FAKULTÄT
FÜR !NFORMATIK

Faculty of Informatics

Designing a Dashboard for Student Information Systems

DIPLOMA THESIS

Submitted in partial fulfillment of the requirements for the degree of

Diplom-Ingenieur

in

Media and Human-Centered Computing

by

Johannes Dostal
Matriculation number 1226714

To the Faculty of Informatics
At the TU Wien

Supervisor: Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Peter Purgathofer

Vienna, 07.07.2019

_____   _____
(Signature of Author)   (Signature of Supervisor)

Designing a Dashboard for Student Information Systems

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Diplom-Ingenieur

im Rahmen des Studiums

Media and Human-Centered Computing

eingereicht von

Johannes Dostal
Matrikelnummer 1226714

an der
Fakultät für Informatik der Technischen Universität Wien

Betreuer: Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Peter Purgathofer

Wien, 07.07.2019

(Unterschrift Verfasser)   (Unterschrift Betreuer)

TU Wien

Diploma**Thesis**

Research Division of Human Computer Interaction

Institute of Visual Computing and Human-Centered Technology

Designing a Dashboard for Student Information Systems

Johannes Dostal

Supervisor Assoc.Prof. Peter Purgathofer

Research Division of Human Computer Interaction
TU Wien

Jul 07, 2019

Johannes Dostal

Designing a Dashboard for
Student Information Systems

Jul 07, 2019

Supervisor: Assoc.Prof. Peter Purgathofer

TU Wien

Institute of Visual Computing and Human-Centered Technology

Research Division of Human Computer Interaction

Karlsplatz 13

1040 Vienna

Declaration

Hiermit erkläre ich, dass ich diese Arbeit selbständig verfasst habe, dass ich die verwendeten Quellen und Hilfsmittel vollständig angegeben habe und dass ich die Stellen der Arbeit – einschließlich Tabellen, Karten und Abbildungen –, die anderen Werken oder dem Internet im Wortlaut oder dem Sinn nach entnommen sind, auf jeden Fall unter Angabe der Quelle als Entlehnung kenntlich gemacht habe

Vienna, Jul 07, 2019

Johannes Dostal

Acknowledgement

First of all, I want to thank my Supervisor Peter Purgathofer, who brought me to the topic of this work and supported me with all kinds of questions and always had time for a talk, even when his own time was short. Furthermore, during my studies, Peter was one of the Lecturers who made studying exciting and joyful, which helped me in staying motivated through, even the less pleasant courses.

My thanks also go to my wonderful girlfriend Ingrid, who always supported me during my studies and took care of our newborn son Adrian when I was at university. Adrian himself was a big motivation for me. He always laughed at me with a big smile on his face that warmed my heart when I came home at night.
I also want to mention my Family and Parents, who enabled me to study and supported me financially.

Further thanks go to the operators of the Student Information Systems who granted us insights to their Systems. This includes Wolfgang Spreicer (TISS, TU Wien), Ulf Thor (CACI, OSIRIS), Joachim Wille (SAP) and Johann Loibl (LPIS, WU Wien). I also want to mention the Students who helped us out with their personal accounts of U:Space and FH Complete, Lukas Neugebauer and Alexander Klakocer.

Since this work was partly elaborated with my colleague Kristina Heidinger, who works on a complementary topic, big thanks also go to her.
Others that supported me with feedback and ideas include my colleagues Marc Kroll, Rafael Vrecar and Matthias Steinböck. Thanks also to my friends and study colleagues, who helped me with the evaluation of the final concept and all others who supported me or offered their support.

Last but not least, I want to mention Daniel Bauer, who did me a big favour with proofreading this thesis!

Abstract

This Thesis is about various design aspects of Student Information Systems (SIS) and how to improve them. In an in-depth literature review, design criteria for SISs were elaborated based on web-design guidelines and literature about information systems. Furthermore, aspects of information architecture, interaction aesthetics and corporate design are tackled.

A significant part of this work is the evaluation and comparison of seven existing SISs. First, they are independently evaluated, and the results are discussed. During the second step, we organized a workshop with experts in the field of *User Experience*. The experts were introduced to the systems so they could identify strengths and weaknesses.

Based on their insights, we designed the concept for a dashboard, which provides the most important information for students on the landing page of the SIS. In the final step, the concept was evaluated with different students to find out if and how they would benefit from it.

Kurzfassung

Diese Arbeit beschäftigt sich mit verschiedenen Designaspekten von Hochschulinformationssystemen (Student Information Systems kurz "SIS") und wie diese verbessert werden können. In einem ausführlichen Literaturreview werden Kriterien zur Gestaltung von SISs aus allgemeinen Web-Designguidelines und Literatur über Informationssysteme zusammengetragen. Des Weiteren werden Aspekte wie die Informationsarchitektur, Interaktionsästhetik und Corporate Design behandelt.

Einen zentralen Teil der Arbeit nehmen die Evaluierung und der Vergleich von sieben bestehenden SISs ein. Zuerst werden diese unabhängig voneinander evaluiert, um in einem weiteren Schritt gemeinsam mit Experten aus dem Bereich *User Experience* verglichen zu werden. Hierfür wurde ein Workshop veranstaltet, in welchem die Systeme den Experten vorgestellt wurden und auf ihre Stärken und Schwächen abgeklopft wurden.

Auf diesen Einblicken basierend, wurde ein Konzept für ein Dashboard entworfen, welches die wichtigsten Informationen für Studierende auf der Startseite eines SIS bereitstellen soll. Dieses wurde anschließend mit Studierenden in Usertests evaluiert, um herauszufinden ob es für den realen Studienalltag nützlich ist.

Contents

Introduction

> *If we want users to like our software, we should design it to behave like a likeable person.*
>
> — **Alan Cooper**
> (Software designer and programmer)

Student information systems (SIS) are among the most important administrative tools for students in high schools and universities. They allow students to access information about their studies, such as course information, dates, personal progress or notifications quicker than before. Furthermore, they allow students to organise their personal matters without having to attend an institution thanks to online registration and communication.

When talking to students from different educational institutions, it appeared that the quality of SISs from different institutions varies from poor to good. These are only subjective impressions without any scientific approach. Searching for scientific works on this topic only yielded papers that approach a specific Design aspect on a single Student information system. We found no publications investigating all aspects of design on various SIS. Based on this, it was unclear what the most critical design aspects were and what exactly a well designed SIS should look like.

Furthermore, each university has its own requirements, which are often satisfied with different designs. This is not to be taken as a contradiction to the previous writing but to emphasise that good design varies depending on the requirements.

Since there is no public knowledge on what makes an ideal SIS and students in different universities are not always fully satisfied with the solution they have to use, we wanted to find out what makes a good SIS and how to design it. Therefore our goal was to research how to design web applications, and any given aspects have to be taken into account. Furthermore, we had to distinguish what parts of web design guidelines were relevant for information systems and what was not.

With this knowledge gathered, we review and compare existing SIS in order to find out how to improve them or how to build a better one from scratch.

Related Work

> *Collaboration is like carbonation for fresh ideas. Working together bubbles up ideas you would not have come up with solo, which gets you further faster.*
>
> — **Caroline Ghosn**
> (Businesswoman)

For the theoretical part specifically, much literature is available. There are books covering all aspects of web design in general, like *The Principles of Beautiful Web Design* by J. Beaird and J. George [1] or *Webdesign: Das Handbuch zur Webgestaltung* by M. Hahn [2]. There is also literature covering single aspects of design in more depth.

Some of the most popular works about typography are *The Elements of Typographic Style* by R. Bringhurst [3] and *Web Typography* by R. Rutter [4].

The book *Information Design: Research and Practice* by A. Black et al. [5] deals with information design and the papers *Toward an articulation of interaction esthetics* by J. Löwgren [6] and *Design aesthetics : principles of pleasure in design Design aesthetics : principles of pleasure in design* by P. Hekkert [7] are about interaction and design aesthetics.

There are some papers about the design of SISs. One of them is *Mobile student information system* by M. Asif and J. Krogstie [8]. It shows that a mobile version of SISs is in high demand. The paper itself is from 2010 since then first SISs with a mobile-only or mobile first approach like OSIRIS by CACI [9] have been established. Unfortunately, CACI itself has no statistics about the devices on which students use their system, so we still have to collect some statistics to gain a better insight.

Student information system satisfaction in higher education: the role of visual aesthetics by P. E. Ramírez-Correa [10] shows that visual aesthetics have a significant impact on user satisfaction. *The Impact of Information Quality and Usability on Intention to Use Student Information System* by M. Atta and A. Romli [11] describes how important information quality and usability of the system are, to satisfy and encourage students to use the system more often as a source of information.

Peter Purgathofer already supervised three theses whose aim was to evaluate TISS and make improvement suggestions. These theses were either written in order to receive a bachelor's degree or as a term paper. Therefore they had a narrow focus on a part of the system, and no other systems for comparison were used. In the *TISS Design Report* [12] it was evaluated that TISS belongs to the best SISs used in Austria and that there are only minor issues to improve. In the bachelor thesis *Richtlinien für die Gestaltung von TISS* [13] by D. Benkő and S. Sterz guidelines were elaborated on how such a system should work, based on interaction principles. These guidelines are more focused on functionality rather than design.

S. Hayden wrote his bachelor thesis *Evaluierung von Designkonzepten für die Studienplanung* [14] about a concept on how to improve a part of TISS used by students to plan their studies and what courses they want to do during a semester. It describes some innovative ideas that could be used, but the whole concept lacks simplicity, so it would not be a direct improvement over the available system.

Design

3

> *Visual design is about problem solving, not about personal preference or unsupported opinion.*

— **Bob Baxley**
(Design Executive)

In this chapter, we want to explore different design criteria and guidelines for websites and Information Systems. Visuals are the most commonly used sensory aids in our culture, and websites target this perceptual channel the most. As such, this area of design is researched and documented the most. The literature on visual design of websites we considered for this includes how to set up layout and composition, the effectiveness of different colours, how to use typography and the effects of using different Fonts. The usage of well-chosen imagery is also essential. For these topics we also introduce some tools and guidelines which help to realise the mentioned criteria.

Besides these, we also had a look at the corporate design, which is based heavily on visual design and other less researched design aspects like interaction aesthetics and information design.

The criteria collected here will help us with the evaluation of several existing SIS later, along with helping us design our concept for a new SIS dashboard.

There are many guidelines and recommendations on how to design a website. They exist in many forms such as blogs, books and web seminars. Usually, they focus on different aspects like principles or trends, complete solutions or details. However, they have one thing in common; they all describe how to design a conventional website.

Since we are interested in how to design an SIS, our requirements differ from the ones of a generic website. We do not want to advertise a company or promote a product. Our goal is to make an information system that is as accessible as possible. In order to do so, some of the standard design recommendations are useful to us while others are not. We will describe what we considered useful for SISs and how to apply it.

While previous works [12][13][14] focused on the usability of TISS, they neglected design. As Hahn describes it, a website or service gains more credibility with

high quality and professionalism [2]. This includes a professional appearance since visitors experience the website visually first. DeLone and McLean defined six important categories for a good Information System, two of them are *system quality* and *user satisfaction* [15]. As shown by Zviran et al., these factors can be improved through good design [16]. Based on DeLone and McLean, Atta and Romli describe that the intention of users to actually use a system is another factor by which to measure the quality of a system [11]. This factor can be influenced by good design as well.

However, visual design is not only about looking good. Mesibov distinguishes it from interaction design as follows:

> Interaction design focuses on the functionality needed to accomplish a task. Visual design engages users by drawing the eye to the correct functionality, prioritising tasks on a page through size, colour, and the use of whitespace, and even increasing brand trust through the use of visual cues.[17]

Now we will elaborate on what visual design for SISs should look like, in order to achieve the desired functionality.

3.1 Layout and Composition

All good websites share a similar anatomy. They use the same base components with a composition akin to other websites. These components are:

- A container. This container is often realised in the form of an all containing <div> tag, defining the borders of the content.

- The Logo of the website, usually in the top left of the website. The position is chosen because in our culture, we read from left to right and from top to bottom, so the top left is the place of a website where we look first. This positioning helps in creating a strong identity for a brand or company [18].

- Navigation is often the first thing visitors of the page look at since they are usually not interested in the start page but specific information on another part of the website[2].

- The content section includes the actual information on a website. It can consist of text, images and videos. It is important that this section is structured well, so users can find the information they are looking for.

- The footer contains all information that is not relevant for the main content but necessary on a website such as copyright, legal information or contact information.

- Whitespace or negative space is not the actual content. It is a form of space that helps to keep the design well arranged and emphasises important information.

These components are defined by Beaird and George [1] but can be found in other sources defined in very similar manners[19].
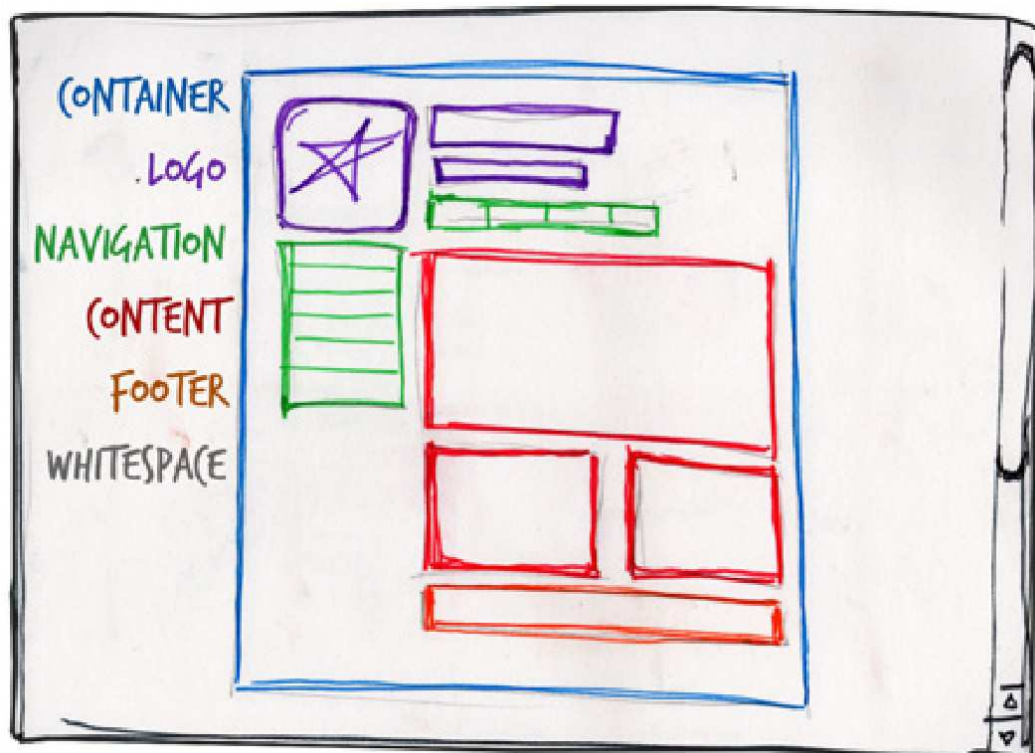

Fig. 3.1: Website anatomy by Beaird and George [1]

The similarity of websites helps users in dealing with different websites and knowing where to search for relevant information. Sometimes web designers break these rules in order to create unique websites, which leads to a unique user experience that can be great or awful, depending on how well the designer understood what he was going for.
These unique designs are often based on trends [20][21][22], which are favoured for some years before they start to look annoying to users and get replaced by new trends. In contrast to this, Beaird and George argue that good design is timeless and even an old website can still look attractive if it was designed well without being influenced by trends [1].

While some web designers argue there is a trend towards asymmetrical layouts in websites [20][21] others see a trend towards grid systems [22]. Since, for our purposes, we want to lay out a professional IS where users find the desired information quickly, a structured page anatomy as shown in 3.1 with a grid system seems to be the best fit. This also suits the argument that good design is timeless since it is recommended in general to use structured grids for websites [2].

