Is usability in user experience design all about minimalism?

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To all my friends from class: Yes, it's finally finished!

Abstract

The importance of usability has increased throughout the last decades. Research has shown that usability is a key factor in how users perceive interactive systems. This perception has an impact on the user experience, whose design aspects try to serve usability. On the other hand, the visual design depends on the aspects of minimalism and therefore correlate with user experience design [Unger and Chandler, 2012]. The aim of the dissertation is to understand the further relation between usability and the principles of minimalism. It will be clarified to what extent good usability is conditioned by minimalism. The following question arises in this work: Is usability in user experience design all about minimalism? In this context, the term usability means "the effectiveness, efficiency and satisfaction with which specified users achieve specified goals" [ISO, 2018]. User experience means "user's perception and responses that result from the use and/or anticipated use of a system, product or service [ISO, 2018]", which leads to the fact that user experience design describes the perception of the user of the visual representation of interactive products. Minimalism in this context, is the simplification of visual elements [Obendorf, 2009]. Based on the principles outlined in the chapter "Usability, User Experience Design and Minimalism", a case study was designed to compare the correlation of usability and minimalism between two interactive systems. In both prototypes, minimalistic aspects were used to create the interface for the user. In one prototype, there was more minimalism applied and in the other one less. A usability test was condoned in the form of a questionnaire and an interview. Such a test was implemented to assess the perception of the user towards the prototype. The results showed better usability efficiency in favor of the prototype with more minimization. This output implies the importance of minimalism in terms of successful usability. However, the case study also reveals exceptions of minimalism, when the over-use of it lead to the removal of necessary information. Apart from this aspect, it is concluded that it is advisable for creators of interactive systems to always include minimalism when planning usability but ensure a right balance between necessary details in context of the product.

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1 Introduction

The increasing digitalisation of everyday life and constant digital progression has changed the attitude of people towards technology. Since the emergence of new technologies, such as the computer and the smartphone, a different behavior with such applications has consequently evolved [Nielsen, 1994]. Logically, adjustments must be made to those changes in order to meet the demands and needs of consumers. A significant change can be noticed on the World Wide Web. What was published back in the past is hardly found in the same way nowadays. As companies try to gain more consumers through web appearance, the importance and demand for good Web products (e.g. Web sites and apps) have increased [Nielsen, 1999]. But an appealing Web presence is not only important for companies, Web sites like blogs also strive to appeal to a specific target group. Good Web presence is particularly conditioned by "good" design. Good design causes a good user experience because the interaction with the Web site or application is perceived as pleasant. However, the term "good" is subjective and perceived differently by each person. Nonetheless, there are basic approaches that help maximize the success of Web products with matching designs and ensure that the user experience is good [Unger and Chandler, 2012]. On the other hand, there is also the user interaction with the Web product, which should be optimally compensated by usability aspects. Usability describes how the user interacts with the product in order to achieve a specific goal [Nielsen, 1994]. Above all, it is important not to frighten the user with an overload of information and to limit the content and interactions to the essential aspects. This kind of minimization is supposed to simplify the behavior with the page or application. The resulting minimalism is chosen primarily in design as an approach to represent content. This is comprehensible because minimalist design has its origin in art [Obendorf, 2009]. However, the question arises as to whether usability chooses minimalism as an approach of achieving its goals in the same way. Since usability is used as a tool for user experience, the importance of minimalism in usability is an essential question to be taken under consideration as it offers a potentially interesting insight.

1.1 State of art

The World Wide Web offers so many different approaches on how to create Web products. However, designers as well as developers have to pay attention to certain aspects in order to maximize the success of the visual appearance and consequently the success of the business. Currently, terms like usability and user experience are ubiquitous in the World Wide Web and their importance is strengthened by this presence. In fact, their importance has increased significantly over time as these two aspects help to provide consumers with a better experience with Web products [Nielsen, 1999]. Mads Soegaard describes a direct correlation between user experience and usability. He explains that usability is part of the user experience, as the way the user optimally uses the application is due to the implemented user experience design [Soegaard, 2019]. Minimalism as one principle for the creation of user experience designs is often chosen as an approach [Obendorf, 2009]. Kate Moran explains that minimalism influences user experience designs by simplifying the presentation of content to facilitate interactions [Moran, 2015]. The benefits to this approach are obvious, as the user can focus on the most important content and functionalities of the Web product. It is obvious that there is a correlation between minimalism and user experience designs. As usability also correlates with user experience, it is interseting to ask whether usability also correlates with minimalism. Though, user experience design is based on aesthetic representations of elements and usability is the successful use of these functionalities, the application of the term minimalism in two different fields reveals an interesting section to this investigation. Does usability use minimalism in a way that user experience design does and is minimalism the key to optimal usability?

1.2 Purpose and structure

The aim of this research paper is to determine how and whether usability in user experience design is affected by minimalism and how the principles of minimalism is used to create a more user-centered Web solution. For this reason, it is necessary to gain a basic understanding of all the different terms to ensure an understanding of the topic.

This will be followed by an analysis of the correlation between the different notions. The correlation will be quantified with the help of a case study which should support the outcome of the analysis. The case study should work in correlation with the argument of my thesis. For this reason, the further argumentation will take the created case study into consideration when explaining the impact of minimalism in all the different notions. Lastly, the question concerning whether minimalism is the key to optimal usability in user experience design, shall be answered.

2 Usability, User Experience and Minimalism

As stated in the introduction, the following thesis shall discuss the correlation and interdependence of the above mentioned terms. However, before analysing whether minimalism is the key to usability, it is necessary to explain what those terms exactly mean. This knowledge will help gain a better understanding for these terms and will be of advantage throughout the discussion and conclusion. Therefore, this chapter will serve as an overview of the notions: usability, user experience design and minimalism. Nevertheless, this background chapter is only supposed to describe essential principles of each term. The correlation and interdependence of these terms are going to be analysed in the chapter correlation.

2.1 Usability

Usability is a term that is described by the DIN EN ISO 9241-11 norm which explains usability as "the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments [ISO, 2018]." In other words, the aim of good usability is to give the customer the possibility to use products in a proper and satisfying way. With regard to a Web product, the aim of the user is to achieve the goals that are initially planned when entering the Web product. If the aim of a Web site or an application is to compare cheap flights, the usability of the product should support the user on achieving this goal. Not every Web product is automatically usable or unusable,

it depends on the context of the user and the product. There are several aspects to be kept in mind when dealing with usability of Web products. There are five usability attributes that are usually associated with usability: Learnability, Efficiency, Memorability, Errors and Satisfaction [Nielsen, 1994]. It should be easy for the user to get to know the system and learn how to use it. Once the user has learned how to use the system, it should be efficient and straightforward to use it. The Web product should support the user on remembering the product even after it has not been used in a while. Furthermore, it should not enable errors and keep the error rate low. But in case of errors, it should be easy for the user to recover from it [Nielsen, 1994]. Also, the user should be satisfied from the use of the Web product to ensure an optimal experience with the functionalities. In general, it can be said that users should easily understand Web products, easily achieve their objectives when using Web products and easily recall the functionalities in later processes [ISO, 2018]. Usability has gained a greater importance because of internet economy therefore it is no wonder that there have been several researches made on this topic. But what is the correct approach to ensure ideal usability tailored to a Web product?

