practices to follow in the areas to be evaluated, presenting solutions to specific problems and adapting them to a given interface, in accordance with usability standards.

“Heuristic evaluation is an informal method of usability analysis where a number of evaluators are presented with an interface design and asked to comment on it” (Nielsen; Molich, 1990). It is the most popular of the methods of systematic inspection of the usability of interactive systems, aiming to find usability problems in the design so that they can be attended as part of an interactive design process. The heuristic evaluation cites usability problems in the interface with references to usability principles that were violated in the evaluator's opinion.

There are multiple advantages of using heuristic evaluation, and below are some listed by Nielsen and Molich (1990) which were essential in order to make the choice of using this evaluation method:

- Low cost compared to other evaluative methods
- Intuitively and easily taught to other possible evaluators
- It does not require advanced planning
- Evaluators do not need formal usability training
- It can be used at the beginning of the interface development process
- Performed in less time than laboratory usability tests.

In order to make this type of evaluation, some standards of usability developed by specialists had to be chosen, which led to the *Ten Heuristics* developed by Jakob Nielsen followed by the *Eight Golden Rules* by Ben Shneiderman. Since Jakob Nielsen is considered the father of usability and he focuses more on evaluation than Ben, it was decided to use his heuristics as basis, then compare those to Ben Shneiderman’s golden rules, which are more focused on design, in order to make the evaluation. This

method evaluates the interfaces based on the skills of the specialists, and it does not involve equipment and the users' availability to perform the tasks.

These heuristics chosen will be the base of the evaluations and therefore are crucial to the extent of this paper.

3.1.1. Ten Heuristics by Jakob Nielsen

From Nielsen's Ten Heuristics, developed in 1990, together with Rolf Molich, it is possible to verify specific usability problems in the system. The principles of usability were adapted by Nielsen in 1994 for Web interfaces in order to avoid errors, given that heuristics are presented as a guide for the user to arrive at an efficient solution. Thus, the goal is to build on a set of general interaction design principles to improve usability in visual web interfaces and make the user experience rewarding.

1. Visibility of system status:

In general, the human being is very dependent on the vision, yet when we are in a physical environment we have other senses that inform us what is happening; when we speak of a system, a software or an interface, that story changes a bit. In digital environments the dependence on vision is even greater and because of this it is essential that the interface provides the user with the status in relation to his position within the system, that is, to inform the user about which environment he was in, where he is and to which other environments he may be directed from its location.

One of the most common example is, after performing an action, the user does not get all results clearly and visible, sometimes having to give up or go to another menu. To do this, it is necessary to have visual information for the user to understand if he is on the right path, such as the progress bar of a download, the opening of a page, or even the visualization of the page where he is.

2. Match between system and the real world

It is necessary for the user to become familiar with the system so that the information displayed is of interest to him and, mainly, his knowledge. Thus, the language used should be familiar and should be appropriate to the target users, the user should not have to make efforts to find the information he wants to obtain, but rather have a dynamic experience.

Another aspect of system-real-world compatibility is the symbols used within an interface. It sounds like something of no importance but choosing correctly which icons will be used to put in an interface can make it easier or worse to understand the information.

3. User control and freedom

The system should enable the user to exercise control and feel free. The way out of a page should be clearly visible, as well as other links or even return to the homepage. Some examples are the "redo" and "undo" buttons, as well as other familiar buttons for users, such as the home page (usually recognized by the logo).

The point here is that when the user performs actions by mistake, which is often the case, the system must present the user with an "emergency exit" since the possibility to revert actions removes the insecurity of the user when using the website.

4. Consistency and standards

This heuristic is somewhat simple but often not applied in the construction of interfaces. Maintaining consistency between the screens of an application is essential so that it is not necessary to understand different patterns and forms of different interactions for each screen; once learned it will be something replicable in other contexts. In addition, the user experience becomes much more interesting because there will not be that feeling of being lost. Often the reason users do not interact with applications is this feeling caused by lack of consistency and standardization.

The design elements should always have the same effect and the meaning of the functions of a system must have a consistent appearance, that is, equal functions even in different situations, in order to normalize the system. The consistency of design often becomes visible in the colors used, in terminology, in formats, among others.

5. Error prevention

The system should prevent the user from errors that arise during use, since errors in the system are misdiagnosed. The structure of an application can not always be the most correct and simple from the point of view of the users, causing them to make unexpected errors.

Therefore instead of messages saying that the user made some mistake, it is better to prevent that the user makes mistakes. Confirmation boxes, such as those that appear when you delete a file making sure you indeed want to delete a file, is an example of a confirmation option before the user proceeds to the action to avoid errors.

6. Recognition rather than recall

The brain is very good at recognizing patterns and to the extent that objects, actions and options are exposed to the user, more tips come from the brain making certain actions familiar, that is, it is preferable to give the user ways of recognizing patterns than having to force him to memorize various information as he navigates through the application. The big difference between recognizing and memorizing is the amount of tips that are provided for a knowledge to be accessed, recognizing patterns provides much more tips than trying to access memories.

The design elements shall be clearly visible and easily accessible where necessary in order to generalize the user's recognition. In this way the user's memory must be reduced through the use of several actions and visible options that facilitate the user to remember the information, such as icons and function keys well identified.

7. Flexibility and efficiency of use

Ideally, the interface is useful for both beginners and experienced users. Beginners need more detailed information to be able to accomplish tasks, but as they grow in knowledge about the interface, the need for faster forms of interaction to accomplish a task begins to emerge.

The application should allow the user to create shortcuts in order to shorten and adapt frequent actions, as well as their preferences.

8. Aesthetic and minimalist design

The greater the amount of information, the longer it will take for the user to analyze and make decisions in regarding what they want to do, so it is crucial that the structure of the system must contain relevant information and never unnecessary or rarely used information. The secondary information can be left in the background (menus, tabs , etc.), so the application becomes very efficient in terms of transmitting information to users.

9. Help users recognize, diagnose, and recover from errors

The system should assist the user in their search by suggesting help solutions, such as error messages. Messages must be expressed in an appropriate language and all its functions must contain form and meaning, so that the user can do their research in an obvious, fast and effective way.

An example is those forms warnings in fields that were not filled correctly. It's a simple way to show the user that he made a mistake, where he missed, and what needs to be done to correct that mistake.

10. Help and documentation

Usually these are the least accessed areas but they are still important within a system because you never know when a user will need a little help. In order to facilitate the individual tasks of users, the system must be prepared to provide a place where the

user can easily solve certain problems, like a "do-it-yourself" way for the user to resolve their doubts about what actions to take within the application, making them more independent of the support.

Although most users do not read the documents, it is important that the interface provides help documentation, and for that it must be accessible and easily searchable. The document should offer a simple language, not very extensive and focused on the tasks of the user.

From this set of heuristics provided by Nielsen and Molich is intended to find certain problems that may exist in the interface. Each heuristic is presented in a structured way, having specific points that aim to improve the interface and its interaction with the user. Heuristics examine what the system should do, or what users are able to do to heuristically.

3.1.2. Eight Golden Rules by Ben Shneiderman

The Eight Golden Rules of Interface Design are a set of usability principles established by Ben Shneiderman in 1998, applied in visual Web interfaces. The Principles, such as Nielsen's Ten Heuristics, are intended to improve the usability of systems.

1. Offer informative feedback

For every user action, there must be system feedback - a feedback to the user, a message, a warning, a satisfaction of what is happening.

For frequent and minor actions, the response may be modest, whereas for sporadic and more important actions, feedback should be stronger and more prominent. Thus, a selected menu item should indicate that it has been selected, the download of a file must indicate the estimated time for completion and its progression, at the same time as an action that results in an error, information should be given about the error and what steps are required to resolve it.

The user always has to know what is happening with the actions that he does within the interface.

2. Support internal locus of control

More experienced users like to feel that they control the system processes and that the system only responds to their actions. Some examples that can produce closure and dissatisfaction to users are the difficulty in obtaining desired information and inability to produce the intended action.

3. Strive for consistency

Consistency is required to avoid doubts and maintain a visual pattern regarding colors, layouts, and fonts, and use the same terminology in different menus, help screens, and commands.

The more different forms of interaction the greater the difficulty the user will have in using an interface, so maintaining consistency has a fundamental role as it creates ease in assimilating that specific moment that the user is living to other situations previously experienced, therefore, the decision of what action to take becomes much simpler and easier.

4. Offer simple error handling

People do not like to be told that they are wrong, especially the users. Every interface must have mechanisms that are able to avoid as much as possible that users make mistakes (foolproof), but when errors that are impossible to avoid happen it must present the user with a simple, step-by-step way of solving the error that occurred the fastest possible.

5. Reduce short-term memory load

Limiting people to information processing in short-term memory requires designers to avoid creating interfaces in which users must memorize information from one screen and then use them on another screen.

The exhibition should be simple and intuitive due to the limitation of information in human memory. Whenever possible, forms that result in user memories, such as abbreviations, codes and other information, should be provided.

6. Enable frequent users to use shortcuts

As the level of knowledge we have over an interface increases, the need for faster forms of interaction to accomplish a task begin to emerge.

Differences between beginners and experienced, age groups, disabilities and technological diversity enrich the range of requirements that guide the project. Adding features for beginners as explanations, and features for experts as shortcuts, can enrich the interface design and improve system quality.

Reducing the number of interactions and increasing pacing through the use of specific abbreviations and commands are useful for the user experience, and can improve interface design, system quality, and interaction.

7. Design dialog to yield closure

Sequences should be organized so that the user can understand the steps and know when they were successful, or even if they were not completed.

Telling the user that he has completed a cycle is essential. Allowing the stream to simply end without communicating to the user causes doubt as to whether the action done by him was correct or not. Feedback information after completing some actions gives users satisfaction of achievement, a sense of relief and an indication to prepare for the next task.

8. Permit easy reversal of actions

One of the main functions that every interface must provide to the user is to allow the user to return an action or even a group of actions taken during use.

Whenever possible, actions by users should be reversible. This alleviates the user's closure, since he knows that mistakes can be undone, and encourages the exploration of other options, since he will not be afraid to err when using the product you designed.

These principles must be interpreted and refined for each situation, for each project. These rules have their limitations, but they provide a good starting point for the interface design of websites, software, and applications.

The intent here is to strive to increase user productivity by providing simplified data entry procedures, understandable displays, and fast, informative feedback to increase feelings of competence, mastery and control over the system.

3.2. Questionnaire

Engaging users in the design a website is one of the best ways to get a clear result on the level of usability of a website. There are different ways in which users can contribute to the evaluation of a Website, from an informal conversation about what the user has found about the usability of the Website, to the formulation of a questionnaire containing tasks that the user must do, and next to them, a ranking so that the same can evaluate how difficult it was to complete each task. “Although it is an artificial situation, usage testing yields realistic results, people get very involved with tasks and suspend their disbelief.” (Nielsen, 2005).