3.1.1 Grid Systems

The first drafts of a website should always be done on pen and paper. This means drawing wireframes or building single elements of a website out of paper so they can be rearranged freely. After doing so, the chosen design can be realised on the computer as wireframe, sketch or prototype. For the latter, many tools are available, which can provide a useful grid and make sure everything is structured inside it. One of the first and most popular grid systems was the *960 Grid system* [23]. Due to its static layout, it is not relevant anymore. Ever since the first iPhone, there have been more and more devices with different screen sizes. As such more modern systems like the successor of 960 *Unsemantic* [24] or the more popular frameworks *Bootstrap* [25] and *Foundation* [26] were developed. These new frameworks support Responsive Design 3.1.2 while still being based on a grid. For example, Bootstrap is based on a raster with 12 columns. Such frameworks are not only used for the prototype; they are in use for real production sites as well.

3.1.2 Responsive Design

With the increases in new devices with different screen sizes, and web browser, old static web designs, often optimised for 960 pixels in width, were not suitable anymore. According to Statista in 2018 52.2% of all web traffic worldwide was from mobile devices[27]. So if a website is not optimised for different screen sizes, it will not be (easily) accessible for mobile devices and misses out on about half its potential audience.

To serve all screen sizes, Ethan Marcotte suggested the use of *Responsive Web Design*[28]. This new idea established itself quickly, and it still is considered as one of the most important web trends in the last years [29].

The idea is to rearrange the elements of a website after a breakpoint (defined widths for the template) is reached. For optimal use of screen space, the size of the elements is defined dynamically instead of statically.
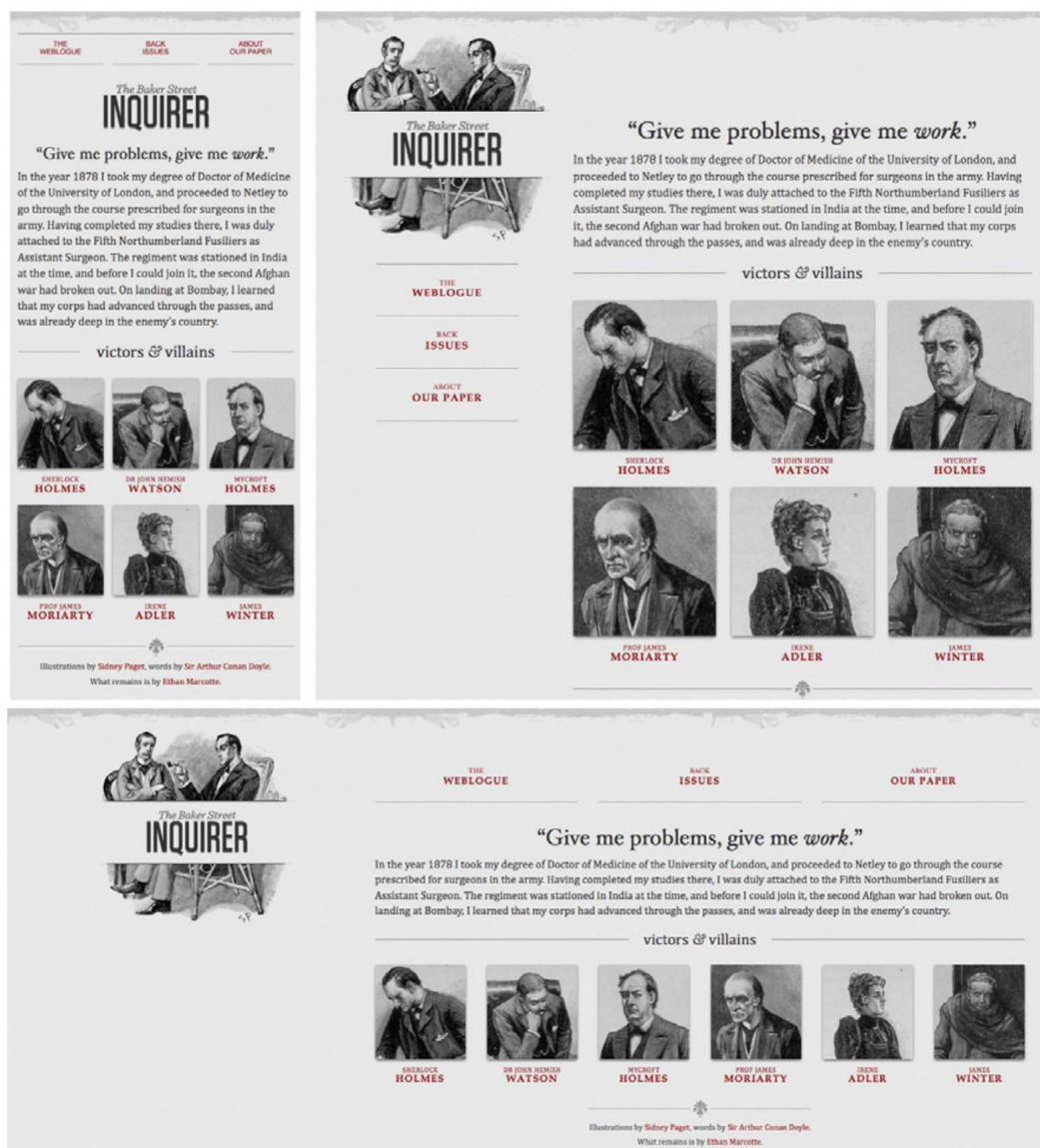
Fig. 3.2: The first responsive website demo by Ethan Marcotte [30]

Modern web-frameworks as mentioned in 3.1.1 support responsive design inherently. So they are a good choice for smaller budgets that still need to achieve responsive design.

"Burger" Menu

A common issue with responsive designs is the *Burger Menu*[1] which while widespread, is commonly used wrong. While it is not always bad, its pros and cons have to be

---

[1]   The visual appearance of the icon has an unintentional resemblance with a Hamburger, so the naming "Burger Menu" or "Hamburger Menu" came up.

considered for the actual use case.

The most apparent advantage and reason why it is used so often is that it saves space and keeps the appearance of a website or app organised and clean. It helps to hide less essential functionalities and focus on the critical content. Meanwhile, the Hamburger-icon is well known and established, so when using the icon, we can be sure most users will understand it. However James Foster did an A/B test in 2014, where he replaced the Hamburger-icon with a simple "Menu" text-icon. He figured out that, back then, 20% more users used the menu with the text button[31]. Furthermore, hamburger-menus allow direct access to functionalities. They can include many functionalities, while alternatives often demand hierarchic access.

On the other hand, some disadvantages arise when using Hamburger-menus. While allowing a clean appearance, important functionalities are hidden and can be overseen by users. It suggests that hidden functionalities are not that important, so users will not search for them.

Another issue with this kind of menu is its typical placement at the left top; while easy to find, it is hard to reach on mobile devices. When holding a smartphone in the right hand, most users can not reach the top left with their thumb and have to use their second hand. This problem can be solved with a *Slide out Navigation*. As usual, the menu is placed on the top left, but it can be slid out of the left display edge as well, which is easier to reach. This is realised within Material Design by default but often forgotten in websites. Another way to make the menu more accessible is to place the icon at the bottom right, as a floating element.

However, no matter how easy we make the menu to reach, it does not solve the issue that it hides essential functionalities of the system. Therefore an alternative like a tabbed menu can be useful. It is well known from iOS applications, where the tabs sit on the bottom of the screen, or atop tabbed menus, which signal more importance but are less accessible. One drawback with these menus is that they are limited to approximately five items, depending on the screen size. When using more than five items, a good compromise can be to show the four most essential functionalities as tabs, and a burger menu for the 5th, where the other items are nested[32].

3.1.3 Balance and Harmony

Balance can be compared with a seesaw, where the same weight has to be applied on both sides to keep equilibrium. The weight is measured in the size of visual components instead of actual weight. This can be achieved with *Symmetrical balance* where the outlines of elements are mirrored in the middle of the page. *Asymmetrical balance* on the other hand, keeps the balance with different sized elements. The only

important thing is that the visual elements on both sides of the website keep the equilibrium of the seesaw.
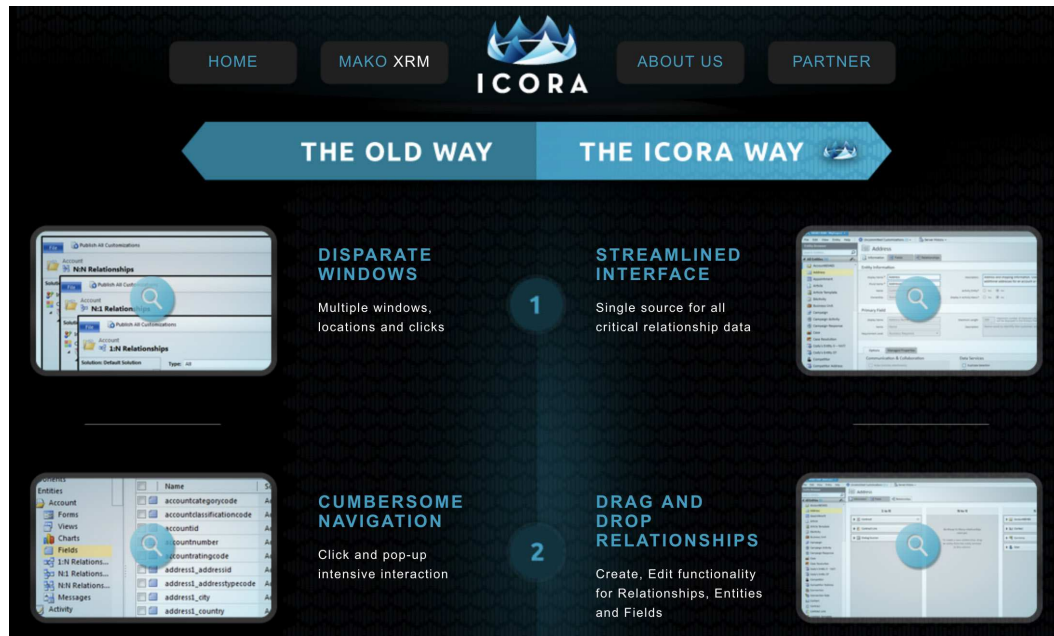

Fig. 3.3: Icora is an example for symmetrical balance in a website [33]
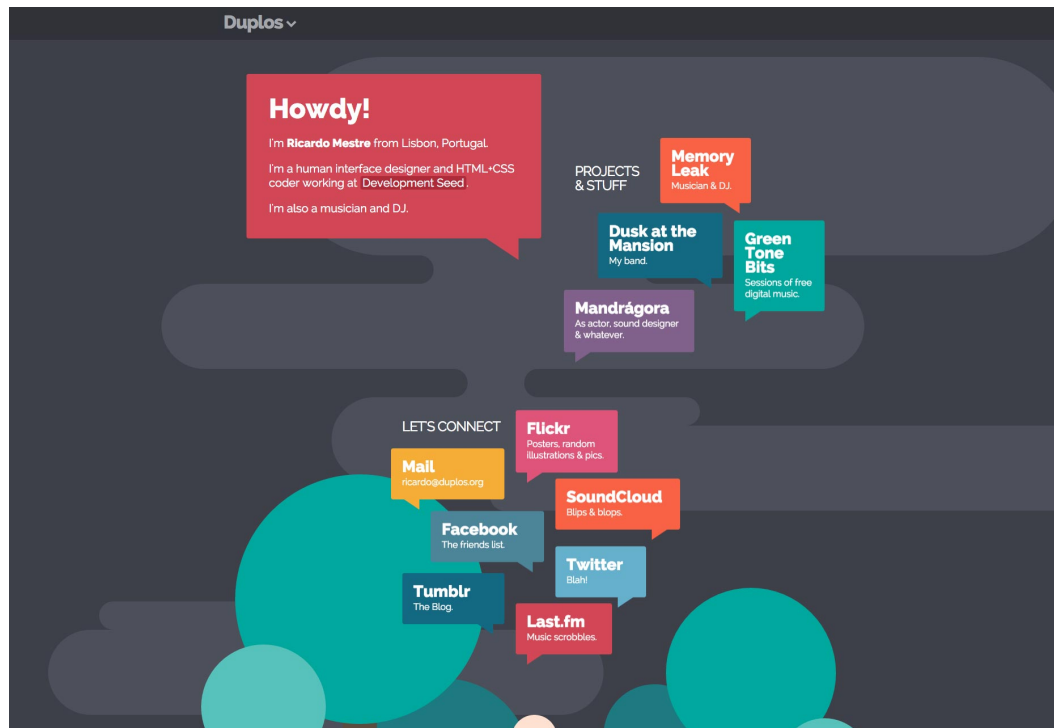

Fig. 3.4: Duplos is an example for asymmetrical balance in a website. Elements of both sides of the middle have the same visual weight. While there are less and heavier elements on the left, there are more lighter elements on the right. [34]

Harmony for websites is harder to grasp. It is necessary to have a feeling for it when aiming to achieve it. A rough description could be that the elements of the website should fit together. This means unity should be achieved by making different pages

of a website with the same design language and fitting elements on one page to a whole picture. It often helps to achieve harmony when keeping the gestalt laws in mind.

3.1.4 Gestalt laws

While not being real laws, the Gestalt laws can help to group, organise and emphasise elements on a website without using disturbing grids. These laws are not by nature but can easily be reproduced in qualitative experiments. They exist since 1923 when they were defined by Wertheimer, Köhler and Koffka [35][36]. While not claiming to be complete, we will now discuss the most fundamental Gestalt laws, which can be important for an SIS and help to achieve harmony:

- **Proximity**
  Objects close to each other are perceived as a group, while objects far from each other are not.

- **Similarity**
  Objects that are similar to each other are perceived as a group. This can be achieved by shape, intensity, pattern and hue.

- **Enclosure**
  Elements in a demarcated area are associated together.

- **Symmetry**
  Symmetry states that objects belong together if they have the same shape, regardless of their distance.

- **Closure**
  Our brain tends to perceive separate small items as belonging together as one bigger item.

- **Continuity**
  Continuity suggests, that our brain groups items to a thought line or pattern, even if this line or group stops.

- **Connection**
  Connected objects are perceived as a group. This law is pretty strong and can oversteer other gestalt laws.

- **Figure and Ground**
  This law describes that dark objects on light backgrounds are perceived faster as objects than the other way round. So if we want to draw attention to an object, it should be dark on light.
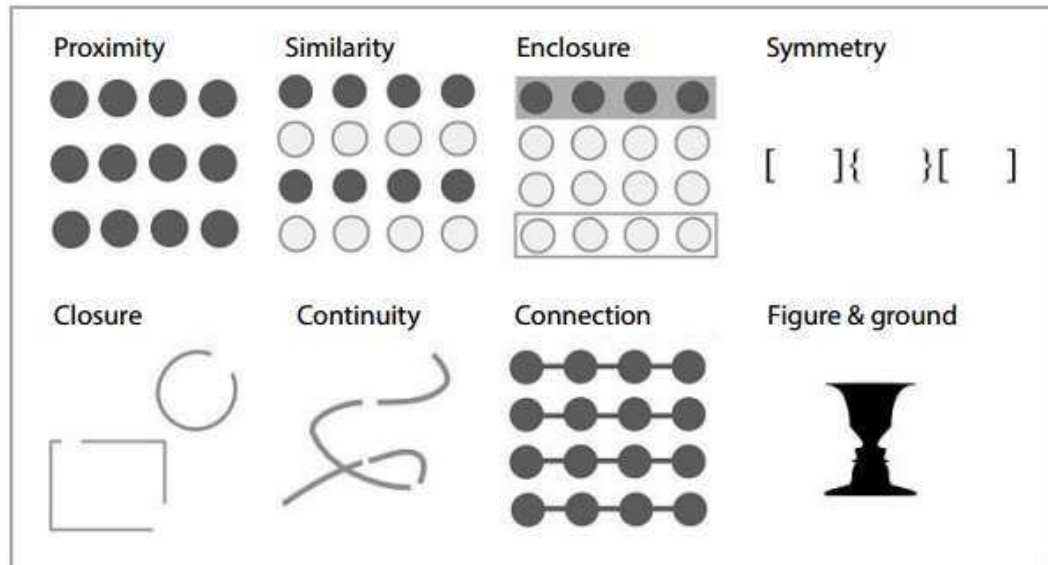
[2][36][37]

Fig. 3.5: In this picture the most important Gestalt laws are shown. [37]

Beside the Gestalt laws, there are several other rules, that can help to design a well-structured interface. Among them are the *Golden Ratio*. Which is a ratio, already studied by Euclid. It is an irrational number which is defined by $\varphi = 1.6180...$ We receive a well looking ratio when using φ to 1. The very same ratio is found in nature in plants and was already used in Egypt to build the pyramids or in Greek for the Pantheon. [38]

Since the Golden Ratio is often hard to apply, web designers often tend to apply the *Rule of Thirds*. It is close to the Golden Ratio but has the advantage that the available space can be divided into three columns [39]. See also section 3.1.1.