2.1.1 Usability Heuristics

The presence and influence of usability on the Web has been explored by several academics. Jakob Nielsen is one of the most important characters when it comes to any topic of usability. How to work with usability aspects regarding Web design has hugely been influenced by his guidelines and are still used as an orientation for various kind of projects. He has created usability guidelines that are nowadays used as heuristics. They are broad rules and not specific usability guidelines but are still acknowledged in this field. The following paragraphs will describe his developed heuristics and will give insights in principles that not only influence the handling of usability on the Web but also the underlying design approaches.

One of Nielsen's heuristics refers to the visibility of the system status. While users interact with a Web product, it is important to give them permanent feedback within

reasonable time about what is going on [Nielsen, 2005]. It might seem redundant but by doing so, it will ensure that the users never feel lost. Another reason why this approach is applied is due to the fact that many users choose functions by mistake. Instead of clicking the intended elements for the functionality users tend to click randomly [Nielsen, 2005]. By clearly showing the user how to escape such situations and giving the possibility to redo or undo their action, will give them their freedom of choice without any bad consequences. Furthermore, what is even better than error massages of the system is error prevention. Error-prone conditions should be eliminated or checked and present users with a confirmation option before they commit to the action [Nielsen, 2005]. But if errors do appear, it should be easy for the user to recover through constructive suggests of solutions. Another aspect is how the Web product manages to address the user with language, words, phrases and concepts that are familiar to the user. It is better to follow conventions that make information appear more natural and more familiar to the user's everyday language. Those conventions are especially advantageous because users don't have to think whether different words, situations, or actions mean the same thing [Nielsen, 2005]. One more heuristic is the "recognition rather than recall" [Nielsen, 2005]. The user should not have to remember information from one part of the dialogue to another. There should be visible or easily retrievable instructions for the use of the system. Moreover, shortcuts and abbreviations can be used to speed up the interaction of the product, especially for advanced users. It's also recommended to allow users to tailor frequent actions which contributes to the flexibility and and efficiency of the Web product[Nielsen, 2005]. What also contributes to a good usability is helping the user through short documentation about the functionalities of the product. Although, it must be said that the optimal system should be usable without a documentation, it is sometimes necessary to provide such information to the user. It should be easy to find and accessible through the system. One final heuristic refers to the aesthetics and minimalist design. Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility [Nielsen, 2005].

Deriving from the explained usability heuristics, usability is presented by different aspects of Web design and interaction. Usability can't be divided into only the technical side of the Web product nor in only the user side. The different heuristics reveal that it's about the interaction of both parameters. As already described in the ISO norm, usability works in combination with the context of the user and the explored Web product. All shown heuristics always include the possible impact on the user created by the use of the system. Therefore, usability is not a static state, it is interactive and needs the input of a user. The importance of usability can only get to its extent in interactive environments otherwise usability is redundant and not applied at all.

2.1.2 Interactive systems

"Interactive system" is a term that arose in the beginning of the computing age and is mostly related to the computer science field. Hermut Obendorf describes interactive systems as the following: "Interactive systems are a class of information processing systems where control is exerted by users in an interactive manner [Obendorf, 2009]." It is highly important in interactive systems that the user is able to understand how to use it. As the cognitive scientist Donald A. Norman explains, the human's interaction with an interactive system depends on the "gulfs of execution and evaluation" [Norman and Draper, 1986]. In other words, an interactive systems is an environment where information is parsed to the user and functionalities are interactively executed by the user's choices. The user must have an initial goal in mind and must perform it to a plan that involves the execution of actions on the system. These actions will lead to changes in the state of the system and consequently must be perceived, interpreted and evaluated by the user. In this context, it can be stated that Web products are interactive system as they provide all the mentioned aspects before. Without this so called interactive system there would be no usability because of the lack of user interaction which is a precondition to examine usability. Nevertheless, interactive systems are not only Web products although this term is mainly based in the computer science department. Other interactive systems are for example cameras, smartphones or washing machines.

However, the focus of interactive systems in the scope of this thesis will lie in the interactive systems of Web products such as Web sites and Web applications.

2.2 User Experience Design

Just like the term "usability", the term "user experience" is specified in the DIN EN ISO 9241 standard: It is the "user's perception and responses that result from the use and/or anticipated use of a system, product or service" [ISO, 2018]. This definition however, is a broad view considering the actual complexity of the term used for different field of businesses. When addressing the perception and responses from the use of a system, it refers to the users' emotions, beliefs, preferences, perceptions, comfort, behaviours, and accomplishments that occur before, during and after use" [ISO, 2018]. Nonetheless, how to handle the "user's perception and responses" differ from field to field and must be approached individually. In this thesis, the focus of user experience is placed on the user experience of digital systems such as Web sites or applications which have other aspects to pay attention to compared to physical systems such as computers [Unger and Chandler, 2012]. Nevertheless, the basic aspects of user experience can be applied to any field. Aspects that should be taken into consideration are "functionality, system performance, interactive behaviour, and assistive capabilities of a system [as well as] the user's internal and physical state resulting from prior experiences, attitudes, skills, abilities and personality; and from the context of use " [ISO, 2018]. Frank Guo summarizes user experience into four basic elements [see figure 1]: Value, Usability, Adoptability and Desirability [Guo, 2012]. "Value" refers to how the user values the interactive system. If the product is designed to support the user in their desires and needs, the product is valued more. User's needs refer to explicit and implicit needs. A lot happens subconsciously and is not expressed directly by users, if a system addresses these subconscious needs it will add a significant improvement to the user experience [Guo, 2012]. Consequently, functionalities and features are the key drivers of the value aspect. "Adoptability" describes the interaction of the user with the product but not in the sense described in the usability. Adoptability is about the approach of beginning to

use the product for example downloading it, buying it or installing it. If this motivation is supported by the design, the user experience is improved. The previous components referred to cognitive and rational aspects of the user experience. "Desirability", however, refers to the emotional level of the user. A desirable product must engage users in relation to their intended use of the product. The desirability is therefore a crucial part of the user experience, too. Therefore, when creating user experience, the question of whether it is useful, easy to use, easy to start and if it is fun and engaging, should always be asked [Guo, 2012]. What can be deduced from this definition is, that user experience design can not omit any of these aspects. When designing for user experience, the focus is on the user and his perceptions in order to achieve a specific goal of the digital product. Therefore, the user experience design is intended to purposefully influence perception and behavior of the user through visual representation of elements and content [Unger and Chandler, 2012]. Also, Web products are related to companies which creates another crucial aim of good user experience design: achieving a rememberable impression of the product in order to stay in mind long-term [Garrett, 2010]. These goals are pursued in the user experience through various design principles. The basic aspects are explained in the following sections of the chapter. In addition, the usability aspect in user experience has also its own chapter because of the importance of the term in this thesis.