The main advantages of having questionnaires as a way to do the evaluation follows below:

- Questionnaires are one of the most cost-effective ways of collecting quantitative data. Especially the online questionnaires and the furniture have a very low cost and a generous reach.

- In addition to being economical and flexible, questionnaires are also a practical way of collecting data. They can be directed to groups of their choice and managed in various ways.
- It's quick and easy to collect results with online and mobile tools. This means that you can win conclusions in as little as 24 hours, depending on the scale and scope of your questionnaire.
- Most questionnaire and survey providers are quantitative in nature and allow easy analysis of results. With integrated tools, it is easy to analyze your results without a framework in statistics or scientific research.
- In the questionnaires online, there is no time limit and no one on the other side waiting for an answer. Respondents can take the time they want to answer the question.

4. Case Study: The Leiden University website

Case study is a method that usually consists of a way to deepen an individual unit. It serves to answer questions that the researcher does not have much control over the phenomenon studied. It is a tool used to understand the form and reasons that led to a decision.

According to Yin (2001) the case study is a research strategy that comprises a method that covers everything in specific approaches of data collection and analysis. This method is useful when the phenomenon to be studied is broad and complex and can not be studied outside the context where it occurs naturally. It is an empirical study that seeks to determine or test a theory and clarify decisions to be made.

On this chapter, it will be presented a case study of the Leiden University Website, containing:

- First, a short description of the main pages of the website in order to understand how the website currently works and the main screens when the user accesses it.
- After the website is properly introduced, then it comes the analysis of it with the two chosen methods: Heuristics and Questionnaire so that is possible to relate the screenshots and description of the pages with the real problem.

4.1. Context

Founded in 1575, the University of Leiden is the oldest university in the Netherlands, offering a wide variety of programs. Leiden University is a truly international university, uniting people and knowledge from every corner of the world. The university is made up of seven faculties, 6 in Leiden and 1 in The Hague. In all, Leiden offers about 50 undergraduate programs and about 80 master's programs with nearly 200 specializations.

Considering the size of the university, and the amount of people thats study there, it's believe that a user friendly website is a need when it is the main way the students get information related to their studies. Below is an introduction to Leiden University website, showing the main pages and some issues already encountered.

All the research that was made in regarding Leiden University's website is only based on accesses made through a Desktop, as the design changes once accessed on a mobile device. The reason of this choice is because the users tend to access the website more via Desktop, than any other platform (as seen on the results of the questionnaire the previous chapter).

4.1.1. Home Page

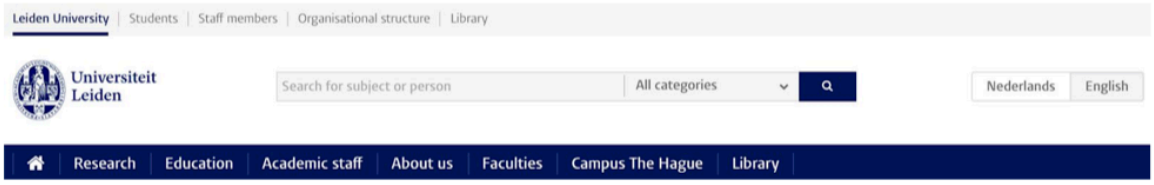

Figure 1 - Leiden University top home page

Figure 1 shows the top of the main page. It contains 2 main menus, 1 showing options in regarding students, staff members, organizational structure and library, and the other showing general information about the university. Both of the menus contain a link to the homepage, as well as a clickable logo which will also redirect the user to the homepage.

The 2 menus can be confusing once if the user is currently a student, he needs to access the "Students" tab, before even looking for his course. Considering the second menu (on the bottom), is highlighted in a different color, it brings more attention to the eye, and the students might end up going directly to it do find information in regarding their course, by accessing the link "Faculties", as an example. If the user access the link "Faculties", which will lead to a list of faculties that Leiden University has, and therefore the respective courses, it will lead the students to general information of the course such as what the programme entails and why choosing Leiden University, but it won't

show information like schedules, announcements and calendar. This way, it is crucial that the user is aware that he needs to click on the tab “Students” before he tries to find any information in regarding his studies, otherwise he will lose time searching for it in a page that it won’t contain what he is looking for.

The search bar is presented throughout the entire website, but it will only search for subjects and people, and therefore is not very useful for the users that are lost in the website looking for a quick way to reach to the page they need to find, becoming somewhat useless.

The website also presents a button which the user can toggle in between English or Dutch, and considering the university is very international, it is a must feature that the university made sure to present.

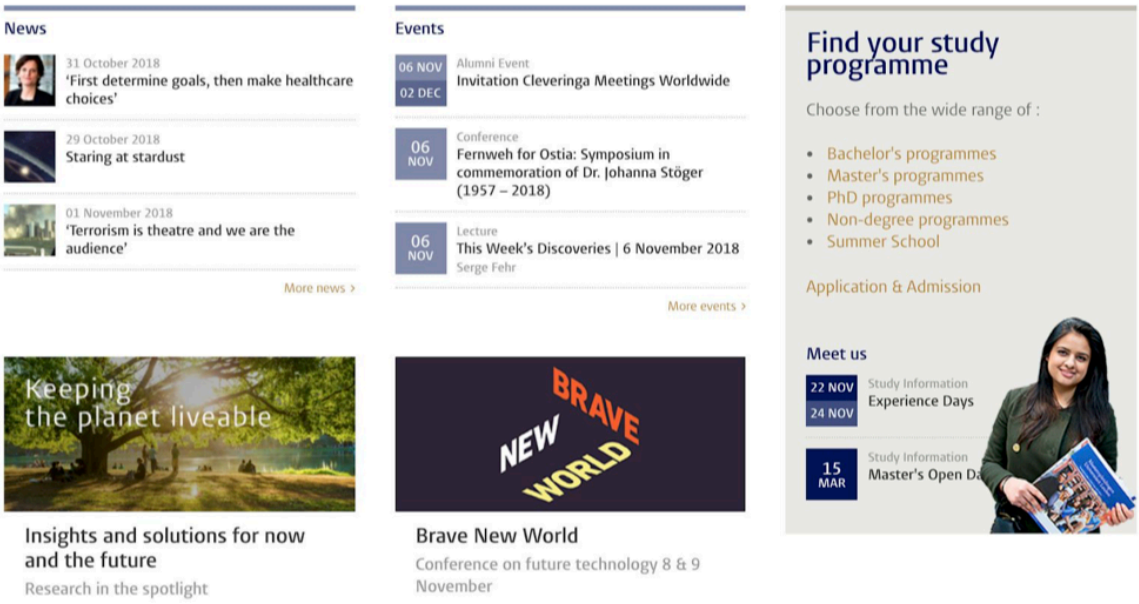

Figure 2 - Leiden University middle home page

Scrolling down the main page, it is possible to see 3 different areas devoted to news, events and the range of programs. The news part, doesn’t show articles only related to the university, but also related to trending news all over the world. The events part, is divided into: Alumni events, conferences and lectures. Both the news and events are

only a preview of the full information, which can be accessed once clicked on each separate event / new, so that the students can get more details.

The part in regarding the programmes that the university provide is divided into the type of degrees: Bachelors, Masters, PhDs, Non-degree and Summer School. All of the links can be clicked and will lead to more information on the courses itself, how to apply, deadlines, student life and more, helping potential new students to find what they need to know about the courses before applying but not providing help for the current students.

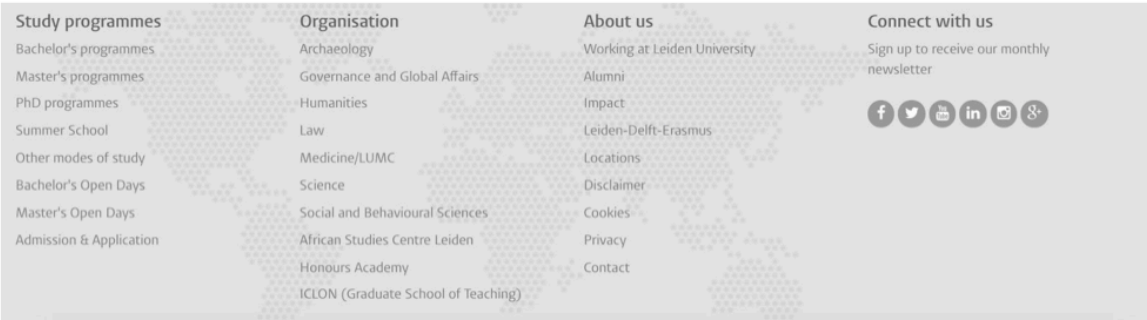

Figure 3 - Leiden University bottom home page

The last part of the website is the bottom bar which remains the same throughout all the pages of the website and its divided into 4 parts. The part regarding Study Programmes provides the same information as the “Find your Study Programme” which is just right above it. So, in the same page, there are 2 menus showing the exact same information where one of the areas could’ve been used to show other type of content instead of duplicating information. The part regarding the Organisation shows all the different faculties and associations that Leiden University has which one clicked, opens another page providing more details. The About Us part, contains useful links to information such as contact, location, working there and more; and lastly the Connect with us part present the social medias of the university which once clicked will redirect the user to the different websites.

4.1.2. Student Portal

As said before, if the user is currently studying at Leiden University, he will only be able to find information about his course once he accesses the “Students” tab. Once the user decides to enter the student page, he needs to click on the “Students” tab before he is able to see any information in regarding his studies (see picture below).

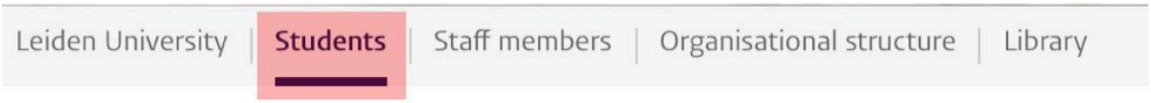

Figure 4 - Leiden University students tab

After entering the Students tab, a pop up message appears asking the user to type the course he is studying, see picture x. The user is able to either type in the course and access all its information, or he can enter as a guest but then again, they will only see the general information.