3.1.5 Design System

Since there are many design aspects to consider when creating and maintaining a website, it can be helpful to use a *Design System*. This is a complete set of design standards to be considered when building a new component or altering an existing one. This includes the layout and grids, color palettes 3.2, typography 3.4, Icons and more. This set of standards is documented and described in a *Style Guide*.
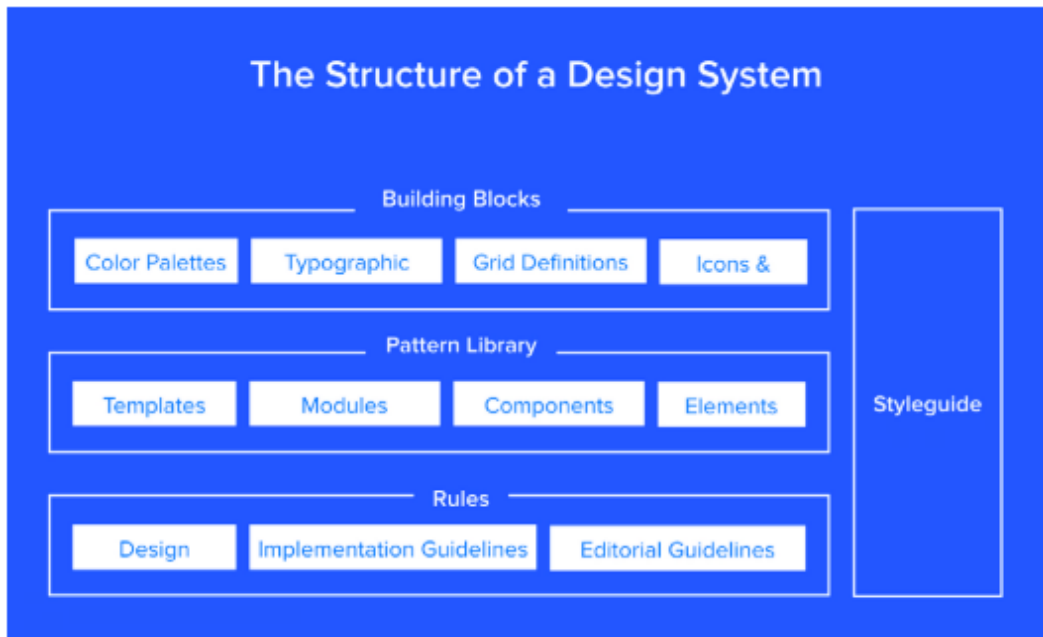
Fig. 3.6: An overview what a Design System includes [20]

Sticking to the Design System does not mean we can not change the design if necessary. However, if we do, we have to do it consistently and change the standard in the Design System as well.

A good example for a Design System is *Shopify Polaris* [40] or, even better known Google's *Material Design* [41].
According to [42] 69% of all Organizations use or actively build a Design System for their Websites.

3.2 Colours

While choosing colours for a Website, many aspects have to be considered. There are aesthetic, identity and usability considerations to take into account [1]. Furthermore, colours have different significations in different cultures. Therefore we defined, that our target group was western culture, where colour associations are very similar.
In our cultural zone, we interpret warm colours as more emotional than cool colours.

- **Red**
  Red awakens strong emotions. It is associated with love, passion and enthusiasm, but also the devil. A good use for red in web-design is to set accents and draw attention to important information.

- **Orange**

  Orange has similar characteristics to red but is not that dominant and aggressive as red can be. It can be used for dynamic and refreshing designs.

- **Yellow**

  Luck and happiness are associated with yellow, and on the other hand, there are negative associations like envy, cowardice and betrayal. It is often used in combination with black, as they form a good contrast.

- **Green**

  Green has a strong connection to nature. It symbolises harmony, hope, growth and freshness. While having a lot in common with blue, it includes a bit of the warmth of yellow. It gives a sense of trust and safety.

- **Blue**

  Blue mediates a lot of conservative characteristics. Including Stability, trust, truth, loyalty and calmness. That is why it is well suited as a colour for reputable services. Many companies and institutions use this colour.

- **Purple**

  The warmth of Red and the coolness of Blue are combined in Purple, so it has the characteristics of these both colours. Historically it is a royal colour and signifies power. This is because in nature, Purple is very rare. It is only found in gems and some flowers and was even harder to reproduce.

- **White**

  The colour of purity and perfection. The innocence of the colour is also the reason why it signifies peace, or why a bride typically wears a white dress. In web design, it can be used in the background to emphasise the content, since it gives a nice contrast to most colours.

- **Black**

  In the absence of light, we see Black. It can be connected with evil and death, but also elegance, strength and power. Therefore it is important to know how to use black so that it will be interpreted in the desired way.

[2][1][43]

When choosing colours for a Web appearance, we should be aware of these characteristics. Often other aspects like the corporate colours of a company have to be considered as well. It has to be considered that not every colour fits another, because of contrast and hue. There are a lot of tools that can help in finding a fitting colour

scheme for a website like Paletton[44] which offers standard methods of picking colours from a colour wheel.

Accessibility is another issue to be considered when choosing colours. About 8% of men and 0,4% of women are colour-blind [45]. The most common appearance of it expresses itself in the form of a red-green weakness. Therefore it is recommended not to combine these colours, so they can not be confused and not associate them with meanings, that are not expressed with a symbol as well. An easy test for accessible colours is to view the design in monochrome. This does not only help colour blind persons but also people without visual handicaps bad lighting[2].

Fig. 3.7: The colour scheme of the TU Wien website[46]

3.3 Textures

While the website itself is displayed on a flat monitor, it can still have a feeling of depth. This can be achieved with visual cues like light and shadow, relative size, perspective or hue[47]. Furthermore, the design of elements on a website can help to produce the desired feeling. Even small details like rounded corners or a rotated heading can contribute a lot to an overall impression.

There are trends of different design-styles which replace each other or exist as alternatives. While skeuomorphism[2] is a trend already passed, a counter-trend of flat design followed it. The design team of Matías Duarte expanded flat design at Google, known as *Material Design*[41]. It divides the items of flat design into different layers and thus gives the impression of depth. *Tactile Design* goes one step further and brings back a bit of realism to a still relatively flat design. This is done by adding

---

[2] skeuomorphism in general means that an item mimics material or form of another item. However, we define it for software as a design style where software mimics an analogue item, that is replaced. E.g. Newspaper or Calendar.

drop shadows to displayed items. Apple[48] uses tactile design to promote their products on its website, but it is found on a lot of other websites as well[29].

Fig. 3.8: Tacile design on the apple website [48]

Depending on the target audience, the appearance of a website can be adapted. Cartoonish-looks are well received among children, natural shapes create an organic impression, and clear lines have a cleaned up serious effect.

3.4 Typography

In 2006 Oliver Reichenstein claimed that 95% of Web Design is Typography[49]. He based this statement on the fact that 95% of the information on the web is in written form, which has to be formatted with typography.

Typography includes more than just setting Fonts and formatting paragraphs. It begins with the composition of a website, which we discussed in Chapter 3.1 already. Grid systems 3.1.1 can be used to create a more organised structure, which is easier to handle and maintain. Even with such grid systems web design suffers a problem, we do not face at print: We have full control over the layout, size and material of the print. This is not true for the web. People will visit our website on different devices with different screen sizes and resolutions. And worse: they will visit our page under different lighting circumstances, from sunlight to a dark room, everything is possible. So there is a known unknown, which we have to work with.

Different screen sizes can be addressed with Responsive Design 3.1.2. When changing the width of text, we have to make sure to fit the line spacing corresponding: shorter rows need less line spacing than longer ones. This is because our eyes need to be guided to the next line.

3.4.1 Typefaces

Different text appearances are distinguished in *Typefaces*, which contain one or more *Fonts*. For example *Helvetica* is a Typeface which consists out of a regular Font, italic Font, bold-italic Font and often several bold Fonts with different stroke widths. We can group Typefaces in different families. The best known are:

- **Sans Serif**
  Typefaces without serifs make the text appear more clearly. They are well suited for short Text and Titles but fatigue the eye faster. Because of this, they are not ideal for longer text.

- **Serif**
  The serifs are mostly horizontal at the end of lines of letters to help keep the eye in a flow. This characteristic helps to read a longer text and makes serif fonts the first choice for content.

- **Slab Serif**
  Emphasised serifs give the Typeface a decorative look. This can help to create the desired feeling but is not conducive for the reading flow.

- **Handwritten**
  The beauty of handwriting with the uniformity of a computer creates a personal feeling, that is still readable. Should only be used for short texts, since it can tire the eye fast.

- **Fixed-width** Monospace Typefaces come from the age of the typewriter, which was not able to create appropriate spacing between single letters. This lead to Typefaces that work with the same space for every letter.

- **Icon Fonts** Icon Fonts are not a real Typeface. They help in including icons into text. Therefore own libraries like *Font Awesome*[50] provide icons that can be included in the text.

A typical problem faced when choosing fonts for a website, is that only a few fonts are supported on every major system. To make matters worse, these fonts are not necessarily appealing thus not helpful for great web design. Luckily, these days it is possible to host personal fonts and include them in a website. This comes with slightly longer load times, so not too many fonts should be loaded this way.
Another aspect of loading times is how Fonts are used. On some Pages, headers and Title Text are transmitted in images. This increases the data volume and load time

of websites tremendously. Since it is possible to format and transform fonts with CSS, this should not be necessary. Another aspect against text in images is inclusive design. It is not possible to read it without an alt-text and makes the navigation with a screen reader more complicated.

3.4.2 Legibility

Good typography is not only readable; it is legible. When reading becomes demanding, readers tend to stop. This is why it is important to make text legible, so readers do not stop reading the content. Good typography is invisible. Choosing a font that does not distract and is easy to read helps to achieve legibility. Fonts that catch the eye distract from the content.

When designing for print, it was important to consider the consistency of the paper. On different papers, the ink trickles differently and affects the result. Therefore fonts were designed with the paper texture in mind. When designing for web, we do not have to consider paper textures but display resolutions, colours and brightness. When in doubt, bigger font size and higher contrast is probably the better choice in helping to perceive the content under difficult circumstances.

When choosing Fonts, we have to be aware that not too many fonts are used. Typically two Fonts are sufficient; one for headers and one for content. When combining them, we have to be aware that they can appear different in size while using the same font size. Often when choosing more than two fonts, it can lead to similarities between them and makes them harder to distinguish. Even when using two fonts, we have to make sure they show some contrast. The most common combination is a Sans Serif for headings, which gives them some conspicuity, and a Serif for the content, which is pleasant to read. When combining a Serif with a Sans Serif, they can have some similarities like the framework, while the serifs distinguish them from each other.

Serifs are not the only way to support the reading flow. It is also important to have some contrast in line width, so it becomes more pleasing to the eye. Too much contrast in line width creates the opposite effect; it draws the readers attention to it and distracts them from the content.

The x-height has to be set right; a low x-height lets the font appear elegant, a higher x-height makes it more legible, and an x-hight that is too high makes it hard to distinguish between letters with and without ascender.

Typefaces are designed for one size and scaled up and down afterwards. When choosing a font that is designed for the desired size, often the best legibility can be achieved. Other facts to consider are that not all Typefaces include italic and bold versions. When using a Typeface without them, that needs italic or bold text, the regular font will be tilted or thickened. The results are not as good as real italic or bold fonts.

When using many numbers inline, own *Text figures* can be helpful to maintain the reading flow. These are figures that behave like lowercase letters and fit into a text. Modern figures create a strong contrast in text, since they appear like a word in UPPERCASE and distract the reader.

Justification has to be considered when putting text on the web. Usually, left-justification or justification is used. However, options like centred or right-justification are available as well. When choosing the justified layout, we have to be aware that the width of the text can change. When using widths that are too narrow with justification, a river can appear throughout the text as shown in figure 3.9. On wider text, this is less of a problem but can still be an issue.

```
I watch three climb before it's my
turn.    It's a tough one.    The guy
before me tries twice.    He falls
twice.    After the last one, he
comes down.    He's finished for the
day. It's my turn.    My buddy says
"good luck!" to me.    I noticed a
bit of a problem.    There's an
outcrop on this one.    It's about
halfway up the wall.    It's not a
```

Fig. 3.9: The *River* through a justified text [51]

Notable not only for Typography but the whole of web design is Hierarchy and Contrast. We need them to distinguish between different elements like title, navigation, content and footer. A hierarchy can be achieved by contrast. Contrasts can be set through size, colour or differences like uppercase and lowercase text or different Typefaces. [2][1][4][52]

3.5 Imagery

Images are a good tool to promote products and emphasise emotions. For Information Systems, this is not primarily important. Therefore choosing pictures is not a concern for us. More important is the usage of Icons with proper meaning. There are thousands of icons available, but we have to be careful that our target group interprets them with the intended meaning. In western cultures, we tend to interpret icons very similarly to other people in our culture. Nevertheless, they should be

chosen carefully, so they will not be misinterpreted[53].

When including pictures on a website, we have to be aware of technical constraints as well. JPEG has been established as a standard for photographic images for a long time and therefore is supported by all browsers. There are new standards like *WebP* that are superior in most regards but are not supported by all browsers yet[54]. Another well-known standard is GIF, which allows animated pictures and transparency, however, supports only 8-bit colours and is as such not suited for photographs. Since GIF was a proprietary format and UNISYS charged royalty fees from companies that offered tools to create GIFs, the W3C established the standard of PNG. It allows transparency and offers 8-bit or 24-bit encoding. This makes it suitable for small graphics and photographs.

Independently from the selected image-format, choosing an appropriate compression is important. While low compression means good image quality, the image size can be too big, resulting in long loading times. Vice versa, a highly compressed image will help to reduce the loading time, while the image quality suffers. It is important to find the right balance between loading time and image quality[1].

Putting in borders or rotating images slightly was done with photoshop or similar tools before. Ornaments like these should be done with CSS nowadays since it helps to keep a consistent design and allows updates to the website with new images while keeping the original format.[1].

3.6 Information Design

> *Information architecture for a user is like a map for a traveler. They are both essential for the journey, and without them, the user & the traveler will get lost.*

> — **Sherif Amin**
> Product Designer

Information Architecture is essential for a good User Experience. It is responsible for creating a structure on which UX is based on and the blueprint of the SIS design. To create it, we need to know what information is essential for users and what is not. Gathering this information, it is necessary to do some user research and learn about the users and their requirements. When doing so for a commercial company, their interests and goals would be aligned with those of the users. Luckily we do not have to worry about this, since our target group are students, while educational institutions do not want to make a profit with the SIS. We need to build a structure,

that enables students to find whatever they need without a hassle.

Morville and Rosenfeld distinguish between 4 types of search [55]:

- **Exploratory seeking** means the search for inspiration without a defined goal.

- **Exhaustive research** describes researching a topic.

- **Known-item seeking** when visiting a site to get specific information about an artefact.

- **Re-finding** re-visiting a site to look up some known information.

While the first two are not relevant for our SIS, the latter two are. Students will search for lectures and certificates, sign up for courses or exams and look up other information relevant to them.