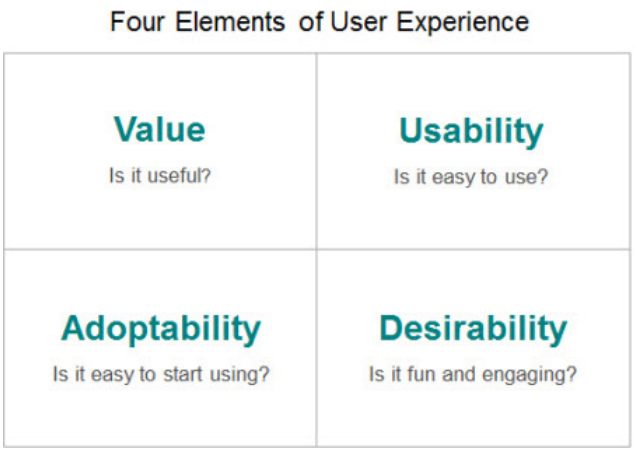


Figure 1: Elements of user experience [Guo, 2012]

2.2.1 Usability in User Experience

When taking the definition of user experience into consideration, it is is obvious that user experience goes beyond visual representation. According to McCarthy and Wright user experience focuses on the question of "how the person feels about the experience, what it means to them, [is it] important to them, and what it is, with their other values and goals" [McCarthy and Wright, 2007]. With regard to this statement, usability serves as a parameter on how a product in the user's perceptual cycle is experienced. According to Mads Soeggard, usability can be seen as part of the user experience because besides the visual aspects, usability also influences the way products are perceived based on how users interact with the functionalities of the Web site [Soegaard, 2019].
Usability is therefore essentially related to the user experience and thus to the user experience design. Poor usability will most certainly lead to a negative experience for the user, which will discourage the user from continuing to use the product. The lack of attracting the user with effective usability will have negative effects on the products' or Web sites' success which is the main goal of good user experience [Unger and Chandler, 2012]. Figure 1 illustrates that usability is a fundamental part of user experience. In general it can be said, that successful usability will have a positive psychological impact on how users perceive a Web product. Furthermore, it is crucial for user experience design to focus on usability aspects while designing the visual interfaces for user experience. The lack of attention to this aspect will have significant negative effects on the user's behaviour and perception.

2.2.2 Visual Design

It makes sense that the objectives pursued in user experience design is based on visual aspects. The visual design affects the user's understanding of the Web product and at the same time builds an emotional relation between the user and the product. Visual designs are especially effective when they address the users on a subconscious level in order to allow them to independently evaluate the viewed product [Unger and Chandler, 2012]. It must be emphasized that effectiveness does not necessarily go hand in hand

with beauty, since this aspect has a strong subjective dependency. Design has always been perceived subjectively and therefore it is difficult to measure the general effectiveness on target groups. However, this does not mean that there are no guidelines on approaching effective design. Indeed, there are fundamental aspects in visual designs that should be focused on in order to create pleasing and usable products [Unger and Chandler, 2012]. Those aspects describe how to generally deal with elements, positions, arrangement etc. of a product's design.

Unity and variety are part of the fundamental aspects. These notions describe how to deal with a huge amount of elements of a Web product. Unity's aim is to present elements that are associated with each other in an obvious manner.

This can be achieved through different visual approaches such as colour, shape, style, or positions of elements in relationship to each other [Unger and Chandler, 2012]. Kurt Koffka has investigated the topic of Gestalt principles which thematise the human perception in situations of chaotic elements' arrangements. The law of proximity explains one principle that the concept of unity seeks to achieve. It states that when an individual perceives an assortment of objects, they perceive objects that are close to each other as a forming group [Koffka, 2013]. On the other hand, variety should ensure that differences in elements are made clear and add more liveliness to the Web product. Also important in presenting a variety of elements is the weighting of the content depending on its meaning and importance. The hierarchy of elements plays a major role, too. Important elements should be highlighted in visual design. Moreover, the hierarchy helps to guide the user more effectively through the product and thus influences the potential behaviour of the user [Unger and Chandler, 2012]. Another aspect is the implementation of minimalism in the design. This approach shall simplify the content and the interaction with the application. The advantage is the uers's focus on the main products and functionalities of the application. Therefore, elements should be purposeful, relevant and information-rich. If this is ensured, it is easier for the user to perceive the product in a clearer manner, thus, leading to successful usage.

2.3 Minimalism

Our increasingly complex society forces us to keep finding solutions for complex issues that are caused by our demand for better life standards. Solutions for calculations and tools in our economy or solutions to make everyday life easier, are easily among those complex issues. Although attempts have been made to handle these complex issues, the interesting thing is that while trying to master this complexity it is often achieved by reducing the complexity and using simplicity to create a useful tool. "Simplicity" is a term that is well-known and used in everyday life. People use it for different fields of life but most often when it comes to design. Somehow, everyone has an understanding for this notion although it is likely that no one knows a specific definition for it. The understanding of the term probably changes with each point of view but despite all different perspectives, "simplicity" "refer[s] to some type of reduction" [Obendorf, 2009]. There is an overall agreement that reduction is the approach to achieve simplicity and minimalism is an approach to describe different ways of reduction. Minimalism is a notion that relates to simplicity. It is interesting that minimalism has its origin in art and music [Obendorf, 2009]. Considering these two disciplines, one might realize that they are actually quite different from each other and therefore, are two different perspectives to look at. This ambiguous use of the term from the past is possibly an explanation for why minimalism is used for so many different fields of life nowadays. With regard to Web design, minimalism in that field is very likely to be a different kind of simplicity than in music or art although it has the fundamental idea of reduction in common. In this thesis, simplicity and minimalism are applied to the design field with specific focus on the creation of Web sites and Web applications. Therefore, it is necessary to explain what principles and approaches are used to achieve minimalist Web products.

2.3.1 Notions of minimalism

As explained in the previous section, minimalism is a term that has no official definition. Depending on the field in which the term is going to be used, it will have a different

meaning according to the respective context, although they all do have the concept of simplicity and reduction in common. As this thesis focuses on Web products as an interactive system, the term minimalism can be structured into four main aspects. Harmut Obendorfer divides minimalism of an interactive system into the following four basic notions: Functional Minimalism, Structural Minimalism, Compositional Minimalism and Architectural Minimalism [Obendorf, 2009]. The figure 2 represents an overview of the four notions dividing them into different classifications of usage. Functional minimalism in interactive systems are used as a tool to help user interact more efficiently with the system whereas structural minimalism is used as a tool to ensure the user to gain access to the functionalities in appropriate situations. On the other hand, architectural minimalism is used in terms of context of the content to ensure the direct access to necessary information whereas compositional minimalism is a tool to be used for the context to be properly interpreted with the help of composition. These different notions address minimalism from different point of views but still have their interdependence. The following passages will discuss the notions in more detail.