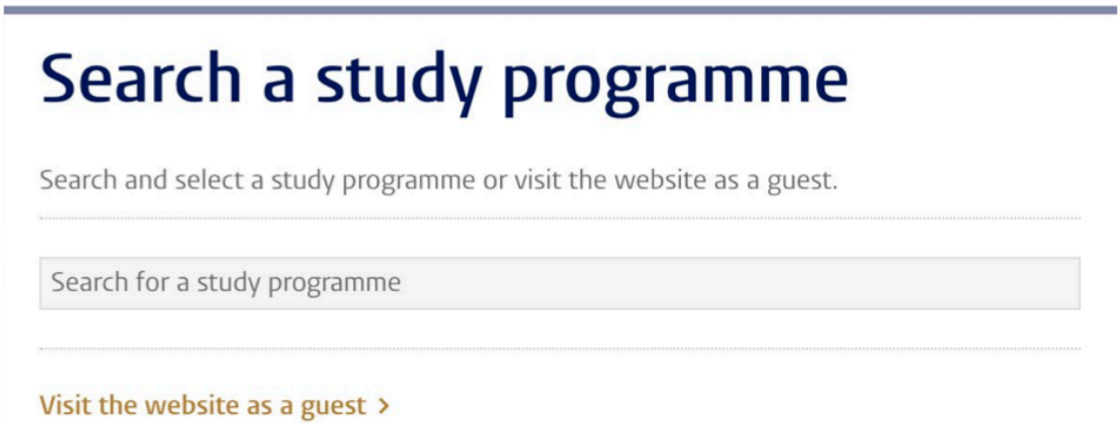

Figure 5 - Leiden University study search

As soon as the user chooses his course, he then enters a page containing the information he needs in regarding his course. As seen on the picture x, the page is

divided into 3 parts. There is a menu on the left, which contains all the information in regarding studying at Leiden University, administrative manners, student life, work information and organisation. In the middle, there is an announcements part, which contains information about the university in general which can be clicked in order to obtain more information. And lastly, on the right, there are direct links for external websites related to the university such as Blackboard and uSis.

Figure 6 - Leiden University students page

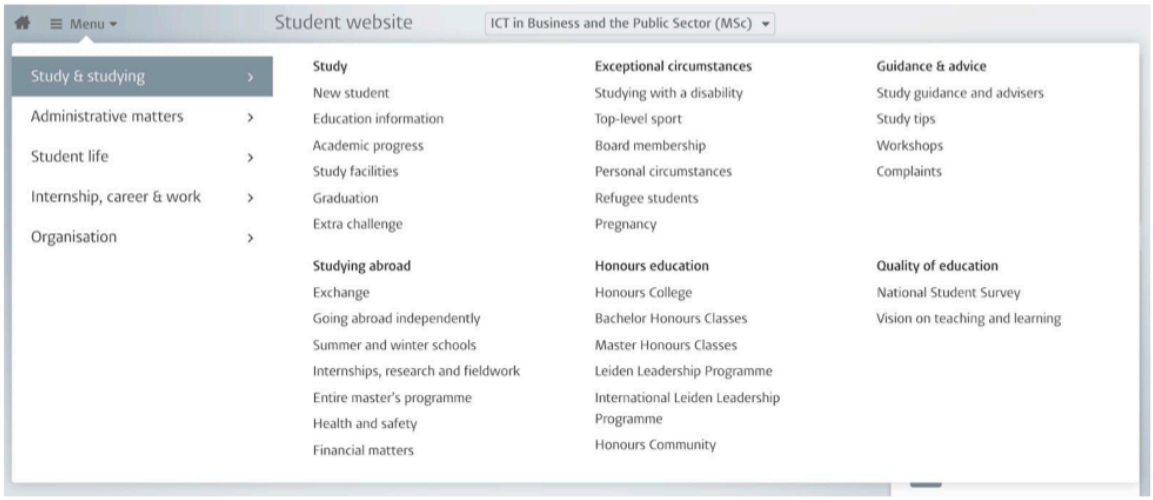

Figure 7 - Leiden University students menu

That menu (see picture x) is the most important part of the page as it contains all the links to what the user is looking for, but it still can be hard to find crucial information such as schedules and courses. For the user to be able to get that information, he needs to enter a sub menu inside the original one to get to it, and it takes at least 3 clicks to reach what he is looking for, so that slows down the productivity. Also, the initial menu is not clear enough to which option needs to be selected in order to find what the user is looking for.

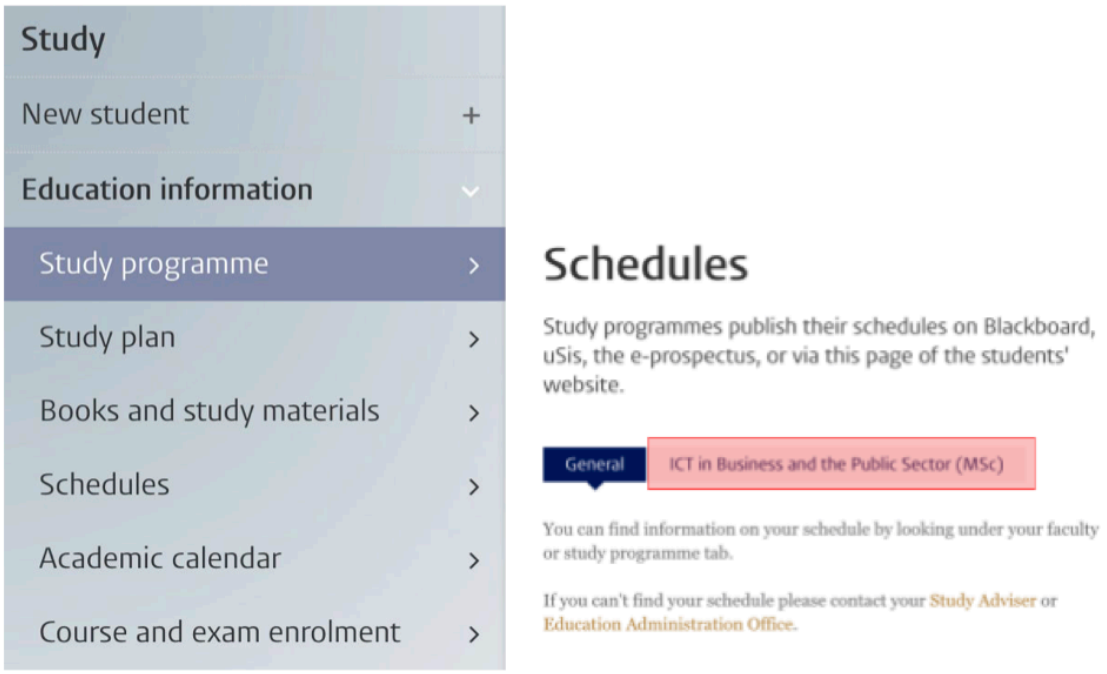

Figure 8 - Leiden University schedules search

As an example, the Schedules and Calendar are under “Study and Studying” > “Study” > “Education Information”> “Schedules” > the course itself, and then, the user will be able to find multiple schedules and has to search until he finds the one he needs.

4.1.3. Contact

The contact page provides a menu on the left, showing different options the user can choose in order to get in contact with who he needs to such as Prospective Students, Visitors, Students, Media and much more. This way, the user can be more certain on who he wants to contact; but if he is not sure which department he want to talk to, there is a general number which is provided in the main screen.

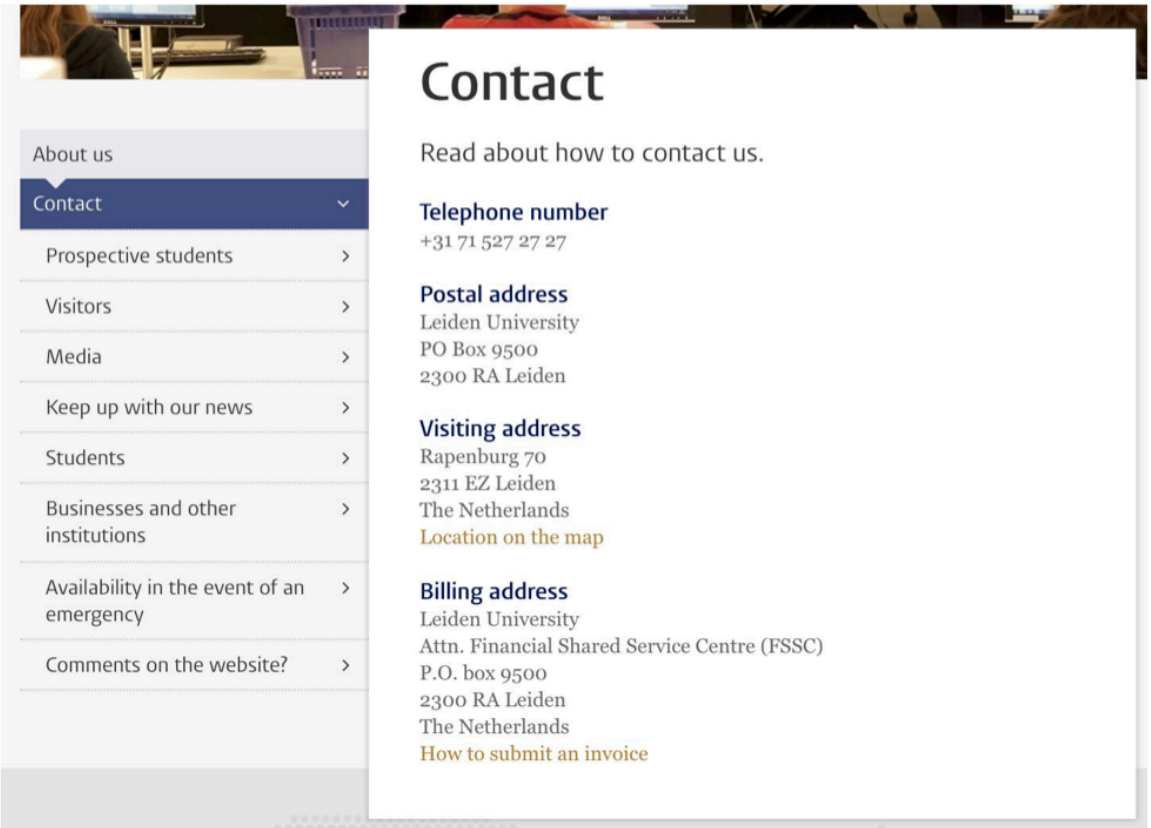

Figure 9 - Leiden University contact page

4.1.4. Site Map

Leiden University's website does not provide a map for the website. If the user is lost, he will have to keep searching and trying to find what he is looking for on a trial and error basis. This leads to disappointment and might get the user to give up on finding whatever he needs.

4.2. Analysis

4.2.1. With Heuristics

The analysis of Leiden University's website sought aspects that were compared with criteria and recommendations cited in the previous chapters. The table below shows a set of checklists created by Paul Christian, a Dutch design consultant that believes that good design is tangible for everyone. Paul specifically focused on the areas User Experience Design and Usability and wanted to make the websites he studied self-evident and ensure that visitors can easily and quickly find what they are looking for. He then developed this checklist for his thesis and still uses it to gain insight into the level of usability of websites he analyses.