A typical system to structure such information is hierarchical. Content is categorised through taxonomies and labelled with a fitting title. The content on most websites is organised this way, it reduces the amount of content to be displayed at a time, and we are used to this structure. For other purposes, other organisations will work better, such as a linear one for iterative processes like the checkout system from online shops, where users are guided through the payment process. An even more complex system is the sequential organisation, which allows several sorting options like by date, name, relevance etc.

The chosen structure will be reflected in the navigation. A hierarchical system can be represented in the form of classic menus, while linear structures are better visualised with an orientation panel. Since sequential structures are more complicated, the visualisation has to reflect this with more sophisticated approaches. Some kind of a spreadsheet can be helpful, but other methods can be better, depending on the content.

Excellent organisation and visualisation can be worthless when the labelling is not done right. It is essential to title content with phrases the user understands. Otherwise, they will not find the desired information.

Depending on the amount of content, a search box can either be helpful or confuse users. When the website contains a lot of content, a search function helps users to find what they want. A helpful feature is making type suggestions for terms the website contains. When there is little content, a search box can be irritating and suggest to the user that there is more content than what is actually available. It also cannot deliver useful type suggestions since there is no content it can base suggestions on.

For good data processing in the search field and the organisation of content, we have

to make sure to link the context with metadata that helps in identifying content. [55][56][57][58]

Another aspect relevant to IA is Information Quality. Without it, IA is useless, since users do not understand the content. Therefore we have to make sure to achieve Information Quality. As Atta and Romli show, this has a high impact on how the SIS is used [11].

This section is only a quick overview of IA. My colleague Kristina Heidinger writes about this topic in more depth in her Diploma Thesis [59].

3.7 Design & interaction aesthetics

Interaction aesthetics describes the beauty and taste of an interaction. It refers to the visual attractiveness and the interactive behaviour of a product. Studies have shown that aesthetically pleasing products are perceived to have better usability and enable a better user experience[60][61]. Not everyone perceives the same as aesthetically pleasing. Therefore it is important to know the target audience. In our case, they are college students with a higher probability for educational degrees.

While design aesthetics is interpreted as a good looking product, the interaction is often neglected despite being important for good user experience. Often small differences can have a big impact on the perception of a product. This can be little animations on clicks or how items appear and disappear when using a filter. It is important not to overdo such animations since otherwise, they might have the opposite effect of what is actually intended. As we will see later, when designing our concept of an SIS dashboard, being aware of such aesthetics can help emphasise the right information at the right moment. This would not be possible when neglecting interactions while designing software.

To create an overall aesthetically pleasing experience, interaction and visual design have to be designed well. If one fails, the whole experience suffers.

> "We experience sensuous delight, meaningful interpretation, and emotional involvement as a unity"[7].

Jonas Löwgren defined *aesthetic interaction qualities*, which helped to describe aspects of aesthetics. They are *pliability, rhythm, dramaturgical structure, and fluency*.

- **Pliability**
  "When an interaction feels tightly coupled and highly responsive, almost to the

point of shaping a malleable material with your hands, then the interaction experience is one of high pliability"[62].

- **Rythm**
  When doing something with software over and over again, we get used to it. If the software always takes the same time, it is more convenient for us, even if the average time spent is higher. The software gives off a feeling of trust and certainty. This can be filing a form or creating similar artifacts[6].

- **Dramaturgical structure**
  The dramaturgical structure can be broken down into three steps: 1. Recognition of a product and its intended function 2. Short periods of frustration about the inappropriateness of the intended function. 3. Sudden insight when realising what the designer intended for us to see. This dramaturgical structure can vary depending on the design of a product. For productive software like our IS, a flat curve seems more appropriate.

- **Fluency**
  Fluency describes the procedure of a task. In an SIS this could be to register for a course or checking dates for lectures. Good software allows doing a task more fluently than bad software. This is not only measured by click counting but also aspects like positioning processing of information.
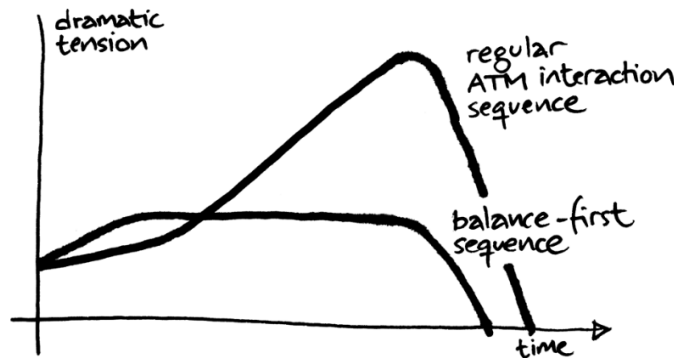
Fig. 3.10: A flat and a steep curve of a dramaturgical structure [6]

In order to achieve such an aesthetically pleasing design, Paul Hekkert defined four *Principles of pleasure in design*[7]:

- **Maximum effect for minimum means**
  Hekkert describes this principle with some examples in the field of architecture, where buildings were built with minimum means but full functionality fitting into the given environment. However, this is not only true for architecture but

software as well. When creating a tool, it is important to fulfil all requirements on an optimum but not overdue with the complexity of the software.

- **Unity in variety**
  Creating unity in variety can be achieved by grouping. The Gestalt laws 3.1.4 are a good tool to do so. It is about the organisation of information. Hekkert also compares it with music, which is only aesthetically pleasing when perceived through the order of single tones in a rhythm. "Detecting such structural relations is thus rewarding, leading some to argue that the aesthetic experience of music is (nothing more than) the perception of organisation and regularities, such as rhythm, motifs, and harmony, in tonal sequences"[63] "Complex pieces of music often require repeated hearing to derive all details of the musical structures and bring them into full integration"[64].

- **Most advanced, yet acceptable**
  People are curious about new developments while not wanting to leave their comfort zone. When innovation is too fundamental people may fear it and will not accept it as a result. It happened several times already that ideas from ingenious inventors where understood years later because they were ahead of their time. The same goes for products. The best aesthetically pleasing product can be created when striking the right balance between familiarity and innovation.

- **Optimal match**
  The perception of all our senses has to match for a pleasant experience while using a product. The unexpected deviation from any of the properties may irritate us. If a solid looking block is very lightweight, it will lose its impression of high quality. The sound of a car door when closing it is designed to fit our expectations and give us a nicer overall experience of using the car. The haptic experience of closing the door and the sound are optimally matched.

To achieve the optimal aesthetic experience, we have to be aware of all our senses and satisfy them in all regards. If failing with one property of the product, the whole experience suffers. This goes for small details like animations in software to the overall appearance. As Ramírez-Correra et al. show, aesthetics have a high impact on if and how students use an SIS [10].

3.8 Corporate Design

Corporate Design (CD) is used to achieve better recognition of a brand and to be familiar with its products or services. An easily recognisable logo helps to strengthen a corporate identity. However, other aspects have to be considered as well. This includes the appearance on the web as well as brochures, letter paper, packaging of products and everything else from the company that can be seen. Therefore good CD is tightly connected to visual appearance 3. Aspects like choosing the right colour(s) 3.2 for the corporate identity, a fitting typeset 3.4 and layout that fit the values the company wants to be associated with, as well as internal company values, are essential. For example, sans serif fonts are recognised as more clean and modern, which is also a reason why so many companies use Helvetica as their main Font, despite being widely overused and not the right choice for a unique appearance. Serif typefaces, on the other hand, express conservative values and stability. A well-known example would be The New York Times [65]. The most unique option is to create an original typeface. The TU Wien uses two Typefaces for their appearance: *TU Headline* for headlines and *TU Text* for content. Unfortunately, it seems that they are not consequent with their personal CD Guidelines [66], since they do not use these fonts on their web appearances.

While CD helps to recognise a brand, it should also help to distinguish it from its competitors. This can be achieved when having strong company values like quality, openness or reliability, which are reflected in the Logo and the whole CD [67].
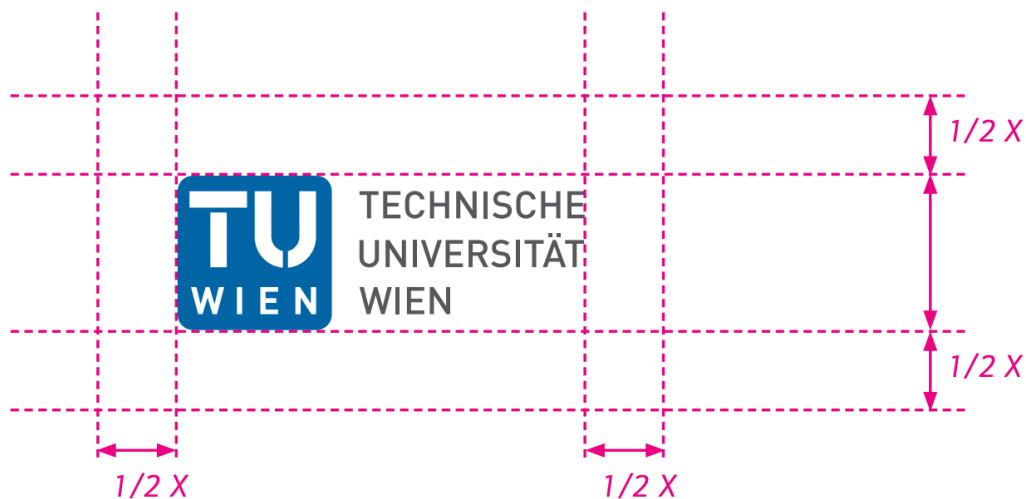
Fig. 3.11: Exact instructions how to use the TU logo found in the CD Manual of the TU Wien [66]

Well-known brands like Coca-Cola have to make sure they are recognised. They change the design of their bottles and glasses frequently but make sure to keep their recognition value while doing so.

Big brands have their own corporate websites, where they provide all information

required by different target groups. Customers will search for product information, journalists for news and candidates for job advertisements while they will not be interested in information for other target groups as much. Therefore the information has to be separated into several sub-pages which can be found from the landing page[2].

Since we want to establish Corporate Design on an SIS, we do not have to worry about these structures. We will use the structure created with the criteria described in 3.6 and apply the established CD on it. This should help to strengthen the identity of the University. While it is most essential to use CD for external appearance, the SIS is only for interns. However, using CD for internal communications helps to let users identify themselves with the University and its brand. This is also the reason why a good CD is applied to internal letters and other internal documents as well.

We now know several design criteria for websites that are relevant for SIS. This includes visual design and several aspects of it as well as corporate design criteria, Information Architecture and how to achieve interaction aesthetics.
Based on these criteria we can evaluate existing SIS. In further steps, this knowledge will help us in comparing the evaluated SISs and to design a new Dashboard for ours.

Student information systems

4

> *There is always space for improvement, no matter how long you've been in the business.*
>
> — **Oscar De La Hoya**
> (Athlete)

We looked at seven different SISs and gathered information on how they look and work, and examined the usability and how they were designed. This information will be used to compare the different approaches used by the systems and to design a new approach based on the results from the comparison. First, we want to introduce the different systems and how we documented them. Since it is hard to get access to such systems, our access to the systems was different, leading to several insights that can not be compared one to one. From this information, equal parts were extracted to be used in a comparative UX-design workshop we hosted.

4.1 Introduction to the Student Information Systems

4.1.1 TISS (TU Wien)

Since we study at the TU Wien, we have access to TISS (TU Wien Informations-Systeme und Services)[68] with our student account. This also means we are familiar with the system and are used to operating it. Furthermore, we got access to the test server of TISS with all rights, so it was possible to look at features for lecturers and administrators. We focused our efforts on the student perspective, so only features available for students will be considered for comparison. We went through all functionalities available and captured a video for analysis. Furthermore, screenshots of relevant screens were taken, and we conducted three interviews with beginner students at the TU Wien, who used TISS for only a few weeks and asking them how they got along with it.

We found lots of details which would need improvements and some of them are already described in the TISS Design Report [12], but we focused on some particular
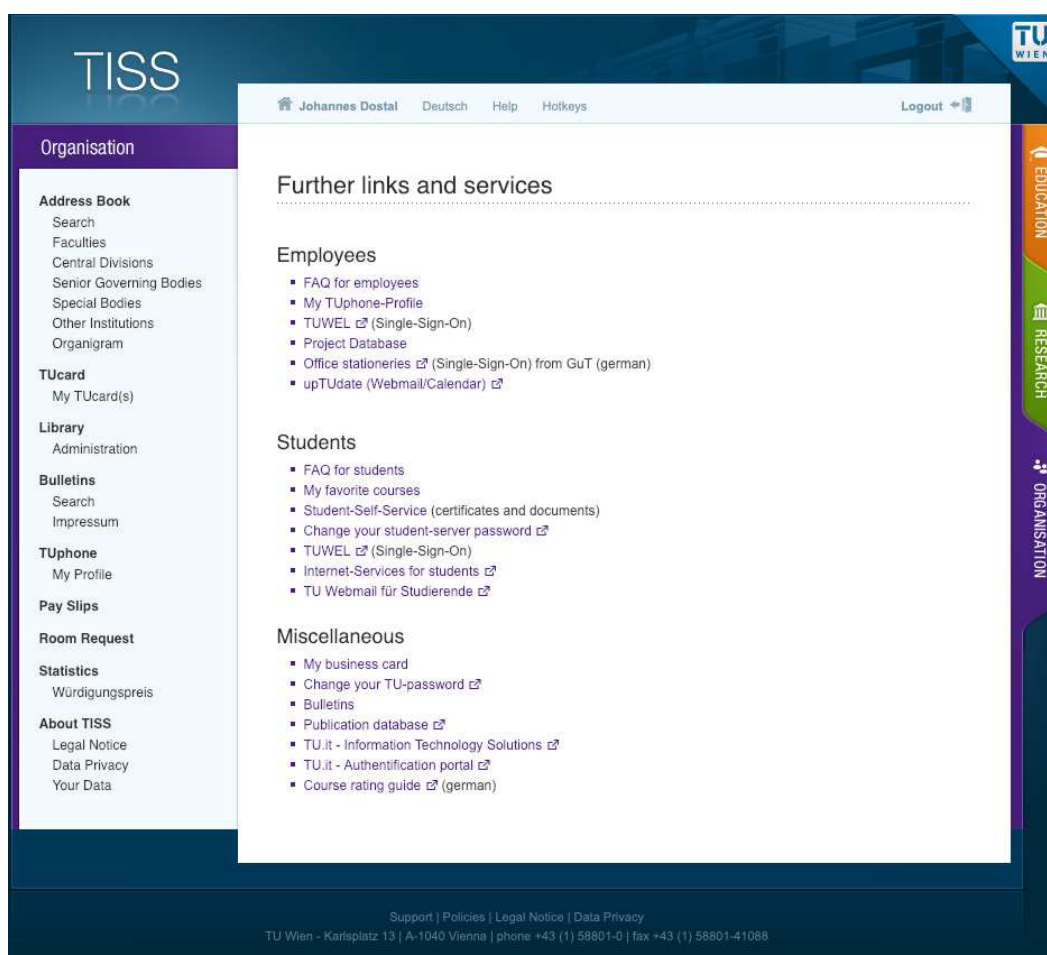
Fig. 4.1: Landing page of TISS after login [68]

main issues. The biggest issue we identified by far is that there are too many functionalities, which are not appropriately structured. The new students were often overwhelmed by the way TISS is organised; they did not find what they needed because too much unnecessary information was distracting them. Hurdles they face include when and where lectures take place. This sounds trivial, but when having a closer look, TISS displays all dates for lectures in the calendar. Unfortunately, these dates are often incorrect because of room reservations or lecturers who forget to update them. This means they are not reliable and can, at best, be used as reminders. When knowing where to search for them, information, on where to find the room, is available also. However, this information is hidden behind a small link that might be nearly invisible to someone who does not know where to find it.