Figure 2: Four notions of minimalism [Obendorf, 2009]

Functional Minimalism

In interactive systems the purpose is to apply functionalities to achieve a certain set of objectives. Although in art, minimalism is often used with no specific functionality at all, in interactive applications there is always an aim with applied functionalities [Obendorf, 2009]. The concept of reduction in functional minimalism is the creation of less func-

tionalities. The reason of reducing the functionalities underlies the idea that a tool can do one thing only if it does this one thing very well [Obendorf, 2009]. On the one hand, the concentration on one single purpose means the loss of flexibility of the system but in turn, the system can be implemented with more focus on the functionality. Therefore, there is more focus on the competency of the tool because the effort is put on achieving the perfection of one important functionality of the system. This does not necessarily mean that functional minimalism is about creating simple tools, what functional minimalism tries to achieve is the impression of being "functionally minimal" [Obendorf, 2009]. The basic idea is to reduce the access or visibility to complex functionalities of a system making it appear less complex. A functionally minimal tool at first sight, can seem simple (e.g. a smartphone) but can include complex functionalities (e.g. operating system) - but as long as those functions are not visible to the user - it will never reveal its complexity and therefore does not decrease its functional minimality [Obendorf, 2009]. The less functionalities that are displayed for the user the more minimal it will appear.

Structural Minimalism

Structural minimalism implies the reduction of structure in interactive systems. In this case, structure refers to the reduction in the perceived access structure which means the reduction of the accessibility of visible functionalities with focus on the more used and important parts of the system [Obendorf, 2009]. However, when certain aspects of an interactive system are still necessary and at a certain point important, the user can be helped by making those functionalities accessible in the background. In this case, the user is not bothered with unnecessary functionalities at first glance and have more focus on the more crucial parts of the system. The user perceives the system as especially minimal when there is less confrontation with navigational structure that can distract the user from the actual objective [Obendorf, 2009]. A minimal system in terms of structural minimalism is given when there is an "optimal balance of provided and necessary functionality - at any point in time" [Obendorf, 2009].

Compositional Minimalism

Designing interactive system and creating their functionalities mainly depends on the interpretation of the user. In compositional minimalism, the composition should be reduced so far that the user has the chance for the most possible interpretation. An interactive system is more minimal when the system itself does not constrain the user in their interpretation by making fewer assumption about its usage [Obendorf, 2009]. A minimal system encourages its use in contexts and tasks throughout the use [Obendorf, 2009].

Architectural Minimalism

The idea of architectural minimalism in interactive systems is based on principles that are used in a certain field of computer science. This field is called information architecture. The aim of information architecture is to structure the information that is displayed on the World Wide Web. This does not only include text content but also graphical and technical aspects. Structuring this content means to display the combination of those information parts in a legible manner so that it is easier for users to understand the system. Architectural minimalism makes use of this concept by reducing functionalities into groups according to their specific use [Obendorf, 2009]. Grouping such functionalities into blocks of certain similar usage contribute to a more effective and efficient understanding of the system. Especially, when interactive system are complex and not limited by one specific task, the combination of different parts that would seem unnecessary when looking at them separately become necessary functionalities when combined [Obendorf, 2009].

3 Case Study

For the purpose of this research paper, a case study has been created to gain more insights into the potential effect of principles of minimalism on usability. For this reason, two different mockups have been created in which minimalist principles have been applied in order to affect the usability functionalities. This case study has been chosen to have a direct comparison of the same application with different levels of minimalism. The level of minimalism describes how much of minimization has been applied to the prototypes. The aim of creating two individual prototypes instead of comparing two existing Web sites was to have a direct comparison in order to answer the question, it is really all about minimalism? Moreover, it is more meaningful to compare two interactive systems with the same tasks because the differences can be better analysed from that. The prototype of a mobile application was chosen because of the functionalities in apps. Apps are more suitable to analyze because they are basically a framework of functionalities.
The two prototypes represent an application of a rating system of attended lectures. Both are similar to each other and differentiate in terms of the amount of applied minimalism. The different perceptions of the testers and their behavior with the prototypes will be analysed through an interview and the IsoMetrics questionnaire based on the ISO norms of usability. The tester is advised to accomplish the task: "Rate the Game Studies and Game Design lecture from Mads Haahr on the 17th of April." The result from the case study intends to contribute to the later discussion concerning the question, whether minimalism's influence is key to good usability. The correlation or non correlation of both terms shall become more clear. Nevertheless, it should be pointed out that due to the little range of possible testers, the argumentation of this thesis cannot be applied as general statement but is an attempt for further researches.

3.1 Usability Assessment

A/B testing was used in combination with an interview and a questionnaire for the comparison of the usability of the product. A/B testing is a test method to test prod-

ucts with minor changes to improve the functionality of the elements [Wikipedia, 2019]. Most of the time, A/B testing is used for Web products to improve conversion rates. Conversion rates describe "the percentage of users who take a desired action" [Nielsen, 2013] like buying products from a Web site. A/B testing has been used for this scope because the two prototypes provide the optimal basis for it to compare which implementation of the design achieves more success regarding its usability. In the course of the test, the participants should fulfill a single task, which is communicated to them in advance. After the successful or unsuccessful completion of the task, the testers will evaluate their perceptions on the used prototype. In order to analyse the quality of usability in the prototype, it is necessary to declare what measurements are used for that purpose. As usability is part of the ISO norm that sets the standard for the appropriate usage of usability, it is necessary to include in the analysis the main aspects (Learnability, Efficiency, Memorability, Errors and Satisfaction) of usability which were described in chapter 2.1. In context of this criteria, a questionnaire has been developed by Willumeit, Hamborg and Gediga [1998] to gain information about these specific criteria. The questionnaire takes this criteria into consideration and asks specific questions related to each of the mentioned aspects. The different sections of the questionnaire follow the stated requirements of usability in the ISO norm. The question to each usability aspects are answered according to a scaling system from 1 to 5, which indicates how strong the participants can relate to the statement. Nevertheless, the questions don't give the possibility to add further impressions and comments on the tested prototype. For that reason, an additional interview is used to receive further subjective impressions of the participants about the system. This enables more flexibility and deeper insights into the perception of the participants. Moreover, the time needed to complete the task will also be recorded in order to assess the efficiency of each prototype. The results taken from the questionnaire will be summarized in a table and based on the answers an average value will be calculated with the aim to have a quantitative number to evaluate the differences.