Paul Christian's checklist applies very well to the Leiden University's website because it focuses on the main aspects of usability. Paul first created it to analyse websites of psychologists (on his thesis project) but then he modified it in order to fit with general websites and made it available on his website for people to see it. It relates very well with this research as the checklist contains important topics that are related to Nielsen's and Schneiderman's work.

This checklist deals with following website elements: the homepage, the navigation, the main menu, the general website navigation and hyperlinks, the website content (content, texts, images and more), the website layout and the design.

Together with the checklist, it shows the Nielsen's heuristic(s) in which the specific topic can be related to, as well a score showing if the site meets the criteria in question. The scores will rate from 1 to 3, using the *Likert* scale - the Likert scale usually ranges from 1 to 5, but it was decided to use a scale from only 1 to 3 to better understand the issues addressed. The scores developed for the evaluation have the following criteria:

1 Point: Website does not meet the criteria in question

2 Points: Website partially meets the criteria in question

3 Points: Website fully complies with the criteria in question

ID	Checklist	Score	Heuristic IDs
1	Does your website use a clear, easy to remember and not too long domain name?	2	2,8
2	Do you use a 'clean' and logical website address for your homepage?	1	2,8
3	Does the homepage tell your visitor immediately and clearly what kind of website this is, and what he can do with it?	3	2,8
4	Does your homepage contain a slogan or company motto that says immediately and clearly what the company is doing?	2	2
5	Is the company / website logo in a prominent place and is it large enough to be legible?	3	4,8
6	Does the logo of your website / company appear at the top left of the website page?	3	3,4,8,9
7	Is the company logo clickable and does it refer to the 'Homepage'?	3	3,4,8,9
8	Are the most important parts of the website directly accessible via the homepage?	2	4,8
9	Do you prevent the use of 'tools' or additions to the homepage that are not relevant to your visitor?	2	8
10	Is the homepage clearly unique and different from the other pages of the website?	2	2,4,8

11	Does the homepage tell us immediately and clearly which products or services can be found on the website?	2	4,8
12	Are the most important tasks for the visitor highlighted on the homepage, so that visitors have a clear start / starting point?	2	2,6,8
13	Are the most important parts and the main message (s) of your website visible at a glance, without scrolling at a resolution of 1024 × 768?	3	4,8
14	Is there a phone number and possibly (visiting) address on your homepage to read?	1	7,10
15	Do you prevent the use of an animation or music on your homepage?	2	4,8
16	Is the main menu of your site in a clear and conspicuous place?	2	4,6,7,8
17	Is the main menu on each page of your website in the same place?	2	4,6,7,8
18	Do you avoid drop-down or rollover menus in your main menu?	2	4,6,7,8
19	Are there fewer than 10 items in your main menu?	2	4,6,7,8
20	Are clear and logical names used for the main menu items?	2	4,6,7,8
21	Is there a 'Home' button / link in your main menu?	2	2,3,4,6, 7,8
22	Is it clearly visible in the main menu where your visitor is?	2	4,6,7,8
23	Is there a search field near your main menu?	2	2,3,4,6, 7,8
24	Is there a clear button with "Search" in the search field?	2	2,3,4,6, 7,8
25	Is there a clear 'about your company name' page for information about your company / the site / product in your main menu?	2	2,4,8,10
26	Is there a clear 'contact' link or button in your main menu that leads to all contact information 'interesting to the visitor'?	2	2,4,8,10
27	Do you use a bread crumbs trail in your website?	3	1,3,4,5, 6,7,8
28	Does the navigation consist of 'selectable' text instead of graphical 'buttons'	2	3,4,7,8

29	Do you use logical names for the links on your website?	2	2,3,4,5, 6,7,8
30	Are the links on your website as short and specific as possible?	2	2,3,4,6, 7,8
31	Are all links underlined or 'clear' clickable and do they appear in the texts?	3	4,8
32	Are the 'clicked' links of a different color than the not clicked links?	1	1,4,8
33	Do all links have the same color?	1	4,8,9
34	Do you prevent that there are links on your website that open a new window?	1	1,3,4,5, 8
35	Are all your contact forms on your website with fewer than 4 fill-in fields?	2	7,9,10
36	Can your visitor easily contact you from any page?	2	2,4,7,8, 10
37	Does your website contain a site map?	1	2,3,5,6, 7,10
38	Do you understand clearly; titles, subtitles (sub-paragraphs) and texts?	3	2,4
39	Do you use headers and subheaders on your website to subdivide your texts?	2	2,3,4,6, 7,8
40	When you want your visitor to do something, do you tell him exactly what he has to do, and how he should do it?	1	2
41	Is your text aimed at helping the visitor?	2	2
42	Do you prevent the use of photographs as decoration?	1	4,8
43	Do the images on your website contain a good / descriptive name and alt tag?	1	n/a
44	Are the texts of your website checked for errors?	3	2,4
45	Do you use bullet points, bulleted lists, white spaces and / or appropriate images to interrupt your text?	2	2,8
46	Do you prevent the use of unnecessary content for your visitor?	2	2,6,8

47	Do you prevent the use of exclamation marks in your texts?	3	2,8
48	Do you prevent the use of words that consist entirely of capital letters?	3	2,8
49	Do you prevent the use of unnecessary dots or spaces between letters?	3	2,4,8
50	Does the website look professional and well-cared for?	2	2,4,8
51	Is all text on your website easy to read?	3	2,8
52	Are the most important items / items on pages emphasized / bigger / more striking?	2	2,4,8
53	Do you prevent the use of 'noise' (elements that require attention) on your website?	2	4,8
54	Do you prevent your visitor from scrolling somewhere horizontally on the website (at a resolution of 1024 x 768)?	2	4,8
55	Are your website pages clearly divided into panes?	2	4,8
56	Do you prevent the use of many different types of text formatting?	3	4,8
57	Do you prevent the use of website animations?	2	8
58	Do you prevent the use of pop-ups on your website?	2	4,5,8
59	Do you prevent the use of Flash elements?	3	4,5,8

Table 2 - Paul Christian's checklist for usability

After scoring all questions one by one, they were separated into the heuristics that they refer to. This way, it was possible to calculate an average per each heuristic in order to be able to analyze them separately. As an example, to calculate heuristic 1 (Visibility of system status), the scores from the questions 27 (score of 3), 32 (score of 1) and 34 (score of 1) were summed up and divided by 3, resulting in an average of 1.67. The same method was applied to all heuristics, and the results are shown below.

ID	**Jakob Nielsen, 1995**	**Score Checklist**
1	Visibility of system status	1.67

2	Match between system and the real world	2.14
3	User control and freedom	2.08
4	Consistency and standards	2.17
5	Error prevention	2.00
6	Recognition rather than recall	2.00
7	Flexibility and efficiency of use	1.94
8	Aesthetic and minimalist design	2.16
9	Help users recognize, diagnose, and recover from errors	2.25
10	Help and documentation	1.67
	Total Average	2.01

Table 3 - Scores for the heuristic analysis per heuristic

Given all the calculations divided by heuristic, it was calculated a total average which can rate the website as a whole from 1 to 3, and the final result was a score of 2.01. This shows that the website partially meets the criterias that were set for this study, and still has more to improve. These numbers will be compared, later on, to the results of the questionnaire that was acquired by interviewing Leiden University students.

4.2.2. With questionnaire

The method chosen was the development of a questionnaire, which can be found in the appendix, so that each user responds individually according to their difficulties. The questions were created based on the heuristics by Nielsen and Schneiderman as well as the checklist by Christian - mentioned earlier on.

The choice of comparing the three researchers into one questionnaire was not only possible, but a more concrete method, due to the similarities in their researches: Nielsen and Schneiderman have similar heuristics, and Christian based his checklist on Nielsen's work. Instead of asking direct questions to the users in regarding the heuristics, the questions developed all have a heuristic that relates to it in the

background, so that the user indirectly evaluates the website accordingly to the heuristics and the checklist.

It is also important to point out that the questionnaire is not biased in any way. There are different type of users (age, nationality, degree…) which can be seen in the chapter showing the results, and also the questionnaire is not affected by the Hawthorne effect (which is when the user acts differently when he knows he is being observed) due to the fact that the questionnaire is online, and there is a less pressure on the user when he has to answer to it.

The questionnaire contains:

- 5 questions in regarding the user's profile, asking about age, nationality, last degree and current situation at Leiden.
- 2 questions in regarding the user's expertise with the website throughout his studies
- 16 questions in regarding the user's experience with the website, containing tasks for him to perform and evaluate the level of difficulty of completing, and also general questions of what he found of the website - which were all based on the heuristics previously chosen

Questionnaires were sent to around 100 (one hundred) students through social media and also around the main library of the university. It is also believed that these students, had the opportunity to get to know the website throughout their studies and that they had a good interaction with it. The final number of usable questionnaires that were used in this study is 57 (fifty seven). Some of the questionnaires that were answered had to be taken out of the study because:

- They were incomplete (the person didn't finish answering the questions)
- They were answered too quickly (Less than 5 minutes to answer the whole questionnaire)

All the questions are presented in the appendix and shown exactly as the users saw it, but for the purposes of analyzing the results, all questions were converted into a way

that they can be measured on the same scale as the Heuristics evaluations (Likert Scale from 1 to 3).

Each answer had a weight to it, and they were summed up, then averaged out to result in a total score per question (as seen on the table below). Like the Heuristic evaluation, the questions also shows the heuristic(s) in which the specific topic can be related to.

Some of the questions were broken up into different topics due to the answers being specific to different heuristics. Also, the questions are shown in the appendix with the results in form of percentage as an addition to the Likert scale.

ID	Topic	Total Score	Heuristic
1	Saved Bookmarks	2.38	6,7,4
2	Correct Website	1.54	2,8
3	Course Search	1.81	1,2,4,6,7,8
4	Schedule Search	1.04	2,4,6,7,8
5	Student Tab	1.62	2,4,6,8
6	Schedule Search after information about Menus	1.58	1,2,4,6,7,8,9,10
7	Teachers Search	1.87	2,4,6,7,8
8	Contact Search	2.06	2,3,6,7,8
9	Left Menu Useful	2.00	4,6,7,8
10	Search bar	2.12	2,3,4,6,7,8
11	Shortcuts	1.50	3,7
12	Maps / FAQ	1.77	2,3,5,6,7,10
13	Clean and simple	2.00	2,8
14	Intuitive	1.77	2,4,6,7,8
15	Too much information	1.54	1,4,6,8,10
16	Menus are helpful	1.54	1,3,4,6,8
17	Well structured and consistent	1.54	1,3,4,6,8

18	Easily get back to the previous page	1.62	5,9,10
19	Clickable link	1.92	4,8
20	Friendly language	2.38	2,5,9,10
21	Locate yourself because of menus	1.54	1,3,4,6,8
22	Locate yourself because of logic	1.54	1,3,4,6,8
23	No extra help	2.23	7,10
24	Took too long to find information	1.92	2,4,6,7,8
25	Felt lost at some points	2.58	2,4,6,7,8
26	Felt lost for most of the time	2.54	2,4,6,7,8

Table 4 - Scores for the questionnaire analysis

Again, after scoring all questions one by one, they were separated into the heuristics that they refer to. This way, it was possible to calculate an average per each heuristic in order to be able to analyze them separately. As an example, to calculate heuristic 10 (Help and Documentation), the scores from the topics 6 (score of 1.58), 12 (score of 1.77), 15 (score of 1.54), 18 (score of 1.62), 20 (score of 2.32) and 23 (score of 2.23) were summed up and divided by 6, resulting in an average of 1.85. The same method was applied to all heuristics, and the results are shown below.