OSIRIS has a superior solution for this 4.16, it provides all the necessary information directly in the details view of a date, so students do not have to search for them. The Vienna University of Economics and Business provides another useful approach with its tool *WU Campus Plan* [69] that even can provide route information to a desired location at the campus (Figure 4.13). Other issues we spotted include the self-administration where students can download documents like a confirmation of study

Fig. 4.2: The room information is hidden behind a link, where most students can not find it.

Fig. 4.3: Once the link to GUT is found, there are detailed information about where to find the room.

enrolment, achievements and certificates. This area is unnecessarily complicated. Students have to generate documents, that then appear in a list where they can be downloaded. Elements inside this list cannot be removed, so outdated elements distract from the necessary ones. Information like creation date of documents or two different validation mechanisms, which are not even used by any person we spoke to, make the view even more complicated. We would suggest to remove or hide such information so that it is only available when needed.
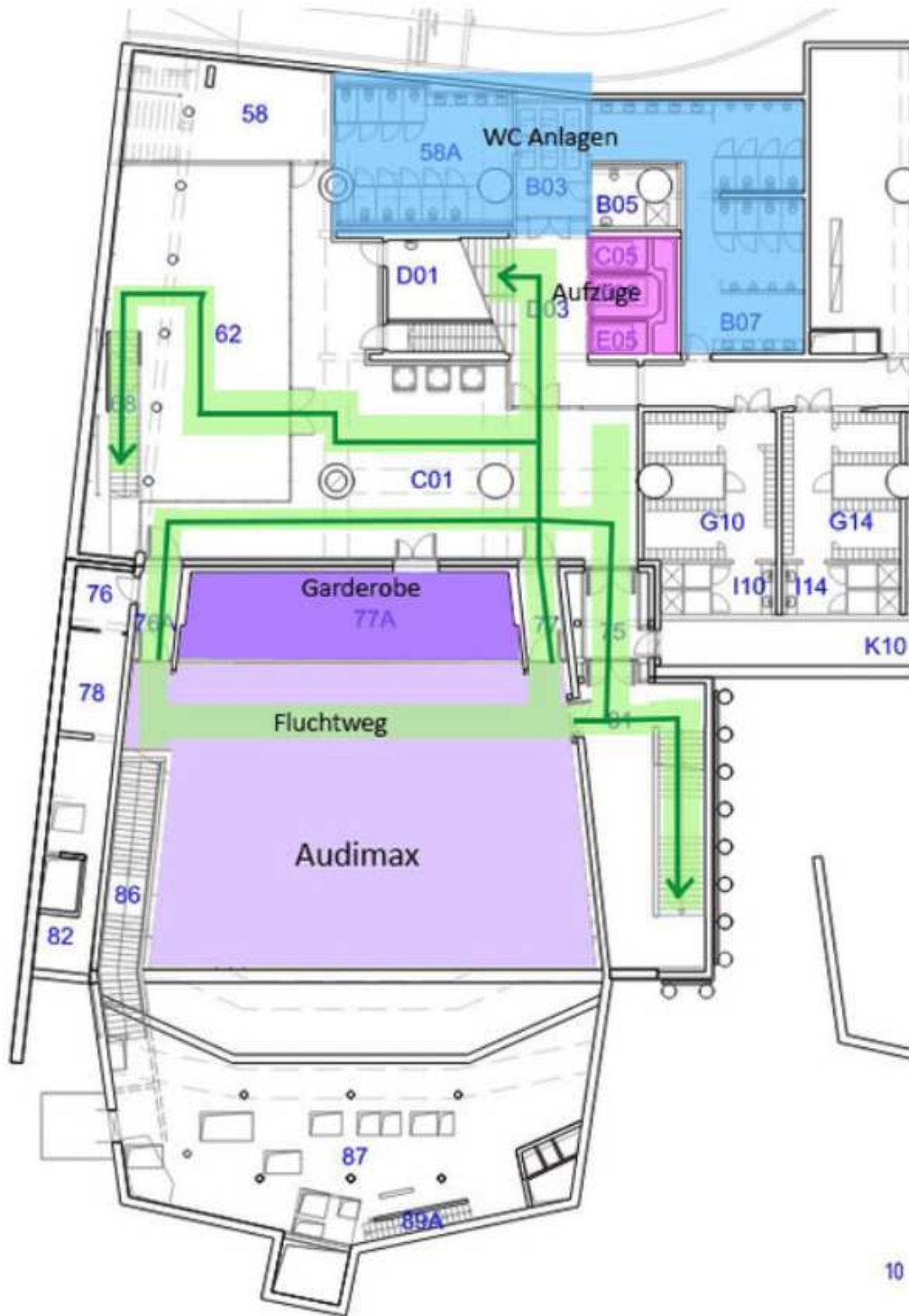
Fig. 4.4: GUT provides a view for the indoor location of the room.

Certificates for single courses are placed separately from collected certificates, while there is also an own point for "certificates" in TISS, where students can see their grades but not download them. So there are three different places where students find different forms of certificates instead of one place. The same issue occurs with

Fig. 4.5: The cluttered Interface of the Self Service Area

"Lectures" where the search (labelled as "Courses") is separated from the Academic Programs, where all courses can be found as well. We also identified a problem in the "Academic Programs" view, where students face a list of all Academic Programs available, instead of the content of the Program they are enrolled in. This leads to another problem; the whole System is designed statically, instead of being context sensitive. This means the system does not consider what a student is enrolled up and what they have achieved already. This could help to enrol in courses faster and see relevant pieces of information right after signing into TISS.

While some information is hard to find for students, other information that is not relevant takes a lot of space in TISS. This includes the research area and the organisation area, the latter of which includes the landing page of TISS and provides some links that can be useful. Unfortunately, they are so inconspicuous that no student we talked to knew about it 4.1. The Font size in TISS is set relatively small, so it appears fuzzy on displays with lower dpi. The Font face Arial is used with Helvetica and sans-serif as a fallback, which does not help to improve readability either along with bad formatting of text. As we discussed in Chapter 3.4, the font should be readable even in adverse conditions. These criteria are not fulfilled by TISS and contribute to the fact that finding desired information is even harder.

Fig. 4.6: Font declaration used by TISS

Students told us in interviews "I am always scared that I am overlooking or forgetting

something. TISS does not really help me either." so it seems like TISS is failing in one of its main purposes as an Information System; it does not reliably provide students with the information they need. This problem is similar to another one we identified in an earlier study we conducted [70]. We figured out that students who are new to the university did not know where to find relevant information and how to make sure they do not overlook some important facts. We came up with a concept of a website that contains all relevant information in the form of a step by step guide. Maybe such a guide could be included in TISS in a help tab. At least an introduction to TISS should be available, so new students know where to find what. The University of Vienna provides a better solution, they offer an own "About u:space" area, where students are introduced to the functionality of u:space.

The calendar in TISS was mentioned to be somewhat helpful. Somewhat because it can display dates automatically and they can be exported via iCal files, but it lacks reliability and customizability. The dates displayed are often placeholder dates since they are based on room reservations and not curated dates by lecturers. Because of their unreliability, students wanted to edit their calendar manually. Unfortunately, this is not possible either. So the calendar in its current state can only be used as an orientation but not as a reliable source of information for dates. Furthermore features like auto notifications for cancelled course dates were requested that could then be marked in the calendar as well.

In summary, TISS is a very powerful SIS with lots of functionalities. Unfortunately, most of the features could be designed better as described in the workshop results 5. TISS can be described as versatile without specialisation and too many technical decisions that are visible to users.

Suggestion for improvement

We think many of these issues can be solved with a context-sensitive dashboard, where students see all relevant information at a glance after signing in. Such a dashboard should take into account at what times of the year students want to sign up for courses normally or if they can register for an exam. An overview over the next dates and deadlines could be helpful as well as a small visualisation about the personal progress.

In the workshop we conducted, we focused on this aspect and described the results in section 5.
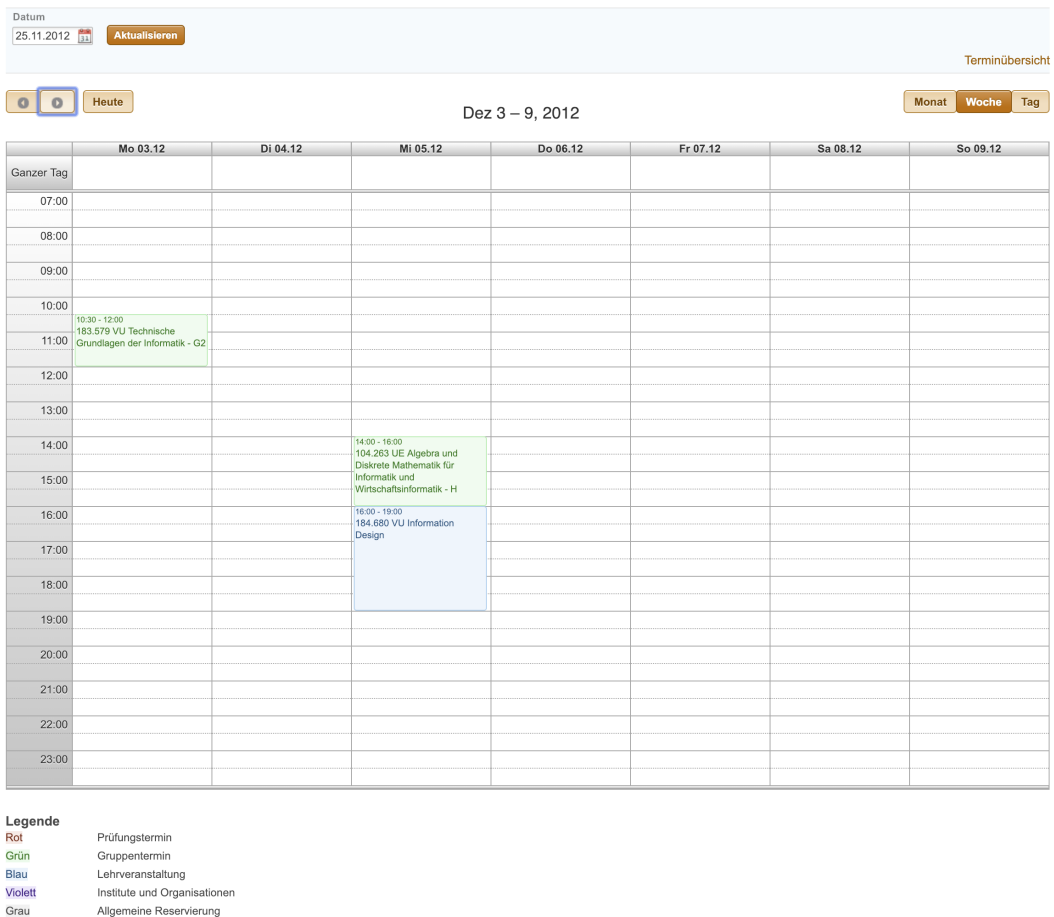
Fig. 4.7: The calendar view in TISS
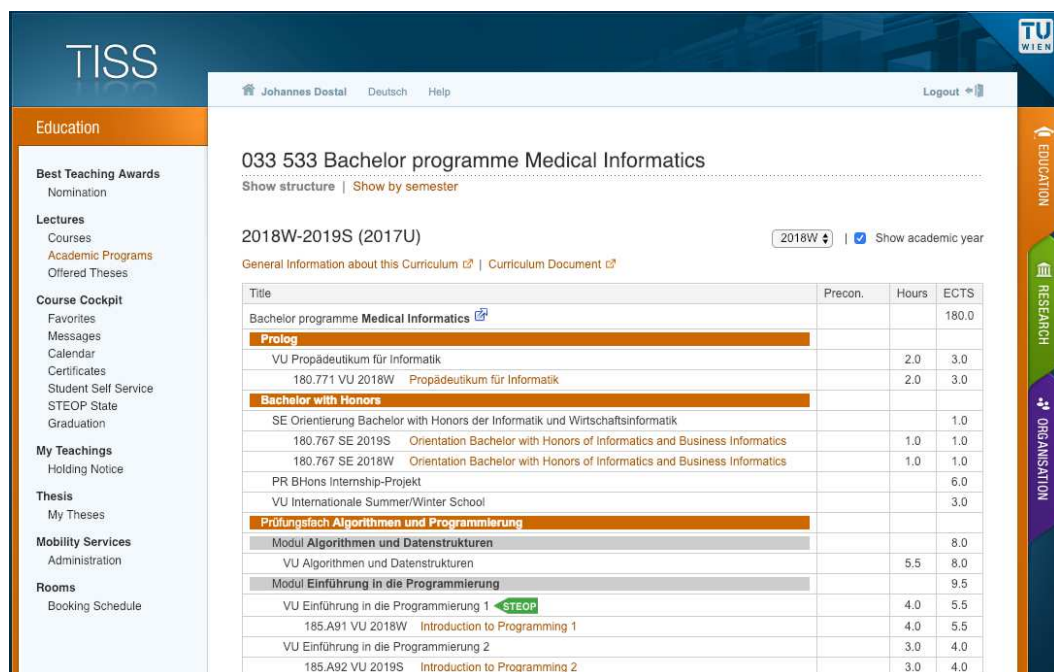
Fig. 4.8: Course listing for a Curriculum [68]

4.1.2 Campus Information System (FH Complete)

The Campus Information System by FH Complete is an Open Source Project initiated in 2004 by the FH Technikum Wien[71]. It is tailored to satisfy the legal requirements for Colleges in Austria. We have got access to the platform with the account of a student at FH St. Pölten[72], which is using FH Complete. He showed us all functionalities of the software he was aware of, and we captured a video of it for later analysis.

It is important to mention that the System was developed precisely for the needs of Colleges, so some functionalities used at Universities are not necessary or are less critical.

The first impression we got is that the Systems appearance is very outdated. In particular, it reminded us of the interface of Windows 95. While we did not see it ourselves, the student ensured us that it had a useful mobile view as well.

Fig. 4.9: FH Complete offers a Timetable instead of a Calendar

While SISs at Universities offer a calendar for dates, FH Complete has a Timetable instead 4.9. It displays all dates for a study program in the timetable but suffers the same problem we discovered at most Universities: The displayed dates are not reliable. Students have to know which dates are relevant for them and which are not. The dates displayed include room reservations, which have been posted to the appropriate study group but are not relevant for (all) students. This leads to situations where the whole timetable is occupied while there is no relevant date. However, what we liked is the way information to dates is displayed when moving the mouse over a date4.10.

FH Complete has an area where students can find and download their documents.
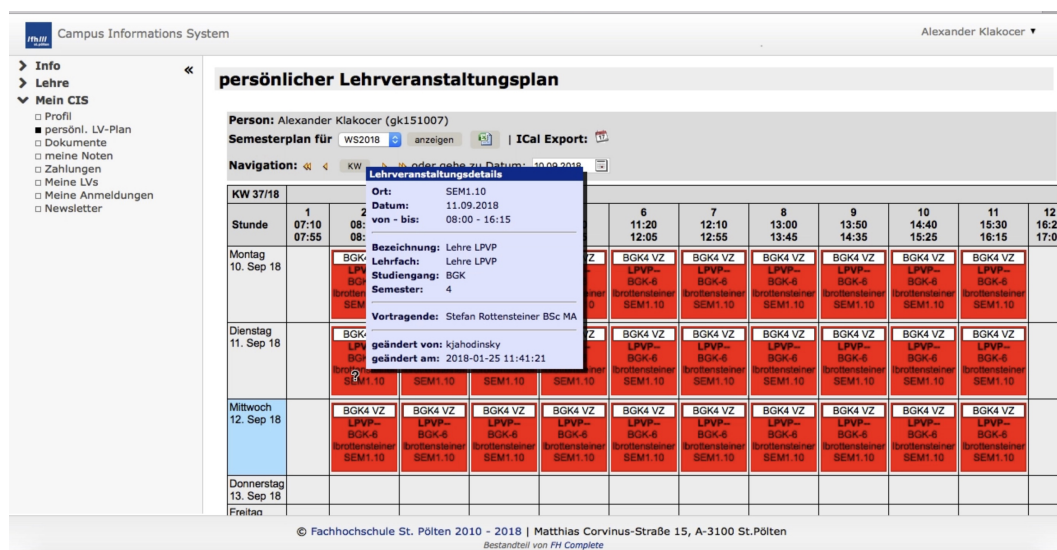
Fig. 4.10: The timetable provides students with relevant information of dates, but often is occupied with not relevant room reservations.