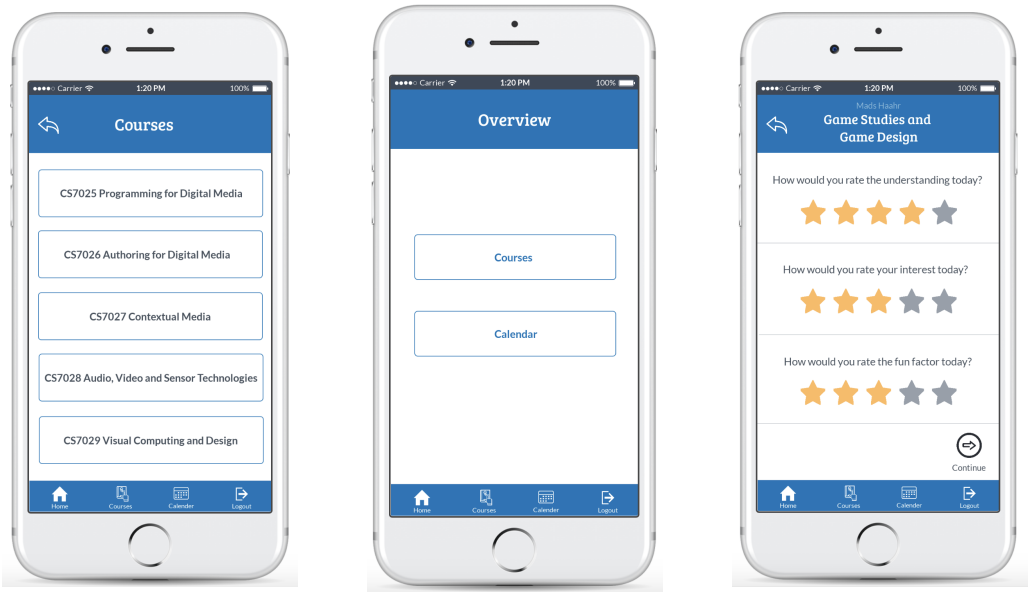
3.2 Prototypes

The case study is based on two high-fidelity prototypes. High-fidelity prototyping means creating a computer-based interactive representation of the product. This kind of prototyping is used to gain detailed insights into the usability of the product and thus generate conclusions about user behavior [Ibragimova, 2016]. In this case study, two prototypes were created for comparison purposes. Basically, both prototypes are guided by visual aspects to be used in interactive systems explained in chapter 2.2.2, whose efficiency should be evaluated by the following usability test. In addition, the prototypes were also created by taking the usability heuristics into account and the minimalist principles. With regard to the four different notions [chapter 2.3.1], minimalism was used in different proportions within each prototype to test whether the differences in the user behavior are noticeable.The following passages will describe the two different prototypes and explain the connection between the different notions of minimalism within usability and user experience.

Prototype A

In terms of functional minimalism, the application has been set to a fundamental goal: successfully assessing a lecture combined with providing the most important functionality at the same time. The prototype was therefore minimized to the most important function. The evaluation of lectures, however, is supported by other functionalities, which are not in the focus of the application and rather represent a subconscious functionality for the successful execution of the main functionality. Thus, in every view of the prototype, the functionality was reduced to a minimum. Apart from the basic functions for navigating the app (login, logout, home, submit, etc.), the user can only perform functions that will gradually lead them closer to the evaluation. The prototype also restricts the possible functionalities and interactions with the rating system. The evaluation can only be carried out by clicking on the stars which is a function that is simple and intelligibility self-evident. The limitation of the functionalities helps to make the target more successful with a higher probability. In terms of structural minimalism,

the prototype has been structurally adapted so that, on the one hand, only four essential sections are represented in the navigation and, on the other hand, the way to the evaluation is based on two options (courses and calendar [figure 3a]). The structural system of the prototype follows a straight line, starting with an overview of the courses, followed by the overview, the details and concluding with the evaluation. Minimizing the structure and avoiding the display of unnecessary functionalities helps the user to focus on the task.



(a) Courses view (b) Home view (c) Rating view

Figure 3: Prototype A

Due to the minimal functionality of the prototype, not much room for interpretation is possible for the user. The prototype is very clear in its execution and needs no real interpretation as far as functionalities are concerned. The composition of the elements (icons, wordings, titles, etc.) in the prototype are presented in such a way that the user can interpret the functionalities. As far as architectural minimalism is concerned, the elements of the prototype were arranged so that similar and constructive contents in their meaning were grouped together. Therefore, there is navigation, course and calendar section and an evaluation section [see figure 3]. By combining the similar elements into

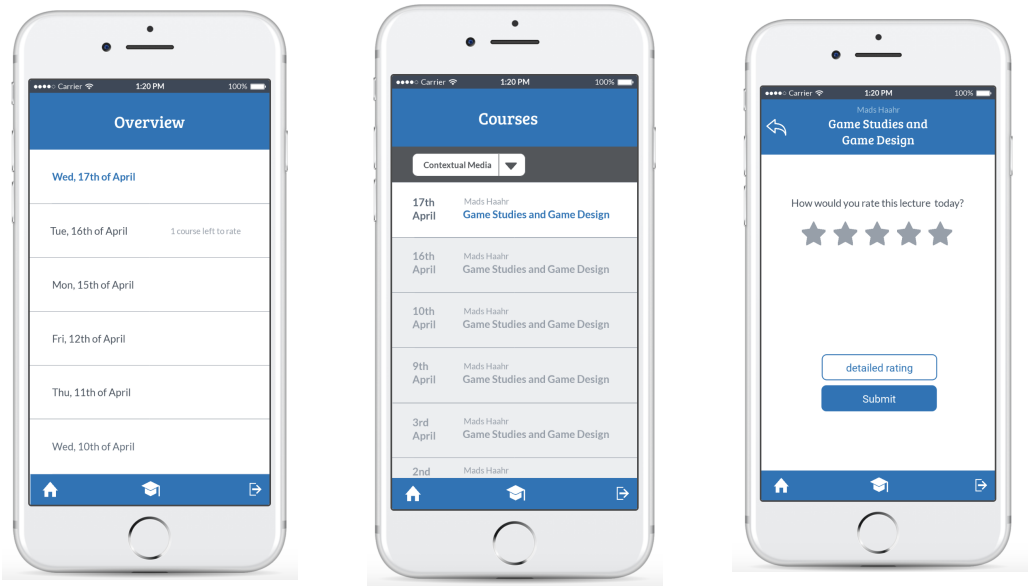
a group, their design is minimized and also helps the user to understand the content and functions more efficiently. This also allows the user to build a faster understanding of similar features.

As for the aspects of visual design, the basic principles explained in chapter 2.2.2 were used in the prototyping process. Especially in terms of the unity of the elements like color, shape and position. For example, the application represents the assessment of the lessons, therefore, the colors of the university were used as a continuous branding. As architectural minimalism deals with the hierarchical arrangement of elements based on content and context, it also covers the wider aspect of the hierarchy [see chapter 2.2.2] of elements in visual design. Regarding the usability perspective, the heuristics involved in chapter 2.1.1 were included using the visual representation. For example, general conventions have been applied to help the user perform the tasks. Depictions of icons like "home" and "logout" are generally known by users and thus no longer require any other representation that unnecessarily needs to build up new knowledge. In addition, user control was supported by the back button and the navigation. Moreover, the descriptive texts of the buttons and labels relate to the real world of the user thus contributing to usability. Since minimalist design is also part of the heuristic, this aspect was covered by the application with the implementation of various notions of minimalism.

Prototype B

The applied functional minimalism in the second prototype takes over the essential functions of the first prototype. Since the second prototype serves as a reference object, the main goal is once again, the successful evaluation of a lecture and the creation of comparative values. In the second prototype, the level of minimalism was increased to analyse the impact on user behavior. In contrast to the first prototype, a supporting function was removed in the application. The ability to choose what kind of view the user desires is not depicted in this prototype anymore [figure 4a]. The removal of this functionality aims to test whether the user reaches their evaluation more efficiently and whether the necessity of the intermediate step is needed to exist at all. Moreover, the removal of

this function also changed the structure of the prototype. By eliminating the selection, the sections of the navigation were adjusted [see figure 4]. Since the user is immediately forced to access the calendar view with the aim of reaching the course more efficiently, the overview section is no longer necessary.