ID	**Jakob Nielsen, 1995**	**Score Questionnaire**
1	Visibility of system status	1.58
2	Match between system and the real world	1.91
3	User control and freedom	1.70
4	Consistency and standards	1.82
5	Error prevention	1.92
6	Recognition rather than recall	1.83
7	Flexibility and efficiency of use	1.94
8	Aesthetic and minimalist design	1.80

9	Help users recognize, diagnose, and recover from errors	1.85
10	Help and documentation	1.85
	Total Average	1.82

Table 5 - Scores for the questionnaire analysis per heuristic

5. Results

After the 2 different evaluations, it was possible to observe the proximity of the results of the tests performed with the users and with the heuristics method, which can be found in the table below. This way, it is possible to make a comparison in between both methodologies chosen to get results that are as clear as it can be.

Looking at the difference in between the scores from the 2 evaluations, there is a small variation, which is an average of 10% of difference. This proves that both of the evaluations came close to the same result, scoring Leiden University's website a total of 1.91 points out of 3; meaning that it partially meets the usability requirements stated by Nielsen and Schneiderman.

ID	Jakob Nielsen, 1995	Questionnaire	Checklist	%
1	Visibility of system status	1.58	1.67	5%
2	Match between system and the real world	1.91	2.14	12%
3	User control and freedom	1.70	2.08	23%
4	Consistency and standards	1.82	2.17	19%
5	Error prevention	1.92	2.00	4%
6	Recognition rather than recall	1.83	2.00	9%
7	Flexibility and efficiency of use	1.94	1.94	0%
8	Aesthetic and minimalist design	1.80	2.16	20%
9	Help users recognize, diagnose, and recover from errors	1.85	2.25	21%
10	Help and documentation	1.85	1.67	-10%
	Total Average	1.82	2.01	10%

Table 6 - Comparison of the scores for both analysis

An important aspect observed in the answers is the difficulty of location within the system, as well as, the excess of information that in the view of the respondents is

unnecessary. The interviewees had small difficulties of interaction with the system in specific types of lack of quality in the interfaces such as: learning difficulties, difficulties of memorization and unpleasant feeling about the visual aspect of the system. The usability difficulties establish serious restrictions on the development of user interaction activities with the system considering that the users felt lost while trying to find the information they were searching for.

The results of the questionnaire were divided into 3 categories: User's profile, User's access and User's experience. This way, it is possible to analyse it in 3 different dimensions.

User's Profile

In this first part of the questionnaire, it is presented the profile of the users, in order to delineate the characteristics of the students of Leiden University that participated in the research. It was analyzed the subjects investigated according to the categories: age range, faculty, last degree, situation and nationality.

In terms of the age group of students, it is concluded that the majority of the students interviewed are mostly young, however, with significant presence of adult students and who may be attending at least the second semester of whatever course they are taking, meaning they should be familiar with the website.

With respect to faculties, the majority of the students participating in the test were enrolled in a program of the Science Faculty. This is, maybe, a consequence of the fact that the author of the experiment/thesis herself came from the Science Faculty, therefore has more contact with those students. This is not a problem due to the fact that all students have access to the same website and have to use it on a weekly basis, so it won't affect the final results.

As next point of analysis being the type of degree, the majority of the students have their Masters as the last degree. This also can't be considered as a problem because it doesn't mean that they have also studied their bachelors in Leiden University and

therefore they shouldn't have more experience with the website than the rest of the students.

In terms of the current situation of the student in regarding Leiden University, the results vary a lot, showing that the questionnaire reached all different types of students, from coursing year 1, to already graduated.

And the last point in regarding the user's profile is in regarding the nationality. Since the website only offers 2 different languages to access it (Dutch and English), it only mattered if the student was Dutch or not. The results shows that the students who answered to the questionnaire were both internationals and Dutch, with not much variation.

Below are the graphs showing the percentage of the results in regarding the user's profile acquired from the questionnaires that were answered.

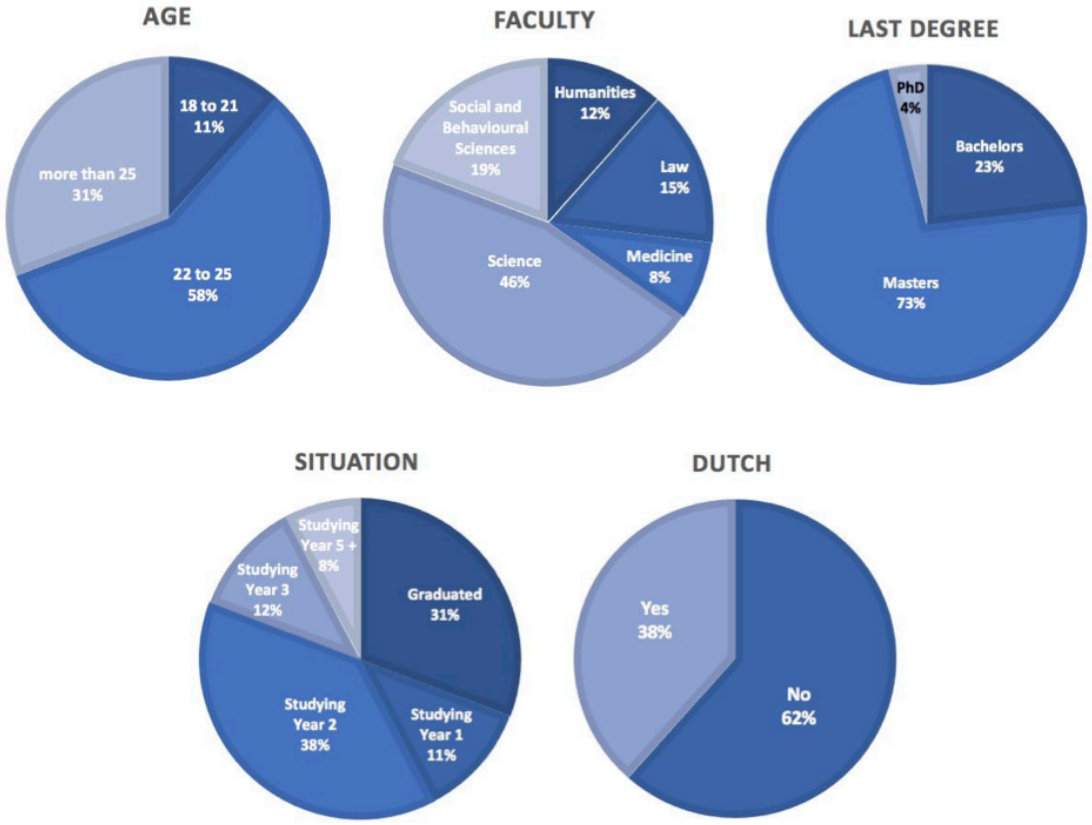

Figure 10 - Results of the questionnaire analysis by profiles

User's Access

In the second part of the questionnaire, it is presented the way the users access the website and frequency of use.

Below, it is possible to notice that most of the users access the website via Computer and that might be because since working on a computer is more practical than in a phone, they are used to reaching out to the computer whenever they have to do something related to the university. The results also shows that the users frequently access the website (1 to 2 times a week), and that might be due to the fact that they are still taking classes and need to keep up with the classes and schedule. It is also possible to see that there is a considerate number of users that access the website once or less than once a month, and that might be due to the fact that they either graduated already, or that they are on the final semesters of their course, and therefore don't have the need to access it frequently anymore.

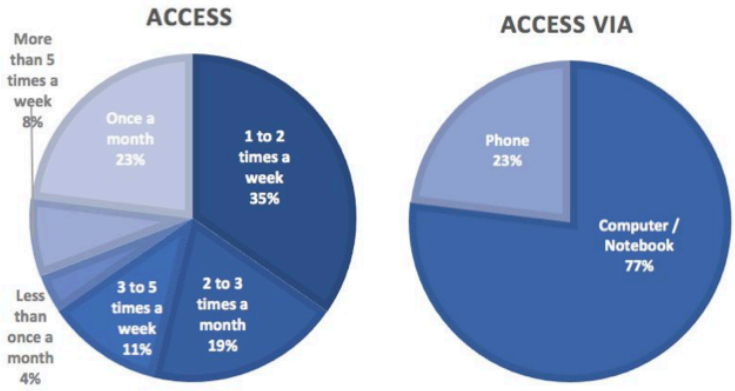

Figure 11 - Results of the questionnaire analysis by access type

User's Experience

To measure the user experience, a series of 16 questions and corresponding tasks were developed. The students were asked to perform the tasks and answer the questions and in this manner they would evaluate how hard it was performing what was asked.

6. Conclusion and Recommendation

6.1. Conclusion and Discussion

After understanding the results comparing the two different methodologies, it becomes easier to get back to the research questions, which are the main reason on why this paper was written, and answer those based on concrete information.
Below are the research questions that are on the beginning of the paper, together with a comment / answer on those in order to understand if this paper achieved the main topics it was intending to.

- Is the interaction with the user effective, allowing it to achieve its goals on finding information fast and complete?

With respect to the interaction of the user with the website, which should allow the user to find concrete information while not taking too much time, it was possible to see that the students (users) are usually able to find the information they are looking for, but that does not mean that they find the complete information and that they find it fast. On the questionnaire, it was possible to see that they take a lot more time than necessary to find what they need, and that sometimes they need more help such as using the search bar or the need to have a website map in order to find everything as fast as they can, while having the complete information.

- What about the efficiency of the system, can the user accomplish the proposed tasks?

With respect to the usability efficiency, which should allow the user to interact with the system while reaching high levels of productivity when carrying out the proposed task, it is verified that the students are able to, in general, carry out their activities (finding their course, access to their schedule, among others), however, there is still more than a third of the students who answered the questionnaire that felt lost at some points.