Some of them are already provided like in U:space 4.12 while others have to be generated before students can download them, like in TISS 4.5 but without the unnecessary accumulation that happens in TISS.

The view for grades is ordered by semesters with the issue that only one semester can be displayed at a time. This is somewhat annoying, especially because it reloads every time after selecting another semester. While students can see their grades in this view, they cannot download certificates on it and instead have to go to the "Documents" area. We spotted this issue in most other Systems as well, like in TISS or U:space. A detail we found on this page was that ECTS did not weight the average grade, so it is not meaningful.

In the section "My Courses" all courses of the current semester are listed. Since students at the college cannot choose their courses, they are enrolled automatically. Students can expand the view of a Course to see details like dates, places and lecturers. The view suffers from the same problem of only showing one semester, which can be switched but needs a reload. This leads us to "Registrations" which allows students to register for optional courses, degrees, parking tickets and others. The problem is that only the registrations for one of these topics are shown and students have to switch between the topics, which requires a reload of the page every time.

Furthermore, functionalities like newsletters are offered, where students can choose which newsletters they want to receive. However, the news is not shown in the System but sent by mail instead.

Suggestion for improvement

The most significant improvements we would suggest are to display all the information available on different tabs instead of switching between semesters or topics. This gives students a better overview of their field and does not require reloads. Furthermore, it would be essential to find a way to only display relevant dates in the timetable and to modernise the overall appearance. A good approach would be to take a freely available website framework and use it for FH Complete like OSIRIS does it with material design.

4.1.3 U:Space (University of Vienna)

U:Space [73] is the SIS of the University of Vienna. It is a relatively new system, that was introduced about four years ago. It replaced the previous software step by step in an agile process, where old parts of the software are still visible for non-essential functionalities. The development is done in cooperation between the University IT and Catalysts [74]. We got access to the system from a student at the University of Vienna who showed us the whole system and provided us with his login data so that we could test the software ourselves in all its details. Furthermore, we recorded his presentation to preserve all relevant details for later analysis.

In the beginning, we went through the registration process for a course. For that, an additional system called *U:Find* is used, where students can find all available courses structured by Study program and field of study. Since many programs are available, finding the desired course can be complicated. When students find the desired course they have to register in U:Find with a link that leads to U:Space. In U:Space they get a confirmation for the registration or an error report when something went wrong. Unfortunately, this was the case in our first attempt since the course was not open for registration. The confusing part in this is that students have to get redirected into another system to see that the course is not open for registration. It would be much more comfortable and less frustrating if students see that information directly in U:Find.

The *Study overview* in U:Space shows students what study programme(s) they have enrolled in, what the status of their study[1] is, how many semesters they have spent on a study and how many semesters it should have taken. There is a direct link to the Curricula, which is very helpful since at other universities, students often have to search for it in external pages.

In U:Space there is the so-called *Registration Overview* (Figure 5.10) where students

---

[1]   The possible states of a study are: active, successfully completed and closed

Fig. 4.11: About u:space introduces students to u:space

Fig. 4.12: My Documents page in u:space, where students can download all documents available.

can see what courses they are currently subscribed to and what they did in the past, ordered by semester. While we liked the order of courses, the green checkmarks at the left are somewhat confusing, since they signal that a student that is registered for a course completed it, but not necessarily passed it. A grey X means that the student unsubscribed from the course and a red warning means they were not able to register due to no space being available. The listing can be filtered by registered or unregistered courses. The student who introduced us to the system mentioned that

he never used this page before, so it is questionable if the functionality is needed at all.

The *Record of examinations* (Figure 5.14) gives students a good summary of what they have already archived and what courses are missing to complete their studies. We liked the idea of the traffic light indicator, that visualises if a study module is started, in progress or completed. Additionally, it displays how many credits have been amassed compared to the necessary amount, but a general counter of amassed and missing credits is not available, so students have to calculate themselves how many credits they have amassed. When looking at the details of a module (With the extension arrow), students can see what courses are done for this module, and sometimes missing courses for the module are shown as well. We think this depends on the module and whether or not it is possible for the system to tell what is missing or there are too many possibilities to fill a module. If the information is not available in the system, it has to be searched for at external pages. The requirement "siehe curriculum" (see curriculum) is not helpful in our opinion and should be specified better. In the English version of U:Space no requirements are mentioned at all.

My Documents offers a download section where students can find all documents they need for official proof. They are sorted by general documents and semester specific ones. When students need a document from the desired semester, they have to select the semester first, before the documents for this semester are available. We think the page is well structured and easy to operate, but some icons or graphical elements instead of text only could brush it up.

U:Space also offers a tutorial page, where video tutorials introduce the system to fresh students. Links to the e-learning platform Moodle and the webmail client are placed prominently in the top right corner beside a language chooser that allows German and English. Some more pages do not offer real functionalities and instead provide information about extension curricula, recognitions or studying abroad.

What we missed in U:Space was a notification functionality. Lecturers cannot send students updates about courses in the system. They either use Moodle or a Mailing list. The only notifications sent by the system happens when a student successfully registered for a course. Also, there is no room information available, and new students are dependent on other services. These formations are not provided by every institute, so only some room data can be found online. The same goes for room reservations; the separate institutes handle those. For example, the Institute for Geography uses an Owncloud calendar. The calendar leads us to another issue: there is not any for students in U:space, so they have to write the dates into their private calendar based on the course information. There is a calendar in Moodle, the lecturers do not use that, so students only see deadlines for hand ins there.

We think the available functionalities of U:Space are well designed and easy to operate with only some minor issues. What we did, however, miss some essential

features like a direct registration for courses inside the system, a calendar that displays all dates of a student and information about rooms and room reservations in a centralised system. Since U:Space is still in development, there are good chances that some of the missing features are implemented over time.

4.1.4 LPIS (Vienna University of Economics and Business)

The *Lehrveranstaltungs- und Prüfungsinformationssystem* (LPIS) [75] of the Vienna University of Economics and Business is a self-developed and maintained SIS. It is implemented with Python and Perl by a team of nine people.

It offers the functionalities to register and unregister for courses and exams and a feature where students can exchange their course group with one another. Other functionalities like certificates, ID and graduation, are in the separated *Student services* system, E-learning functionalities are in *Learn*, the self-implemented alternative to Moodle and Brightspace. The *campus plan* (Figure 4.13) offers an excellent orientation at the campus, and is probably the best-designed system offered by the Vienna University of Economics and Business.

Since the Vienna University of Economics and Business offers only four different study programs, it is simple to represent them separately in the system. As such, there is no search functionality for courses by name. The courses are already assigned to different degree programs or can be searched using the course number.

The registration functionality is limited to two time-slots during only a few days a year. Earlier there was only one time-slot, but the servers were overloaded with the rush, so a second time-slot was necessary. This leads to another problem; students want to register for several courses but can not since only limited places are available and the registration for all courses are at the same time. Sometimes students can only register for course dates they do not want while the desired course times are not available anymore. For this issue, another functionality is offered where students can exchange their course registrations with another 4.14. In our opinion, this feature forces students to register for any date they can, to exchange them later for course dates they want. While this is better than nothing, the real issue of missing resources cannot be addressed with this functionality.

While most SISs we examined have no central certificate page, the infrastructure at the Vienna University of Economics and Business makes no exception. However, when selecting the grade from a course, students get redirected to the certificate page with the selected course highlighted. This helps students find the desired grade faster and improves the usability in this area. The certificates can be downloaded at the Student services area or printed at terminals in the university building. The terminals also allow students to update their ID card and take profile pictures for it.
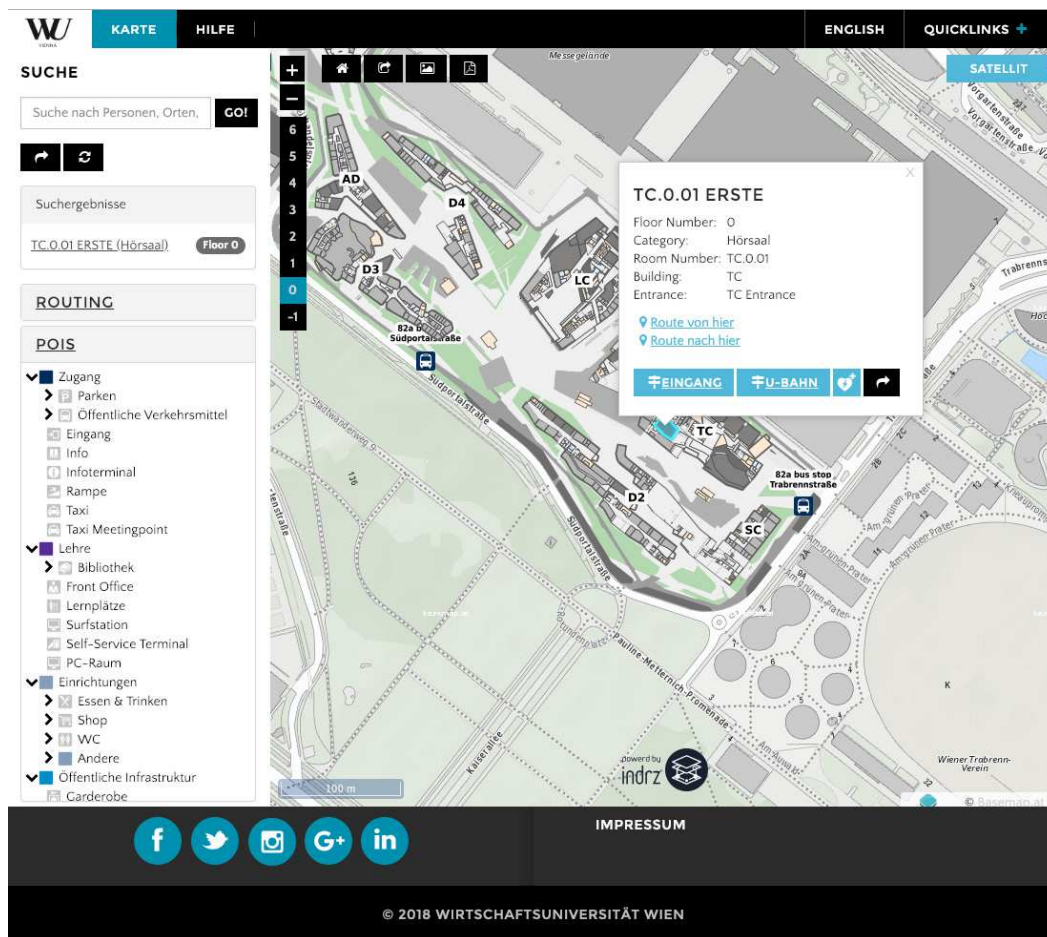
Fig. 4.13: The WU Campus Plan provides navigation information to every part of the university. [69]

While LPIS is responsible for the registration for courses, information about them cannot be found in the system. Students have to look up the course in *Learn*. Also, a calendar functionality is only found in Learn and not directly available in LPIS. For important administrative events, students get notified by mail. There is no notification system available in the IT infrastructure of the Vienna University of Economics and Business.

When students want to go abroad, there is an additional tool where students can apply for a semester abroad.

Earlier, there was a mobile app for LPIS as well, but it was discontinued due to a lack of resources for maintenance.

In general, the Vienna University of Economics and Business offers most administrative functionalities, not in one but many different systems. This not only makes it unintuitive for new students in finding the desired functionality but also stays complicated for more experienced students. We would recommend unifying some of the systems into a completely new one with better structure and design. The graphical interface of the current system would need some improvements toward

Fig. 4.14: the course exchange in LPIS

better appearance and usability. We will discuss this in the comparative workshop in detail 5.

4.1.5 OSIRIS (CACI)

OSIRIS is the SIS developed by the Dutch company *CACI* and used by several Dutch and international Universities [9]. We reached out to the company and asked for a test account. They gave us access to their demo-system and answered our questions regarding the system.

Since we had access to the system for a limited time only[2], we recorded all functionalities and took screenshots of every page for later analysis. OSIRIS is the only system we tested that was designed with a mobile-first approach. Fitting this approach, the design is based on the Google Material Design [41]. This choice also helped CACI in developing a system with a well known and accepted design that is uniform all across the application. A drawback coming with it are some limitations of the Material design, which we will have a look at later. CACI also offers native Apps for iOS and Android, which extend the web-functionality through a digital student ID and real-time navigation to buildings of the University. The only other SIS with a mobile App we looked at was SAP 4.1.6. We had no direct access to it, so we settled

---

2   CACI was even as kind and offered us a longer access period when necessary, which we did not claim

for an interview. At the Vienna University of Economics and Business, we were told they once had a mobile app but discontinued it because of missing resources.
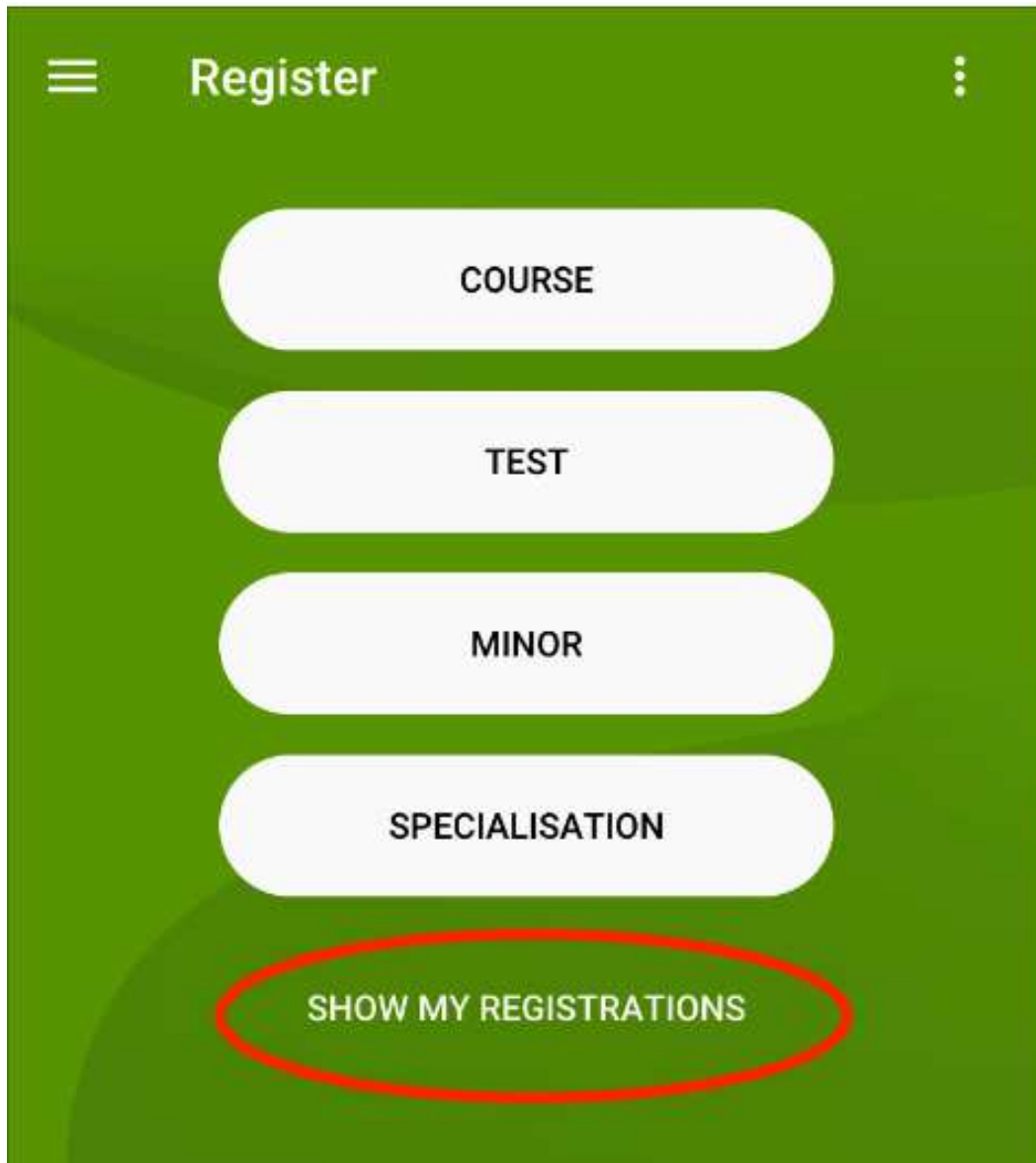