(a) Courses view (b) Home view (c) Rating view

Figure 4: Prototype B

In this way, the user is immediately given access to the selection of the possible courses that are supposed to be evaluated and the unimportant sections will be put to the background. In addition, the rating system was structurally adjusted. Although the structural system of the prototype still follows the same pattern as in the first prototype, the possibility of providing an overall assessment of the lecture has been added in the beginning of the evaluation [figure 4c] and, if desired, a more detailed evaluation can be chosen. This minimization of the structure as well as the function, aims to make the user more willing to give feedback because they do not feel obliged to spend more time. The evaluation procedure is therefore simplified and more accessible to the user. As far as compositional minimalism is concerned, it is applied in the same way as in the first

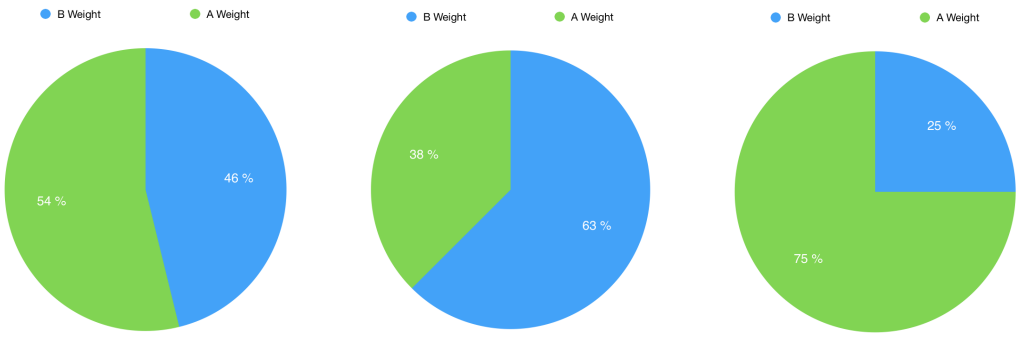
prototype. The only differences arise mainly in the navigation, since in these sections the labeling of the icons are abandoned. The icons should speak for themselves and should be interpreted by the users according to their knowledge. The architectural minimalism is used in the same way in the second prototype as well as in the first example. The elements follow the approach of grouping elements of similar content and functionality. The elements in the course view are displayed differently. The different courses are summarized by a dropdown menu, which should give a more compact impression.
The same visual and usability aspects from prototype A apply to this prototype. Both prototypes share the same foundation of visual design and functionalities. Although it must be said that the minimization of elements and descriptive texts obviously influences the appearance of the second prototype as it should look more compact and summarized. The usability has been influenced as the efficiency is aimed to be enhanced due to the immediate access to get to the evaluation part. The immediate access should also supports the user in learning how to use the application in a faster process.
In summary, it is intended that the two prototypes resemble each other visually. The small differences are intended to expose whether the further minimization of elements clearly affect the usability of a product and if it actually helps to improve the usability.

3.3 Results

This chapter will display the results gained from the usability test questionnaire and the personal interviews. The results from the questionnaire were obtained by calculating the average value of each statement and comparing the average value of prototype A to the average value of prototype B. According to the average values of each statement in each category (self-descriptiveness, controllability, conformity with user expectations, suitability for learning and suitability for task), in comparison to the other prototype by the higher or in some cases smaller value, the better values have been marked as a better impact“ on the participant (e.g. average value of statement S.2. of prototype A is 4.25 and of prototype B is 4.5 which suggests that prototype B made a better impact). The amount of statements that made a better impact have been calculated into an overall

amount and the distribution of those have been depicted in a pie chart. The usability questionnaire can be seen in the Appendix.

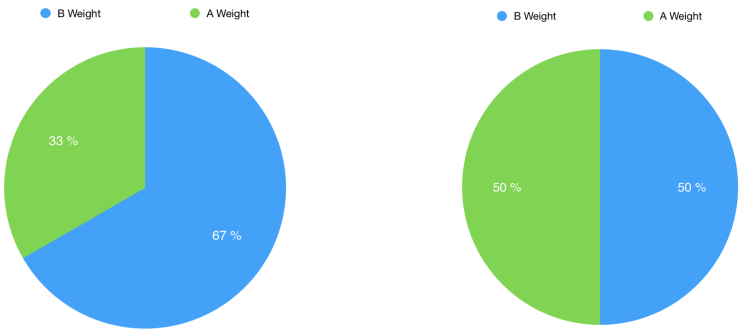
Figure 5a depicts the result from the questionnaire regarding the self-descriptiveness. The category self-descriptiveness deals with the intuitive understanding of the application relating to its representation of elements. The pie chart is divided into two parts, the distribution or prototype A and B in percentage regarding the better impact. The investigated outcome in terms of self-descriptiveness show that this category is slightly predominated by prototype A with 54% to 46%. Prototype A was the prototype that had less minimalist aspects implemented to the design. There was a percentage difference of 9% between both values. The category controllability assesses the possibility for the user to interact freely and independently with the application. In terms of controllability for the user, the data suggests that prototype B outweighs prototype A. 63% percent to 38% display a remarkable distribution in favor of prototype B depicted in figure 5b. However, in context of conformity with the user expectations, prototype A clearly dominates in this category. The aspects of conformity evaluate the predictable assumptions of the user towards the procedures and functionalities of the application. The amount of better perceptions of prototype A in this category is three times higher than prototype B, with an overall percentage of 75% to 25% [see figure 5c].



(a) self-descriptiveness (b) controllability (c) conformity

Figure 5: Distribution of self-descriptiveness, controllability and conformity with user expectations

On the other hand, figure 6a displays the dominance of prototype B in context of the category suitability for learning. This category describes the way that the participant gains knowledge for the interaction with the application and how easy it is to achieve that knowledge. Questions that were asked were for example: "I needed a long time to learn how to use the software" or "I find it easy to use the commands" [see Appendix]. The section of prototype B in this category amounts to 67% whereas prototype A only amounts to a total of 33%. Compared to the category suitability for task [see figure 6b], there is no distinct outcome of the calculated values as both prototype results are equally distributed in this usability test. Category suitability for task evaluates how the participant accomplishes the tasks and how straightforward it is in its procedure.
Looking at the investigated categories, the are two categories that are dominated by prototype A, two categories that are dominated by prototype B and one category that is equally dominated by both.



(a) suitability for learning (b) suitability for task

Figure 6: Distribution of suitability for learning and suitability for task

In addition, the completion rate of the task has been recorded, too. This value describes the time duration that the participant needed to complete the advised task. Figure 7 illustrates the duration differences of each prototype in comparison. As it is obvious, the overall completion rate of prototype A is higher than prototype B. In other words, it took longer for the participants in prototype A to complete the task. As depicted in the figure 7, the time needed with prototype A is almost three times higher than prototype B.