- How satisfied are these users with the system they use?

With respect to the design of the website, in which the system must be pleasant to use so that the user is satisfied when interacting with it, it is verified that most of the students consider the Leiden University website interface to be pleasant, which refers to the satisfaction with the site regarding the fulfillment of its informational needs as a whole, presented relatively low percentages, which may allow the illusion that the site still needs to find ways to successfully heal the informational needs of users.

- How can Leiden University improve their websites?

With respect of what Leiden University can improve in regarding their website, there is a whole subsection on this regarding recommendations (chapter 6.2). Although, it is important to state that recognition is always better than recall, meaning that a user should not have to memorize a website but to be able to remember the patterns and recognize where the information he is looking for should be. When a website has a lot of information, such as a university one, it should be very clear on where it all is located. The menus shouldn't be too long or complex, there should be a site map in order to show all the information the website has available, and also a good search bar when the user still can't use recognition to find the information he is looking for.

6.2. Recommendation

From the beginning, the motivation on the research on Leiden University's website was due to the fact that throughout my studies at the university, me and my colleagues always found the website to be confusing, and hard to find information. When compared to our previous university's websites, we would always say how those websites were easier to navigate and wouldn't take us too much time searching for what we needed.

Based on the heuristic and questionnaire analysis, below are the recommendations that is believed to help to improve Leiden University's website focusing on the heuristics with the lowest scores: Visibility of the system status, User control and freedom, Recognition rather than recall, Help and documentation. Those recommendations were also based on a quick research made with other universities websites in comparison on what they

have, that Leiden University's website doesn't, and other ways that was found that Leiden University's website would benefit from. They also contain a screenshot of the page of Harvard University's website (which was considered to be very complete in regarding usability) where the recommendation in question is shown, as well as a suggestion on how Leiden University can implement the change.

- Site Map: Sites of universities tend to be large, so the site should present a Site Map in the form of a hierarchical list content all or the main pages of the site so that the users don't get lost. This could help the users with finding whatever information they are looking for, if they aim for the site map, they should be able to find the path to the page they want to reach. Leiden University currently has no site map, and its believed that to improve productivity, it would be very helpful to add a map to the website, this way, users can go directly there and search for what they need, as well as use shortcuts (such as Ctrl + F) in order to find the information faster.

Figure 12 - Harvard University Sitemap

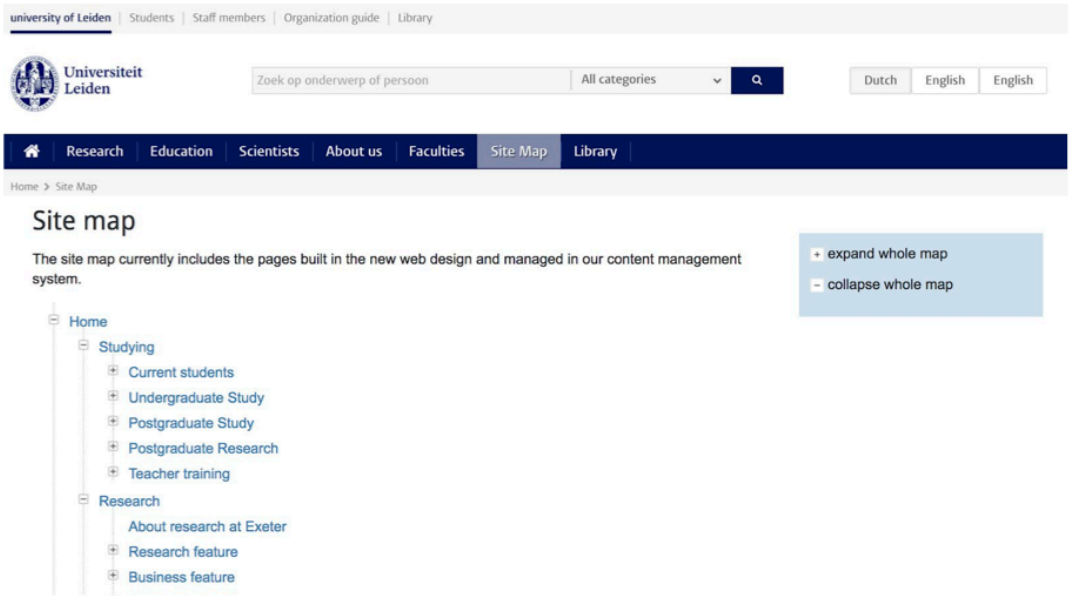

Figure 13 - Suggestion of Leiden University's Site Map

- Search: The site should have a smart search field. In Leiden University's website there is a search bar, but it doesn't search on the entire website, unless you change the preferences. As a default, it is only possible to search a subject or a person, even when the dropdown box says "All Categories". When the search does not find results to be displayed, links to the most accessed and / or most important pages should be provided. In addition, the search box should be present on all pages and be available for all different types of searches without having to choose a category which you are searching for something.

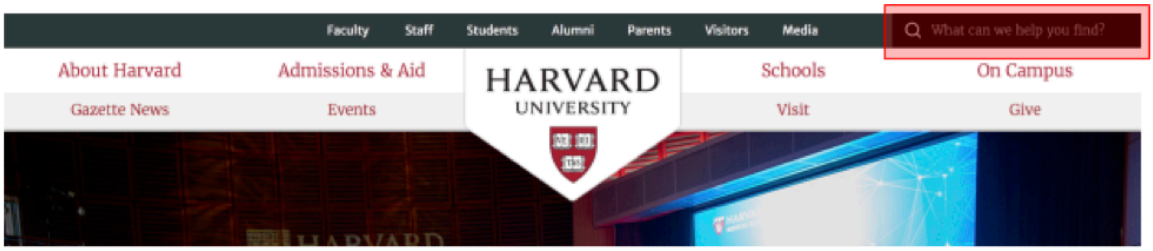

Figure 14 - Harvard University Search

Figure 15 - Suggestion of Leiden University's Search

- Use simple, clear terms such as menu labels: Menu labels should be easy to understand, so the use of acronyms, abbreviations or technical terms should be avoided and should maintain textual consistency with the titles of the pages they refer to. In Leiden University's website, it is navigate due to plenty of sub-menus around the website, making the user search in many different menus to try to find the information he is looking for.

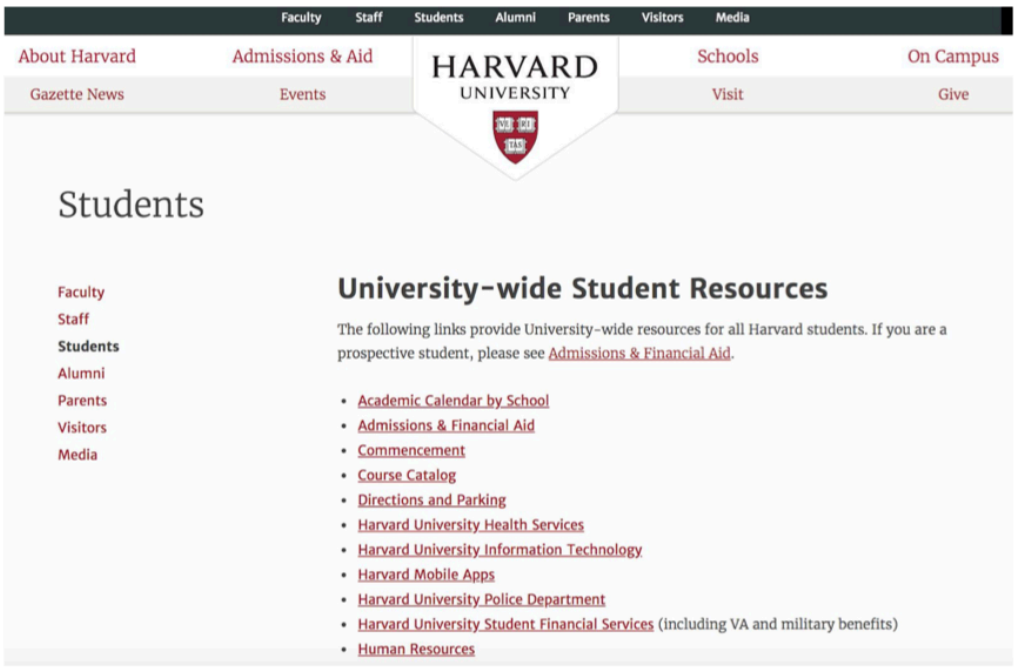

Figure 16 - Harvard University Menus and Labels

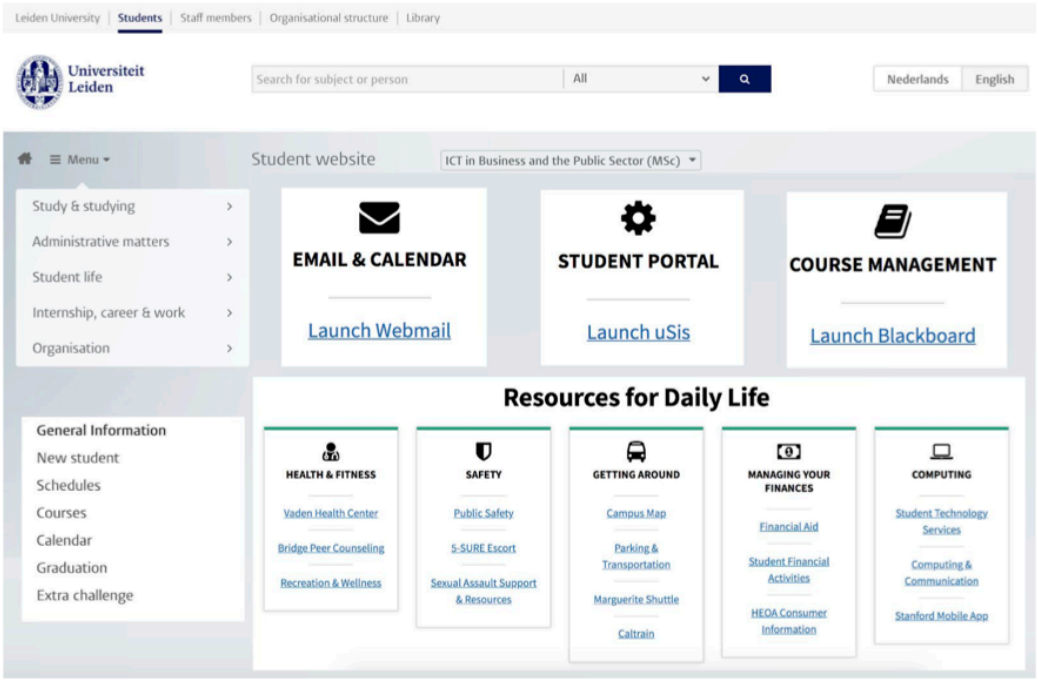

Figure 17 - Suggestion for Leiden University Menus and Labels

- Error messages should be succinct and explanatory: Error messages should be clearly displayed. Avoid using technical vocabulary. When error occurs in forms, position the cursor at the location of the error to make it easier to fix and not to clean the contents of the entire form because of an error. Currently, Leiden University website allows the user to input whatever information he wants under the fields in the forms, as an example. The suggestion would be to check for special characters, number and formats and return a useful message to the user in order to get the right details into the boxes of the forms.