Fig. 4.15: The register page offers different types of registration and a decent link to active registrations. [9]

In summary, OSIRIS is a powerful system. However, besides many positive features, there are also a couple of opportunities for improvement. The first issue we spotted was the way available courses are listed, or to be more precise, how to find this listing. While most other systems we looked at offer an own course listing section like the one in TISS 4.8, OSIRIS requires searching for them under the menu "register" and then choosing "courses". There is no way just to look at them without using the option "register". While students can get used to it, it can be confusing to new students and students from other Institutions. Even more confusing was how to find the overview of courses we were subscribed to. This also hides behind "register" and

an inconspicuous link named "show my registrations" which can easily be overlooked 4.15. We assume the different design for this link comes from the fact that students cannot register here despite this being the purpose of the site, which leads us to the suspicion that "register" is the wrong place for this link.
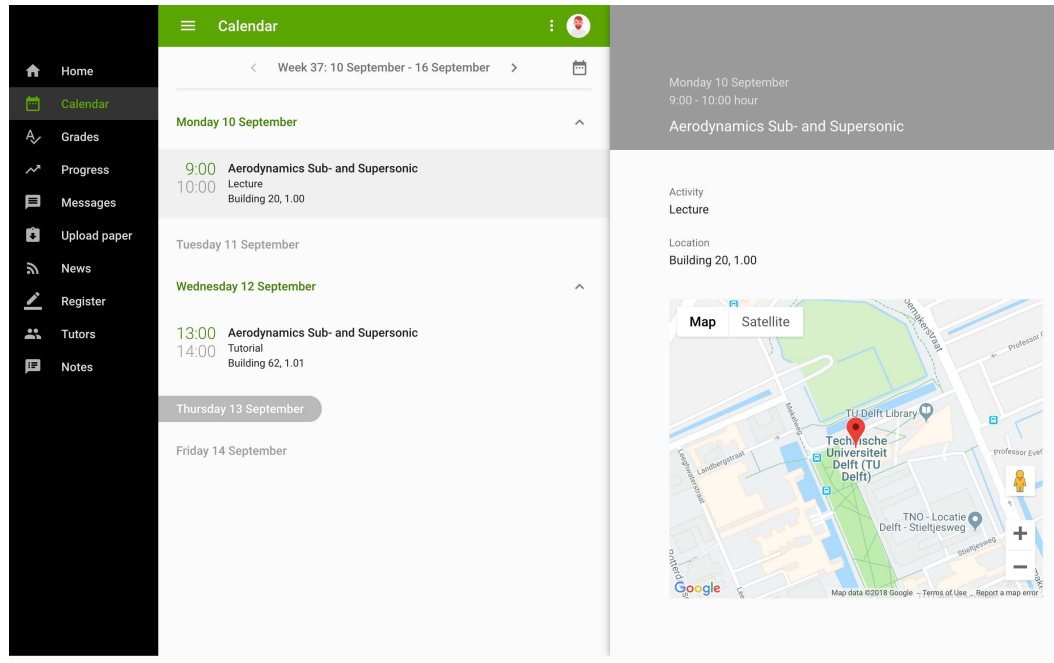

Fig. 4.16: The calendar in OSIRIS includes detailed information about the date, including where a course takes place and how to get there. [9]

The detail page for courses is compact and contains only relevant information which is very positive since other systems are often overloaded with information, that can be considered irrelevant for students. This information contains what students have to archive to get a positive grade, lectures and exams offered as well as when the course takes palace. The only information we missed were the exact dates of the course, which can only be found in the personal calendar after subscribing to the course 4.16. This brings us to another aspect we consider as very well designed; the calendar. Most competitors offer outdated versions of calendars with the typical week view as we know it from times of paper calendars. One example for this is the calendar offered by the ETH Zurich 4.23. The version used by CACI is based on a canvas, displaying upcoming dates. For each of these dates, students are provided with details when selecting them. The detail we liked the most was the integration of a map. When we are informed correctly, this map allows real-time navigation in the app versions of the software. While we like this approach, we think it is not perfect. Indoor navigation to the desired room is not available like in TU Wien GUT 4.4 or the Campus Plan of the Vienna University of Economics and Business 4.13.

The progress view in OSIRIS provides a good overview of courses already passed, courses that were not passed and courses that are mandatory for the subscribed
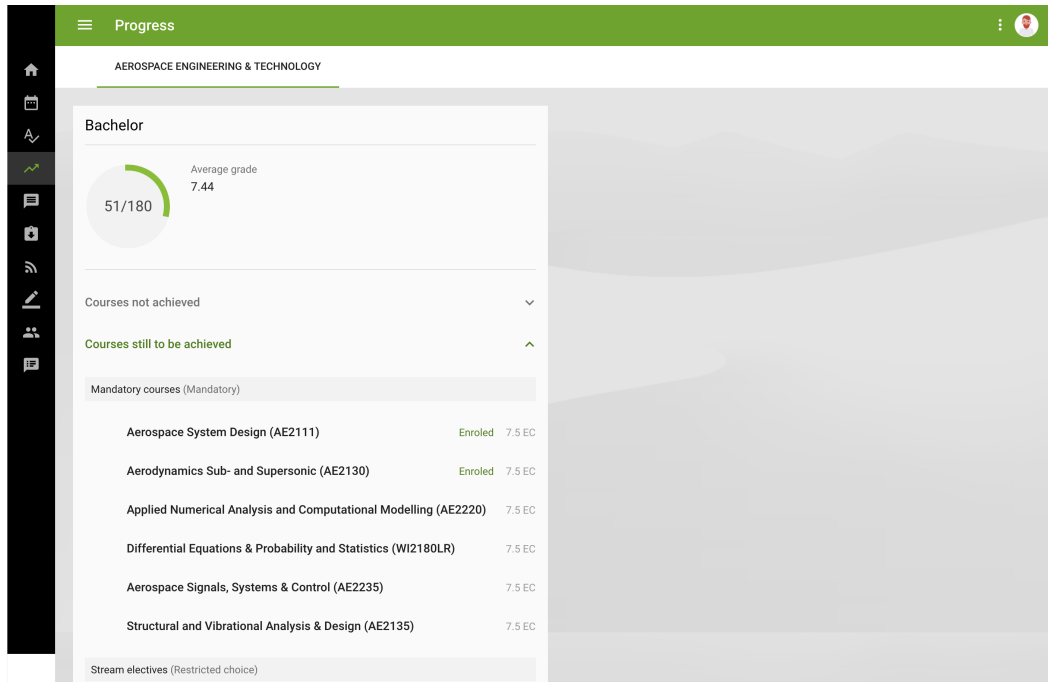
Fig. 4.17: The Progress view in OSIRIS visualizes the overall process of the student in a very simple but effective way [9]

curriculum. What we especially liked was the simple visualisation of the overall study progress with a circular chart and an even more simple XX/180 ECTS. While some Universities provide a similar view, most of them forget to add this indicator 4.17.

While the chosen organisation helps students to have an overview of their progress, it lacks customizability; it is not possible to order the courses in custom categories or delete them. While this is not necessary, some students may prefer to make their own structure. We think a customizable view with useful standard presets (like the one already used) could be an improvement.

Another issue we had with the study progress was that it does not include grades of the courses already achieved. They are found in a separate tab called "Grades". In our opinion, these two topics belong together, and the system should reflect this connection. However, "Grades" provides a nice feature, we have not seen in other systems: It monitors the grade of a student compared to the other students. This allows students to get a better feeling on how well they did 4.18.

As mentioned before, through the usage of Material Design, OSIRIS faces some limitations. The most notable issue is the navigation. Some parts of the software have more than two layers of hierarchy. When entering the third layer in the hierarchy (the detail view) you have to leave it in order to see the main menu and to navigate to the desired page. In our opinion, the main menu should always be available to help the student stay in control.

Speaking of the menu, this leads us to another detail that is limited through the
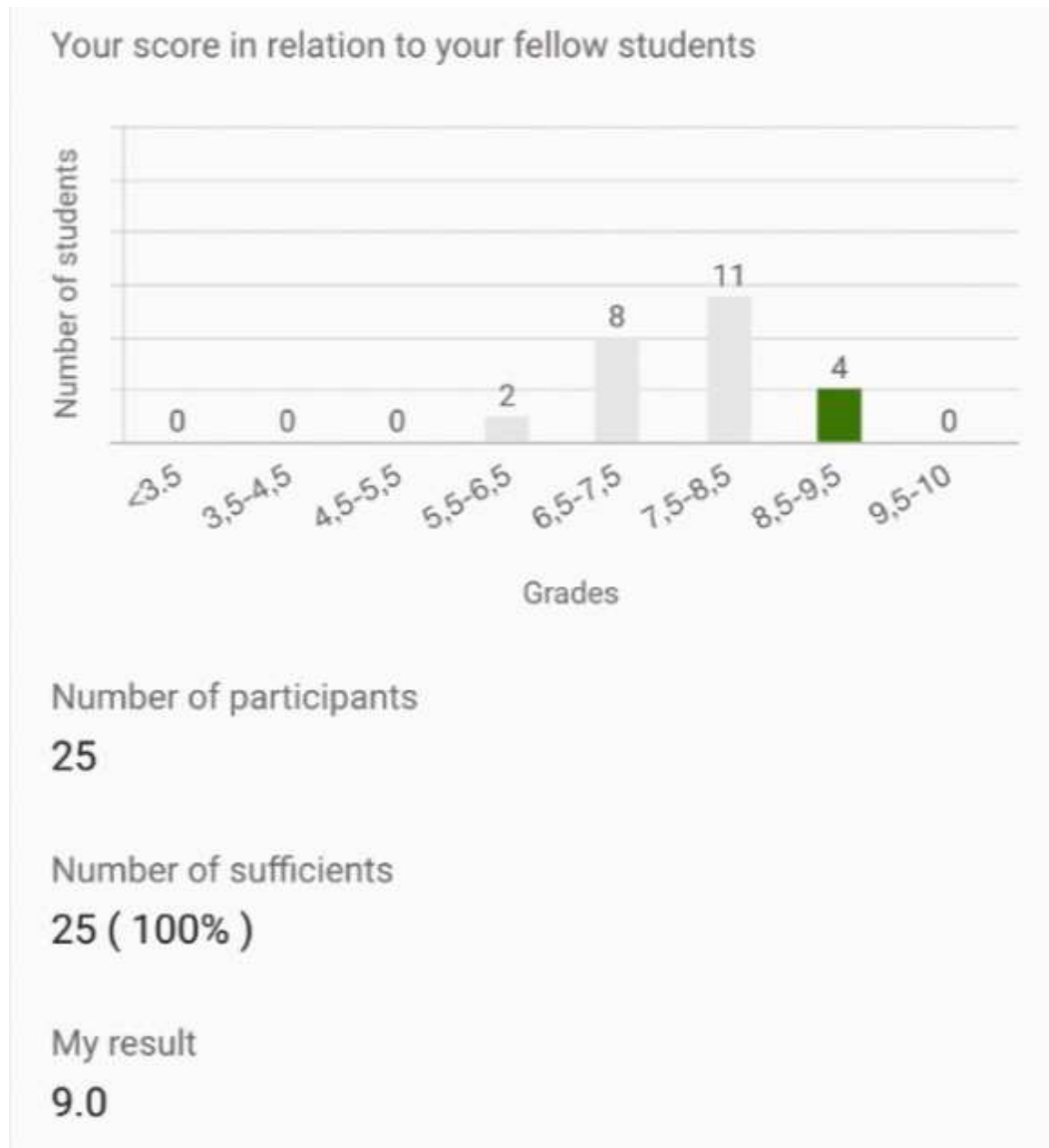
Fig. 4.18: OSIRIS allows students to compare their grade to the rest. [9]

Material Design: The used Iconography in the menu does not always reflect the topic it stands for. While the text in the extended menu as seen in Figure 4.16 relativises this issue, the text is not always visible as shown in Figure 4.17. The "Upload paper" section has an Icon with an arrow that points down instead of up and the Icon for "Grades" is from a spell checker and therefore misused for grades. While the Material Design Icons are limited, we would suggest using the Icon *assignment turned in* as seen in our concept in section 6.

OSIRIS also lacks some functionalities, we know from other systems. Administration of studies like paying tuition fees or printing confirmations of study is not available. Also, there is no way to apply for graduation.

After sending the first draft of this thesis to CACI, we were told that it is possible to do the administration of tuition fees and printing confirmations. Only applying for

graduation is not possible in OSIRIS, since the universities using it have no demand for it.

4.1.6 Student Life-cycle Management System (SAP)

The Student Life-cycle Management System (SLCM) from SAP [76] is the most comprehensive one we compared. It covers all administrative departments for students including enrolment, administration and exmatriculation. Furthermore, it can pass the student data after the exmatriculation to an alumni program realised in a CRM from SAP. SLCM is used worldwide by 108 universities, 46 of which are based in Europe.

The system is built up out of several modules. These SAP Apps and the Launchpad based on Fiori [77] won the Red Dot award for Design Concept in 2015 [78].

The design concept was developed with students at the Technical University of Munich in a lecture where a Design Thinking process was applied. While there is a standard layout, every university can apply their corporate design on the given templates.

The System was presented to us by Joachim Wille of SAP in a video conference. We were allowed to record the conference for later analysis.

Fig. 4.19: A form used in the application process

We were shown the application dialogue for a study program 4.19. It consists of different forms depending on the data the university needs and what the applicant

already entered. These forms allow saving intermediate levels during the input, but it has to be triggered manually instead of being automatic caching.
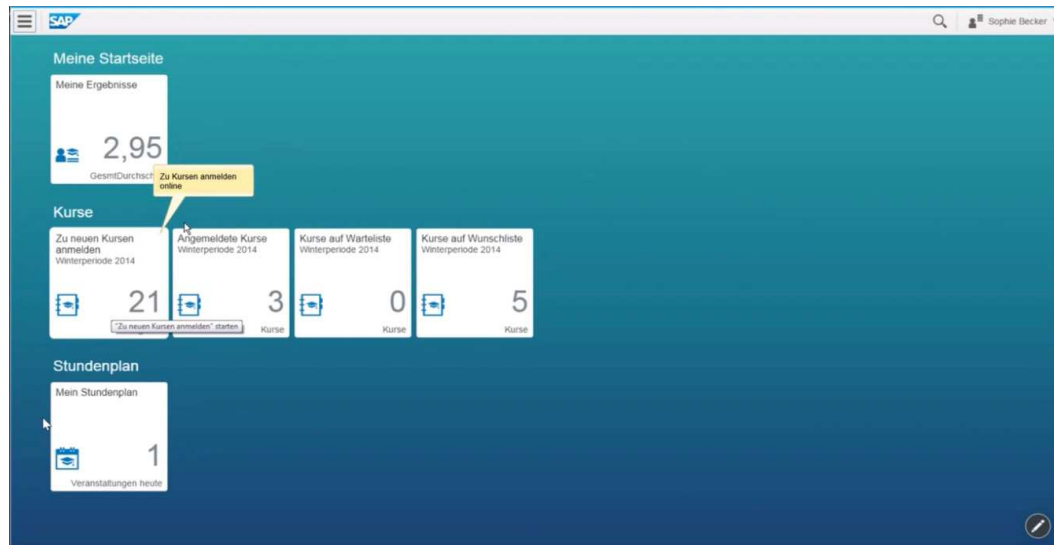
Fig. 4.20: SLCM offers a launchpad, where students get an overview of their study and they can navigate to the functionalities of SLCM.