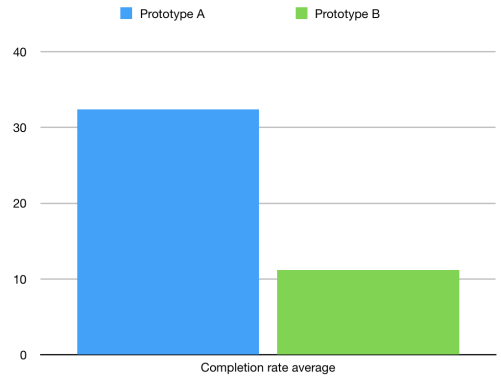


Figure 7: Completion rate average of each prototype

According to the results from the interview, questions were mainly asked about the interaction of the tester with the prototype. The questions were: "In each view of the application, are there any functionalities or elements that you found were unnecessary?" and "In each view of the application, are there any functionalities or elements that you found were missing?" and all were answered with 'no' by the participants. There was an overall agreement that both prototypes had a simple, straight-forward and appealing impression. In both prototypes the participants stated that the completion of the task was easy and efficient. The participants also perceived the procedures of the evaluation as easy and simply understood. Furthermore, they mentioned that the structural organisation of the elements had helped the participants to reach their goal. However, there were slightly more additional comments on prototype A. One participant said that the prototype was text-heavy which forced the them to read more in detail to get to the goal of the task. The participant expressed the preference of less or more summarized text for certain sections but did not suggest ideas. Also, the participant said that it was unnecessary to have two options to get to one goal because it is just unnecessary information. Another participant commented on the structural display of the categories "courses" and "calendar". In the category "courses" it was not obvious enough where to find the sub course "Game Studies and Game Design" which confused the participant. On the other hand, the participant stated it was nice that there was an alternative way for them to get to the evaluation through the calendar view. However, a different

display of the calendar in a weekly view or monthly view would have been preferred. This would lead to a better structural understanding of the system. All in all, both prototypes left a positive impression on the participants. They all expressed a good, easy and straightforward use of functionalities.

4 Correlation

In chapter 2 the different terms were explained as a basis for the discussion. With regard to this chapter, the different aspects faced in usability, user experience and minimalism seem to intersect with each other. This statement is supported when comparing the different aspects of the notions with each other. As already explained in chapter 2.2.1, there is a correlation between user experience and usability. The correlation between an attractive user experience is conditioned by the implementation of good usability. On the other hand, this also means that good usability need appropriate and appealing user experience design. The good visual representation is inevitably necessary for user experience and usability. As chapter 2.1 included the aspects of Learnability, Efficiency, Memorability, Errors and Satisfaction [chapter 2.1] and are guided by the usability heuristics [chapter 2.1.1 when creating interactive systems, it is already obvious that minimalism's influence on the usability aspects are given. Especially the heuristic that includes the aesthetic and minimalist design [chapter 2.1.1 already emphasizes the importance of minimalism in usability. In summary, good usability is influenced by an appealing design and design is influenced by an appropriate degree of minimalism. As everything is obviously based on each other, this means that minimalism does not only influence the design but also the usability that is connected to the design. All of these interaction lead to the higher objective of good user experience. The logical chain of causation displays the correlation of all three notions.

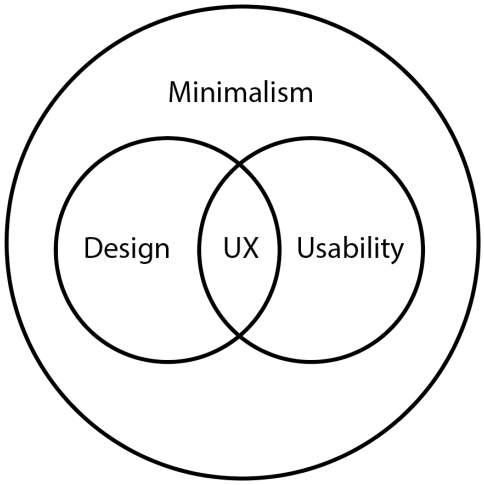


Figure 8: Correlation of design, usability and minimalism

Taking the outcome of the case study into consideration, there are several aspects that can be supported and concluded from the result. The first and probably most important one is that minimalism does influence the user interaction with the application. Referring to the efficiency aspect of usability [chapter 2.1], it can be clearly stated that prototype B was most efficient and effective in terms of completing the task. The average rate of prototype B was three times smaller than prototype A. This proves a clear increase of efficiency. As stated in the interviews, the structure of prototype A containing more details and information, lead some participants to confusion and made it harder for them to complete the task compared to prototype B. This might be a possible reason why prototype A was less efficient compared to prototype B. Therefore, it can be assumed that the higher structural minimization in prototype B contributed to the efficient completion of the task. As we know from chapter 2.1, the completion of tasks represent the main goal of usability [chapter 2.1] and was highly successful in prototype B. Furthermore, the dominant results of prototype B in the category "suitability for learning" supports the impression that the aspect of learnability in usability has been successfully fulfilled. As this category evaluates how the participant learns to use the application, it can be said that the context of elements in prototype B were more easily understood than in prototype A. This condition most likely lead to a better accessibility of the evaluation.

As contextual aspects are covered by the architectural minimization, it can be presumed that the removal of unnecessary steps as they are illustrated in prototype A (showing the courses and calendar option), contributed to the effective learning of the participant and consequently enhanced the usability. Moreover, the usability in terms of the category "controllability" was also predominated by prototype B. As this category assesses the navigation of sections, views and procedures, one possible reason for the dominance of prototype B could be the reduction of navigation anchors and unnecessary steps. Thus, controllability effects the satisfaction of the user experience, too. However, although the results do support the statement that minimalism has its effect on usability, there are also categories that did not result in the expected outcome. In the case study, the self-descriptiveness' of prototype A had a more positive impression on the participant than prototype B. One reason for this result might be the higher amount of descriptive text which lead to a higher understanding of the steps towards the evaluation. So, the extent of minimization might have had a negative impact on the usability in terms of self-descriptiveness. However, the almost even distribution shows that this result cannot completely be representative. Moreover, the small number of participants influence the outcome and more representative statements can be made with a larger amount of participants. This might be an explanation for the category "conformity with user expectations" which is also dominated by prototype A. This category assesses how predictive the interfaces of the application are. There is no logical explanation on why this prototype seems to provide more user expectations because the interfaces are generally the same. To investigate this irregularity it might be necessary to evaluate this aspect again with more participants. In the end, it is interesting that the category "suitability for task" has been equally experienced by the participants. Although, the efficiency of the task is clearly dominated by the participants who used prototype B, the subjective opinion of the completion of the task is not what the efficiency depicts. A possible explanation for this behaviour is certainly the fact that every participant completed the task successfully which made them assessed this category positively. Overall, both prototypes succeeded in their usability because the tasks were completed, but in terms of

the most important aspect of usability that describes "the effectiveness, efficiency and satisfaction with which specified users achieve specified goals" [ISO, 2018], prototype B was more successful.