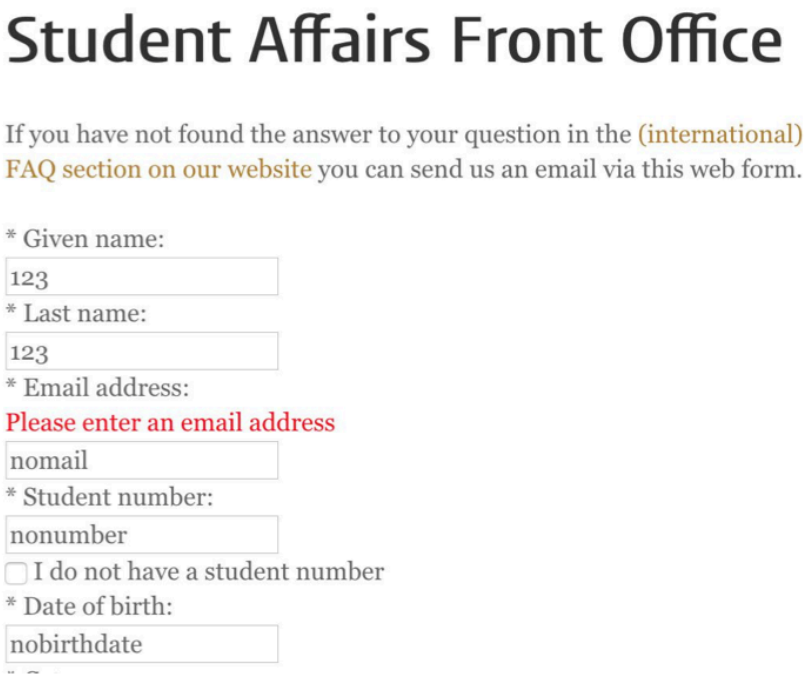

Figure 18 - Leiden University's current error handling

Figure 19 - Suggestion for Leiden University's error handling

- Accessibility with keyboard shortcuts: The site should have shortcuts (for menu, content and search) in order to provide faster and easier searches. If the site is responsive and / or has a mobile version, keyboard shortcuts may be hidden on the smaller screen devices, but the functions should remain. Considering Leiden University contain multiple menus, it is hard for the user to use shortcuts such as Ctrl + F in order to find keywords to what he is looking for, hence the need for a site map which should provide all information in one page, helping the user do his search.

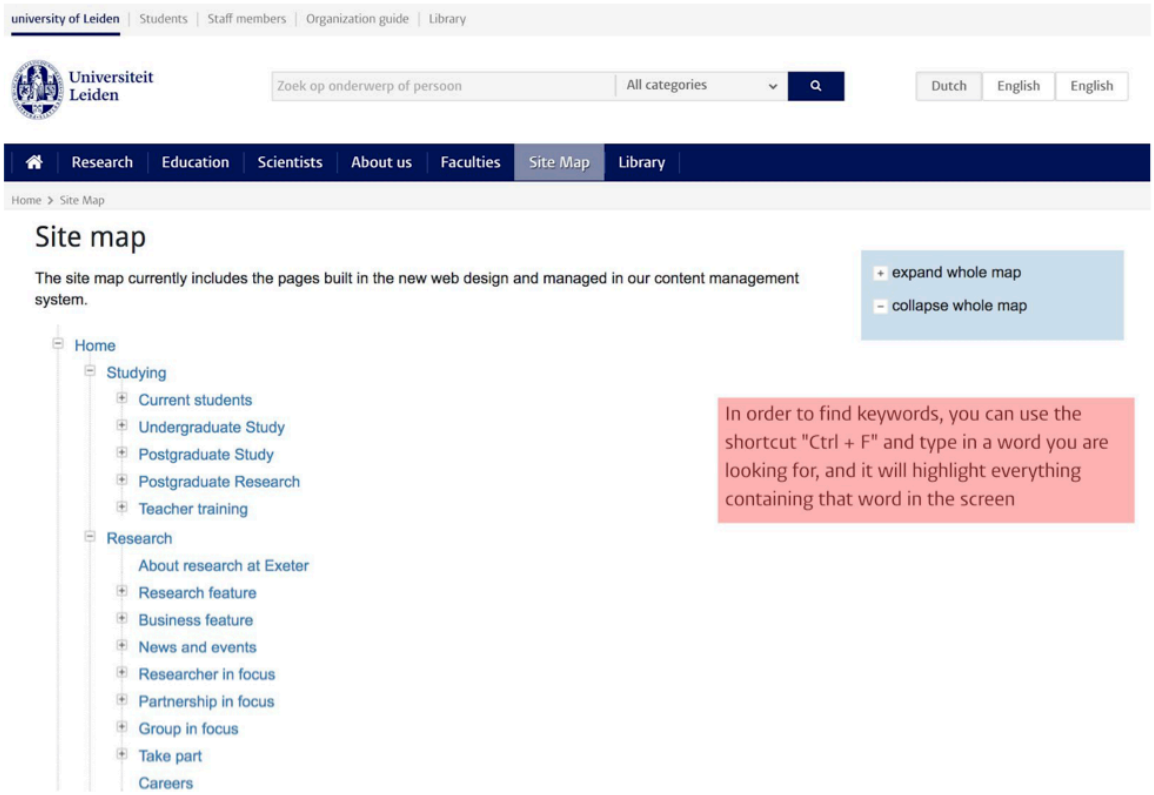

Figure 20 - Suggestion of Leiden University site map with shortcuts

According to the students' questionnaires, it is recommended that such notes be taken into account, since the system must meet the needs of its users, and the best way to do this, according to Nielsen (2007) is to listen to them.

It is understood, therefore, that a good interface should promote the fulfillment of the information needs of the users, thus, it is emphasized the importance of that the whole process of development of interface is in fact centered in the user. In this context, it is important to study the needs of the user and the way it interacts with the system, this, therefore, subsidizing the decision making and the realization of any changes in interfaces, that will interfere in the success of interaction, since the user is the most benefited or directly harmed in the interaction with the system.

The problems encountered throughout the usability tests emphasize the need for this theme to be a concern followed from the very beginning of the development of the product to the Web, while it is advantageous to carry out tests from the beginning of the project, since we can perceive certain functionalities useful to perform the tasks requested, and thus lose less time in the completion phase.

6.3. Final Considerations

Based on the idea that our perceptions of the Web are currently being designed through all the information that is provided to us and the way it is provided, it is not always easy to understand how this is understood by all users. In today's information society, communication becomes increasingly important among people and the way man-machine communication is made, influences their behavior.

There is no doubt that the usability studies have gained a new importance when applied to Web contexts. The studies made it clear that the content began to be seen in a new way and began to give a new meaning to the interfaces. Technological advances and, consequently, the emergence of new devices and the changes in the way of interacting and behavior with the system led to adaptations in the Web.

This work aimed to evaluate the main usability assessment methodologies of the Leiden University's website, in order to understand the benefits and possible problems encountered in the study case, which as well as its benefits and implications, are the basis of all study and analysis.

It is verified, in this research, the importance in obtaining the opinion of the users, their view on the use of Leiden University's website, considering them as a fundamental part in the development process of this information channel. This research allows other studies to enrich this research or to involve the reflections about the usability theme, which were not contemplated in this research, since it was not defined as an objective of the research, namely: research involving other groups of the academic community of

Leiden University: teachers, staff and administrative technicians, as well as research on other attributes of usability and information architecture as well as usability issues related to other external websites related to Leiden University. Finally, it's concluded that it is essential in any study of an interactive information system, to establish the relationship between user studies and usability studies, since both crave the success of the user, the central element of every system.

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8. Appendix

Link to access the questionnaire:

https://leidenuniv.eu.qualtrics.com/jfe/form/SV_3CSzFzU5Bn24qLb

8.1 Questionnaire Screenshots

Thank you for taking time answering this questionnaire. It will take about 10-15 minutes to answer all questions!

This questionnaire is regarding the Usability of Leiden University's website, and the answers will be used in the thesis of the student Daniella Bachour Nicolellis, coursing ICT in Business. The main reason for this questionnaire is to understand how you access the website, how you find all the information you need and if you are satisfied with it.

The **only requirements** for you to answer this questionnaire are:

- **You have studied / are still studying at Leiden University**, and therefore used / uses the website.
- You answer to this questionnaire via a **Desktop (computer, notebook)**

If, at any time, you are taking too long to find the information that was asked, you can come back to the question and answer "I couldn't find it". It is advised to not spend more than 1 minute per question.

What is your age?

- Less than 18
- 18 to 21
- 22 to 25
- more than 25

What is/was your faculty for your degree in Leiden University?

- Archaeology
- Governance and Global Affairs
- Humanities
- Law
- Medicine/Leiden University Medical Center
- Science
- Social and Behavioural Sciences

What is/was your last degree at Leiden University?

- Bachelors
- Masters
- PhD

What is your current situation at Leiden University?

- Still studying - Year 1
- Still studying - Year 2
- Still studying - Year 3
- Still studying - Year 4
- Still studying - Year 5 or higher
- Graduated

Are you Dutch?

- Yes
- No

How often do you access Leiden University's website?

- More than 5 times a week
- 3 to 5 times a week
- 1 to 2 times a week
- 2 to 3 times a month
- Once a month
- Less than once a month

How do you normally access the website?

- Via Computer / Notebook
- Via Tablet
- Via Phone

Do you have the website saved in your bookmarks/favorites?

- Yes, I have one page inside Leiden University's website saved
- Yes, I have multiple pages inside Leiden University's website saved
- No

- Without using Google or your web history, can you type below the main website of Leiden University?
(There is no need to type http://www.)

Now, open a new incognito tab and go to https://www.universiteitleiden.nl/
- For mac users the shortcut for is *Command + Shift + N*
- For windows users the shortcut is *Ctrl + Shift + N*
- Or right click on the link and select Open Link in Incognito Window

Make sure you have both tabs open. Don't close either the questionnaire or the Leiden University's website.

Once you open the website, you will see that everything is in Dutch. If you don't speak Dutch, you can change the language on the top right corner to English.

- Was the website you entered previously the correct one?