5 Conclusion and Limitation

The question to be answered in this thesis is whether usability in user experience design is all about minimalism. As it is undeniably discussed in chapter 4, the importance and usage of minimalism is a crucial part of usability. The influence of minimalist principles in the implementation of design [chapter 2.2.2] is the most important part that has its impact on usability, as explained in chapter 2.2.1. The correlation of all the terms, show the interdependence of the notions. This interdependence ensures an optimal user experience according to the usability of applications. Therefore, it can be concluded that minimalism is the key to good usability. Moreover, aesthetic and minimalist design is also one aspect of the usability heuristics [chapter 2.1.1] which clearly proves the significance of minimalism in usability. One might argue that aesthetic and minimalist design is just one aspect among the several heuristics of usability. However, all the other stated heuristics [chapter 2.1.1] somehow depend on the design implemented in the application. For example, error-prevention, system feedback and user control are managed by the implementation of visual design. This condition leads to the fact that all other aspects depend on minimalism as minimalism is the key to visual design [chapter 2.2.2 and 4]. In addition, the case study [chapter 3] supports the influential behaviour of minimalism on usability as the efficiency and learnability have been increased in the more minimized prototype. So, effectiveness, efficiency and satisfaction [chapter 2.1] have been successfully achieved with prototype B. However, as the case study also reveals, there are exceptions that refer to the level of minimalism used in usability. As both prototypes were created to gain insights in direct comparison, the participants perception was not only in favor of the prototype B. In conclusion, the over-use of minimalism can have an adversely impact on the application, too. The different level of minimalism applied

to the visual design affected the perception of the participant in the case study which consequently affected the usability. Although, all participants experienced the application pleasantly, there were aspects of the application which had been perceived in a better way with less minimization. Especially, in aspects of informing the participant and giving them information about the usage of elements, the high level of minimization ended up having an adverse effect. In addition, it must be mentioned that the results of the case study are limited by the small amount of participants. Therefore, it needs to be proven with a larger amount of participants in order to achieve more qualitative valuable statements. Furthermore, it should be taken into consideration that different kind of tests will provide insights of the user's perception from different perspectives. A "cognitive walkthrough" for example, is often chosen as usability test to get direct information during the use of the system. During this test, users should say loudly what they think and see during the completion of the task [Scholtz, 2004]. By doing this test, it would be possible to access information about how the tester perceives the minimalist design directly while completing the task. When planning usability and applying minimalist designs it should be ensured that minimalism should not remove functionalities and details that are potentially important for the user's understanding. Another perspective is, that this case study is restricted by the simplicity of the task. The given task does not go deep into the complexity of tasks of the application. To gain a better understanding of the usability of the functionalities, a more complex task combined with several functionalities of the interactive system would provide more detailed impression of the application. This would also enhance the meaning of minimalism in functionalities and procedures. Also, the two prototypes were based on the same task and the same visual design. In hindsight, it might have offered more different reactions if the visual design would have been more different but still follow the same procedures of the evaluation. Apart from those perspectives, the usage of the different minimalist aspects [chapter 2.3.1] can be seen as the most important approach to achieve optimal visual design and usability, although it cannot entirely be stated that usability is all about minimalism.

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Appendix

The following images show the usability questionnaire. For more details on the results please get in contact with me.

IsoMetrics^S

Index	self-descriptiveness	Predominantly disagree 1	2	So - so 3	4	Predominantly agree 5	No opinion
S.2	I can call up specific explanations for the use of the system, if necessary.						
S.3	I understand immediately what is meant by the messages displayed by the software						
S.5	It is easy to retrieve information about a certain entry field.						
S.6	When menu items are not available in certain situations, this fact is visually communicated to me.						
S.7	If I want, the software will display not only general explanations but also concrete examples to illustrate points.						
S.8	The explanations the software gives me clearly refer to the specific situations in which they are output.						
S.9	If I want, the software displays basic information about conceptual aspects of the program.						
S.10	The software provides me with enough information about which entries are permitted in a particular situation.						
S.11	I can tell straight away which functions are invoked by the various menu items.						
S.12	The terms and concepts used in the software are clear and unambiguous.						
S.13	The software always visually marks the current entry location (e.g. by a highlight, a contrasting color, a blinking cursor, etc.).						
S.14	I can easily tell the difference among feedback messages, requests to confirm inputs or commands, warnings, and error messages.						

IsoMetrics^S

Index	controllability	Predominantly disagree 1	2	So - so 3	4	Predominantly agree 5	No opinion
T.2	The possibilities for navigating within the software are adequate.						
T.3	The software makes it easy for me to switch between different menu levels.						
T.4	The software lets me return directly to the main menu from any screen.						
T.5	I can interrupt any dialog at any time.						
T.6	It is always easy for me to evoke those system procedures that are necessary for my actual work.						
T.7	It's easy for me to move back and forth between different screens.						
T.8	The software allows me to interrupt functions at any point, even if it is waiting for me to make an entry.						
T.10	The navigation facilities of the software support optimal usage of the system functionality.						
T.12	In order to perform my tasks, the software requires me to perform a fixed sequence of steps.						
T.13	When selecting menu items, I can speed things up by directly entering a letter or a command code.						
T.15	It is always possible to abort a running procedure manually.						

IsoMetrics^S

Index	conformity with user expectations	Predominantly disagree 1	2	So - so 3	4	Predominantly agree 5	No opinion
E.0	The software is inconsistently designed, thus making it more difficult for me to do my work.						
E.1	I can anticipate which screen will appear next in a processing sequence.						
E.2	I have no difficulty in predicting how long the software will need to perform a given task.						
E.3	The designations are used consistently in all parts of the software I am familiar with.						
E.4	I find that the same function keys are used throughout the program for the same functions.						
E.5	When executing functions, I have the feeling that the results are predictable.						
E.6	My impression is that the same possibilities are consistently available for moving within and between different parts of the software.						
E.7	The messages output by the software always appear in the same screen location.						

Index	suitability for learning	Predominantly disagree 1	2	So - so 3	4	Predominantly agree 5	No opinion
L.1	I needed a long time to learn how to use the software.						
L.2	It is easy for me to relearn how to use the software after a lengthy interruption.						
L.3	The explanations provided help me understand the software so that I become more and more skilled at using it.						
L.4	So far I have not had any problems in learning the rules for communicating with the software, i.e. data entry.						
L.5	I was able to use the software right from the beginning by myself, without having to ask coworkers for help.						
L.6	I feel encouraged by the software to try out new system functions by trial and error.						
L.7	In order to use the software properly, I must remember a great many details.						
L.8	I find it easy to use the commands.						

IsoMetrics^S

Index	suitability for the task	Predominantly disagree 1	2	So - so 3	4	Predominantly agree 5	No opinion
A.1	The software forces me to perform tasks that are not related to my actual work.						
A.3	The software lets me completely perform entire work routines.						
A.4	The functions implemented in the software support me in performing my work.						
A.6	The way in which data is entered is suited to the tasks I want to perform with the software.						
A.7	I perceive the arrangement of the fields on-screen as sensible for the work I do with the software.						
A.8	Too many different steps need to be performed to deal with a given task.						
A.9	The way in which data is output is suited to the tasks I want to perform with the software.						
A.10	The software is well suited to the requirements of my work.						
A.11	In a given screen, I find all of the information I need in that situation.						
A.12	The terminology used in the software reflects that of my work environment.						
A.14	The software provides me with a repeat function for work steps that must be performed several times in succession.						
A.15	I can easily adapt the software for performing new tasks.						
A.16	The important commands required to perform my work are easy to find						
A.17	I am able to adjust the presentation of results (on the screen, to printer, plotter etc.) to my various work requirements.						
A.18	The presentation of the information on the screen supports me in performing my work.						