Yes
No
I don't remember

- Now, try to find the page containing the information of the course you last studied / you are currently studying
How hard was it finding your course?

Very easy

Easy

Normal

Hard

Very hard

I couldn't find it

- Now, try to find the schedule of your course on the website.
How hard was it finding your schedule?

Very easy

Easy

Normal

Hard

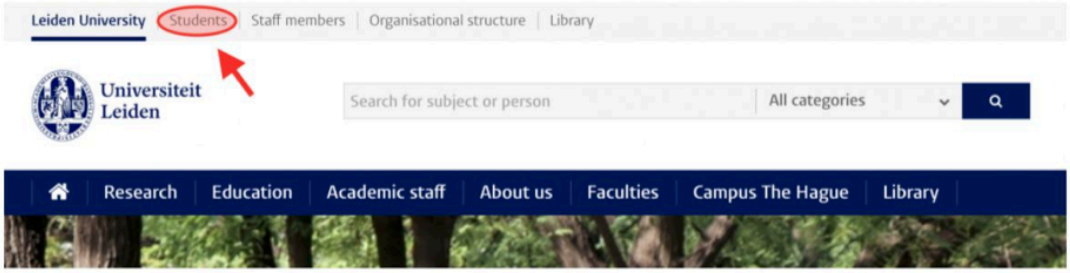
Very hard

I couldn't find it

- Did you know that to get information from your course, (such as schedules, announcements, academic calendar, courses, exams ...) you have to enter the "Students" area before you select your course? (see picture below)

Yes

No



If you don't click on "Students", you will only get the general information of the course for the ones that are not enrolled as students yet.

- Now that you know this information, try to find your schedule one more time.
How hard was it finding it?

- Very easy
- Easy
- Normal
- Hard
- Very Hard
- I couldn't find it

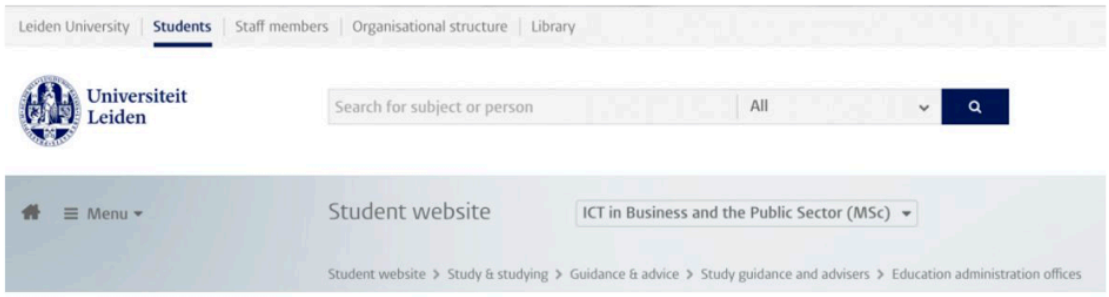
- Let’s pretend that there is a situation where you need to e-mail one of your professors. Can you try to find your teachers information / e-mail on the website?
How hard was it finding it?

- Very Easy
- Easy
- Normal
- Hard
- Very Hard
- I couldn't find it

- Assuming you still couldn't find all the information you were looking for, can you try to contact your Study Programme / the Education Administration Offices?
How hard was it finding it?

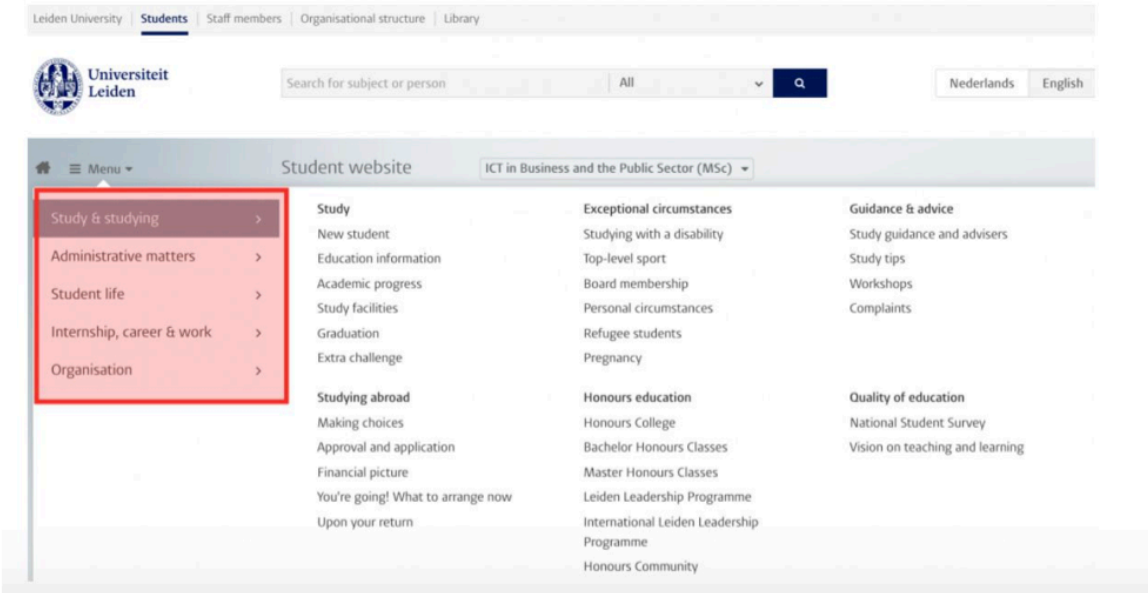
- Very Easy
- Easy
- Normal
- Hard
- Very Hard
- I couldn't find it

- If you, at any point, need to go back to the home page, how would you get there? (Just use the image below to choose where you would click. Once you click on it, a green selection will appear)



- Did you find the menu on the left (see image below) useful?

Yes, I was able to find all the information I was looking for
Yes, but I still couldn't find all the information I was looking for
No



- Did you, at any point, tried to use the Search bar?

Yes, and it helped me finding the information

Yes, but I still couldn't find the information

No

- Did you, at any point, tried to use shortcuts to find the information faster?
example: *Ctrl + F* to search for a keyword

Yes, and it helped me

Yes, but it didn't help me

No

Assuming you need extra help navigating through the website, are you able to find a map of the website or any sort of FAQ pages to help you find what you're looking for?
(You can select multiple answers)

- Yes, I found a map
- Yes, I found a FAQ page and it was helpful
- Yes, I found a FAQ page but it was not helpful
- Yes, I was able to get help in a different source
- No, I couldn't find any extra help

- In regarding the design of the page, please select what you think it applies to the website:
(You can select multiple answers)

- It looks clean and simple
- It is very intuitive
- Theres too much information going on at the same time
- The menu's helped me navigate through the website
- The website is well structured and consistent - there is a logic when navigating
- I could easily get back to the page I was before if I clicked on the wrong link
- I could identify when there was a clickable link (underlined or different colour)
- The language on the website was friendly

- In regarding the website as a whole, please mark that applies to your experience:
(You can select multiple answers)

- I was able to locate myself and know where I was because of the menus
- I was able to locate myself because I used logic to get where I needed to be
- I felt like I wasn't able to get extra help if/when needed
- I had to think and search too much to find the information I was looking for
- I felt lost at some points, but was able to get to most of the information
- I felt lost for most of the time

Thank you so much for you time answering to this questionnaire!
This will really help me with getting data for my thesis.

Have a great day!

8.2 Questionnaire answers in a percentage form

Age	Percentage
18 to 21	12%
22 to 25	58%
more than 25	31%

Faculty	Percentage
Humanities	12%
Law	15%
Medicine	8%
Science	46%
Social and Behavioural Sciences	19%

Last Degree	Percentage
Bachelors	23%
Masters	73%
PhD	4%

Degree Situation	Percentage
Graduated	31%
Still studying - Year 1	12%
Still studying - Year 2	38%
Still studying - Year 3	12%
Still studying - Year 5 or higher	8%

Dutch?	Percentage
No	62%
Yes	38%

How often	Percentage
1 to 2 times a week	35%
2 to 3 times a month	19%
3 to 5 times a week	12%
Less than once a month	4%
More than 5 times a week	8%
Once a month	23%

Access via	Percentage
Via Computer / Notebook	77%
Via Phone	23%

Saved bookmarks?	Percentage
No	62%
Yes, I have multiple pages inside Leiden University's website saved	23%
Yes, I have one page inside Leiden University's website saved	15%

Correct website?	Percentage
Yes	73%
No	27%

Find course	Percentage
Easy	15%
Hard	35%
I couldn't find it	4%
Normal	27%
Very easy	8%
Very Hard	12%

Find Schedule	Percentage
Easy	4%
Hard	23%
I couldn't find it	42%
Normal	8%
Very hard	23%

Students tab	Percentage
No	69%
Yes	31%

Find Schedule 2	Percentage
Easy	27%
Hard	23%
I couldn't find it	27%
Normal	19%
Very Hard	4%

Find Teachers	Percentage
Easy	23%
Hard	23%
I couldn't find it	12%
Normal	15%
Very Easy	15%
Very Hard	12%

Find Contact	Percentage
Easy	23%
Hard	27%
I couldn't find it	12%

Normal	35%
Very Easy	4%

Home Page	Percentage
Home Icon	4%
Leiden University Logo	77%
Leiden University Text	19%

Menu Left useful?	Percentage
No	27%
Yes, but I still couldn't find all the information I was looking for	46%
Yes, I was able to find all the information I was looking for	27%

Search bar useful?	Percentage
No	27%
Yes, and it helped me finding the information	38%
Yes, but I still couldn't find the information	35%

Shortcuts used?	Percentage
No	65%
Yes, and it helped me	15%
Yes, but it didn't help me	19%

Map / FAQ	Percentage
No, I couldn't find any extra help	42%
Yes, I found a FAQ page and it was helpful	15%
Yes, I found a FAQ page but it was not helpful	19%
Yes, I found a map	8%
Yes, I was able to get help in a different source	15%

Question	Yes	No
It looks clean and simple	50%	50%
It is very intuitive	38%	62%
There’s too much information going on at the same time	73%	27%
The menu,Äôs helped me navigate through the website	27%	73%
The website is well structured and consistent - there is a logic when navigating	27%	73%
I could easily get back to the page I was before if I clicked on the wrong link	31%	69%
I could identify when there was a clickable link (underlined or different colour)	46%	54%
The language on the website was friendly	69%	31%
I was able to locate myself and know where I was because of the menus	27%	73%
I was able to locate myself because I used logic to get where I needed to be	27%	73%
I felt like I wasn’t able to get extra help if/when needed	38%	62%
I had to think and search too much to find the information I was looking for	54%	46%
I felt lost at some points, but was able to get to most of the information	42%	58%
I felt lost for most of the time	23%	77%