The Launchpad 4.20 or landing page of SLCM consists of several tiles. Each tile represents an SAP App (functionality) that can be opened. These Apps are delivered in a standard version but can be customised to the customer needs. Therefore, SAP provides its customers with detailed documentation and a tailored development environment. The tiles themselves show the most relevant information of the app in the form of a title and a number that represents a significant value for this app, such as how many courses a student is subscribed to. However, the design can be limiting since it can only show one number and no other information that could be more relevant. For instance, the Calendar app shows the number of dates to date instead of a quick preview of upcoming dates, which would be more relevant for students. Furthermore, on the number of the tile is emphasised despite the title being relatively small and hard to read. This can be a problem for new students, who are not familiar with the system. Students who used the system for a while will know the ordering of the tiles and the title being less important. Still, a consideration could be putting the title in a bolder font and using shorter wording instead.
What we liked about the launchpad in particular, was the ability to customise it for students. Everyone can arrange the tiles the way it is most useful for them.

For registration to courses, there is a view in which details of the course are displayed 4.21. These details include "information", "description" and "contacts", which are separated in their own tabs. For us, there is no reason to do so, since the information available is not too much to be represented on one page while being visible to students at a glance. Instead, students have to switch between the tabs to find all the information they are looking for. Based on this view, we were told that SAP always
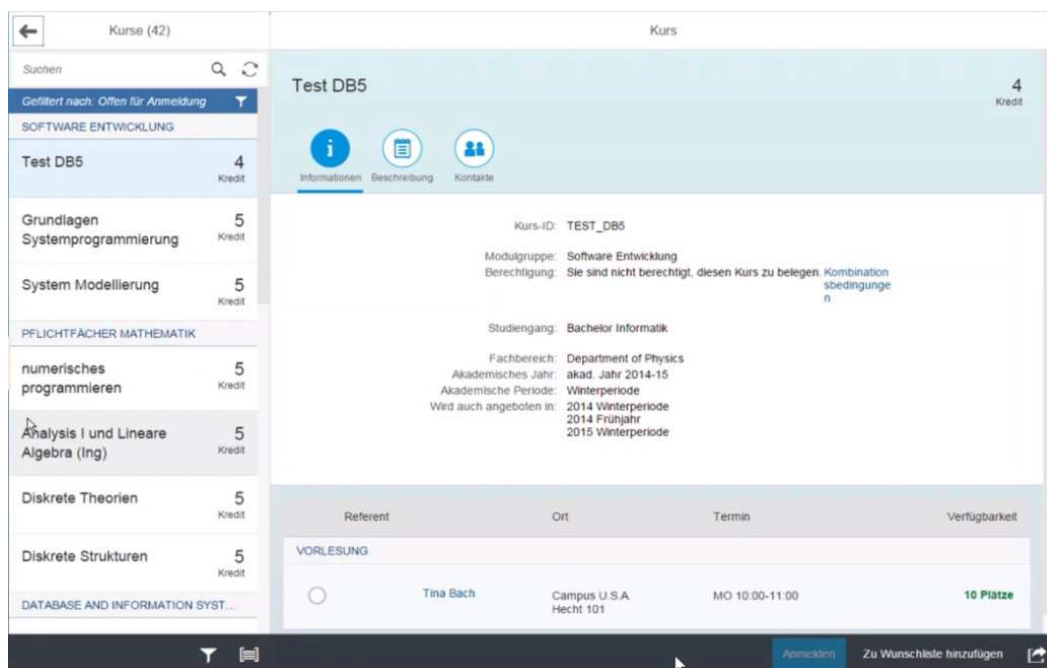
Fig. 4.21: Students can sign up for courses in the registration area.

uses the same layout for such lists. On the left side are the elements of the list and on the right side, details are displayed to an item when selected. The buttons are always in the same position to make navigation easier. While we consider a uniform design as standard, it is good to know these principles were taken into account during development.

For displaying the study progress, the standard solution offers a "My Results" page where students see what they have achieved in the last year and what needs to be done. More details to a course and the grade can be found in the detail page. Unfortunately, it seems like the course title is not shown in this view, only a course number. We were told that a better solution is also available in a dedicated SAP-App on which students can see the whole study progress including all lectures they have done so far and a progress indicator of the ECTS achieved.

SAP supports different types of notifications. It is possible to send messages via mail, SMS message and push notifications to an App.

Overall, SLCM is probably the most diverse SIS we looked at, but we could not see all of its futures since we had no direct access to the platform. What we liked in particular, was the idea of the dashboard, since something similar is missing in most other systems we saw. However, the design of it could be improved when focusing on the essential content of an App instead of only one number. We think some visualisations could help in doing so.

4.1.7 MyStudies (ETH Zurich)

MyStudies is the self-developed SIS of the ETH Zurich. Due to privacy concerns we got no access to it. However, the team of the ETH was kind enough to send us some screenshots and detailed descriptions. This gave us a rough overview of the appearance and functionality of MyStudies but did not allow us to test the system ourselves.

MyStudies offers pretty much the same functionalities as U:Space 4.1.3 where

Fig. 4.22: The registration for courses suggests courses by visited courses and grades

courses are listed in a separate lecture directory while the registered courses and the study progress are shown inside MyStudies. When students perceive a grade, the system sends the students an email to notify them that they were graded. The grade is only visible inside the system as we understood it.

What we liked particularly was a good overview of the study progress (Figure 5.11) and automatic course suggestions based on visited courses, grades and the enrolled study program. On the downside, we see the aged design language, that appears very static and could use a modern touch as well as responsiveness.

4.1.8 Other Systems

We wanted to cover some more popular SISs and got in touch with the responsible people. Unfortunately, they gave us no access due to privacy concerns. The most widespread among them are *Campusonline* developed by the TU Graz and used by about 40 institutions. The team answered our request for evaluating their software
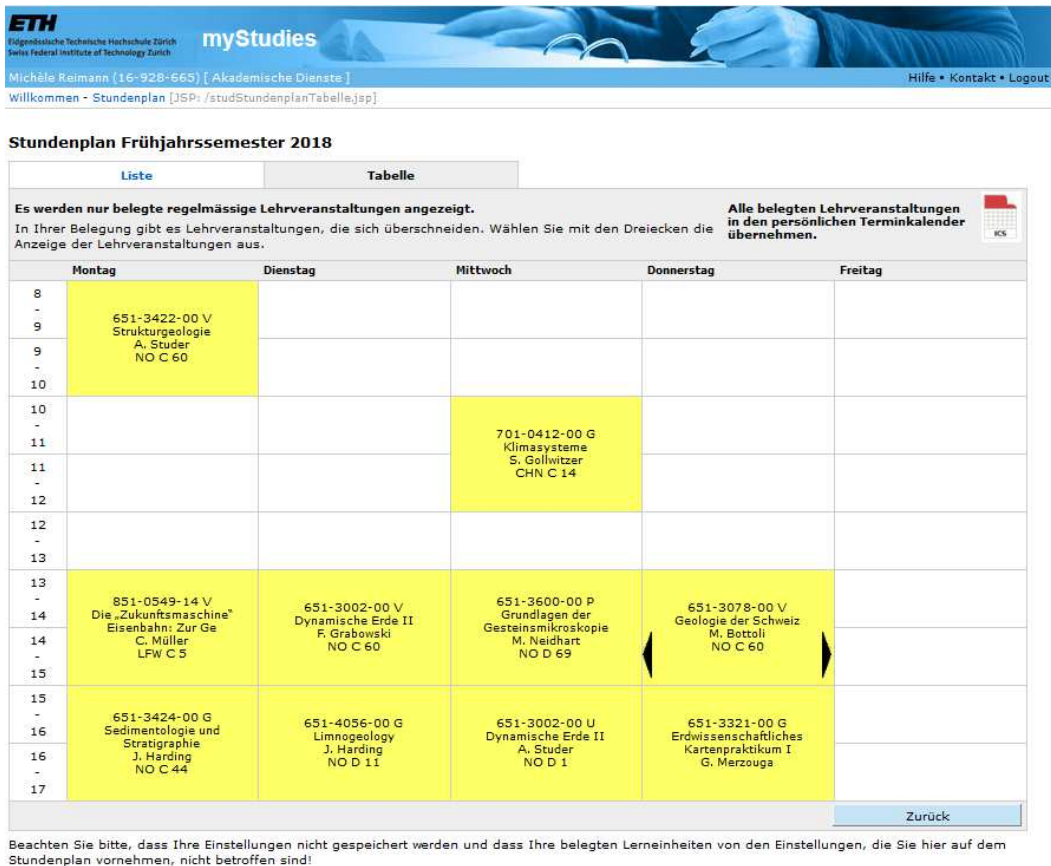
Fig. 4.23: The calendar in the SIS of the ETH Zürich appears in the typical week view

themselves and built a new version based on the evaluation, meaning they are not interested in external evaluation. Still, the only University already using the new version is the RWTH-Aachen where we got no access either.

Datenlotsen [79] is a SIS used by about seventy organisations. While the company was not able to give us access to the system, they offered us to demonstrate it in a video conference. Unfortunately, that video conference never took place. We did, however, have a look at their website and liked the screenshots we saw there. Especially the dashboard looks impressive and reminded us of the dashboard from SAP.

The *Hochschul-Informations-System* (HIS) is developed by the similarly named cooperative owned by universities that use the system. Unfortunately, only members of the cooperative have access to the system, and we were not allowed to evaluate it.

We identified the strengths and weaknesses of the different systems we had access to. This will help us in deciding how to design the SIS Dashboard later. Now, we want to compare their features with the ones of the other systems, so that we know how to implement such functionality the best way.
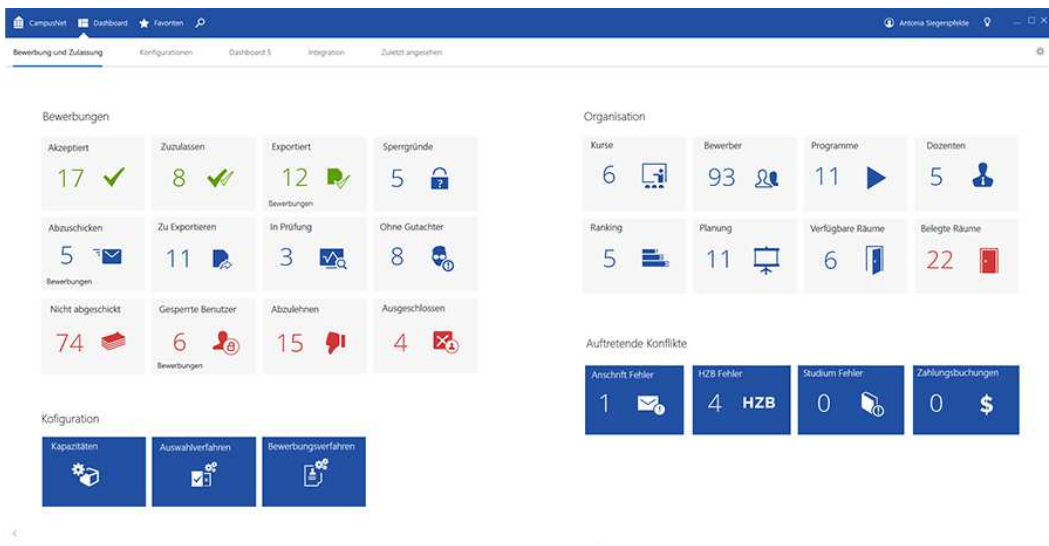
Fig. 4.24: The Datenlotsen Dashboard appears tidy and modern

Comparative Workshop

> *Almost all quality improvement comes via simplification of design, manufacturing... layout, processes, and procedures.*
>
> — **Tom Peters**
> (American writer)

We organised a comparative Workshop to evaluate the different design solutions of the SISs we introduced. We invited experts in the area of User Experience. The workshop took place over three hours with Kristina Heidinger and Johannes Dostal leading it. The Participants were Moritz Resl [80], Tom Haberfellner [81], Georg Kaindl [82] and Peter Purgathofer [83], who are all experienced in the area of User Experience.

The workshop was organised based on the UX Workshop guidelines of the Nielsen Norman Group [84]. Our goal was to evaluate the best design solution for the given tasks is. Our question was; what are the best existing solutions and how can they be improved even further. The process was defined by introducing the experts to a task and the available solutions followed up by a discussion of the main issues and ways to eliminate them.

After we introduced our guests and discussed the most important features with them, we wanted them to define the most important information that should be placed on a dashboard and how this information should be represented.

The whole workshop was audio recorded, and we took notes during it for better memorisation. Now we want to discuss the critique by the experts and suggestions for improvements one by one.

5.1 Documents

We started with the section "Documents" where we only compared the Systems TISS 4.1.1, FH Complete 4.1.2 and U:Space 4.1.3. The other systems either had no similar functionality or we had no access to it.

Fig. 5.1: The participants of the workshop, discussing the different SISs.

The first comments we received were that TISS looks very mighty while U:Space is a bit bare and FH Complete gives off the impression of Windows 95 software instead of a web-interface. After the participants had a first impression, we discussed the solutions one after another.

5.1.1 TISS

Fig. 5.2: The Student Self Service area in TISS offers a lot of functionality, but lacks simplicity.

TISS offers a lot of functionality, which is why its look was described as "mighty". It allows creating documents of the desired type for a selected time. After creating a document, it appears in the list "Generated confirmations" below the creation dialogue. This list can be ordered by document type and creation date. The confirmation list accumulates all documents ever created, so that can get unwieldy over time. A list entry contains information about Type, Study, Date, Language (German or English), Creation date, Validation, Validation view count and a download link. We discussed if all of this information was really necessary and came to the conclusion that a lot of it can be removed to make understanding easier.

The points *Validation* and *Validation view count* confused our participants since it was not clear what they do. We had to explain to them several times that the checkbox below validation allows validating a Document and Validation view count counts the validations for a document. To validate a document means to scan a bar-code on the document, that can be decrypted into a link. This link leads to a page on TISS which confirms the authenticity of the document. After creating a document, validation is disabled by default, which made no sense to us. To activate validation students have to check the box and click the button "Apply settings". This button confused our participants for two reasons: For one, it was not entirely clear what it does, because they considered it to apply newly created documents (which is achieved with another button). Secondly, it has a brighter orange than the other buttons that appear greyed out as if being a button that is not usable.

After a lot of confusion about this functionality, our participants liked the idea of verifying the documents. However, we want to point out that they are experts and were not able to understand the functionality without several explanations. This is why we think that the functionality is too complicated and not really necessary. A better way would be to offer a verification by default but not display it in the documents list. One of our participants would like to see the verification count anyhow, just because he liked the idea. In interviews we conducted with students, it turned out that none of them were aware of this functionality or ever used it. This underpins the argumentation of cancelling the functionality or making it invisible for students. None of the other SIS we looked at had a similar feature visible, so we do not know if they offer a validation mechanism not visible in the system.

It should be taken into account that our participants mentioned that such verification is not very secure since one could create a link that leads to a falsified verification page.

Other details in the list like the creation date were considered as relevant by the experts as well. The chosen approach leads to a visual restlessness because of several colours and icons used in the list. Also, the participants were not quite sure if the orange "Type" and "Creation date" above the list are coloured because these two criteria order the list or if it can be ordered by them. In actuality the latter is true and ordering by other criteria is not possible. We think this is not an issue but rather something that sticks out as a result of looking at a screenshot. Since the

list accumulates all documents created, the question on why it was not possible to filter the list came up. One last functionality not offered that would be useful (and actually is offered by u:space) is downloading documents for a specific study program only.

In general, the concept of creating documents before downloading them is not well suited for this and was confusing for students and experts as well. The other systems offer a more natural approach where students can download what they want with simple selection tools. In TISS, a lot of technical decisions become visible in the interface instead of hiding them and only making necessary functionalities available.
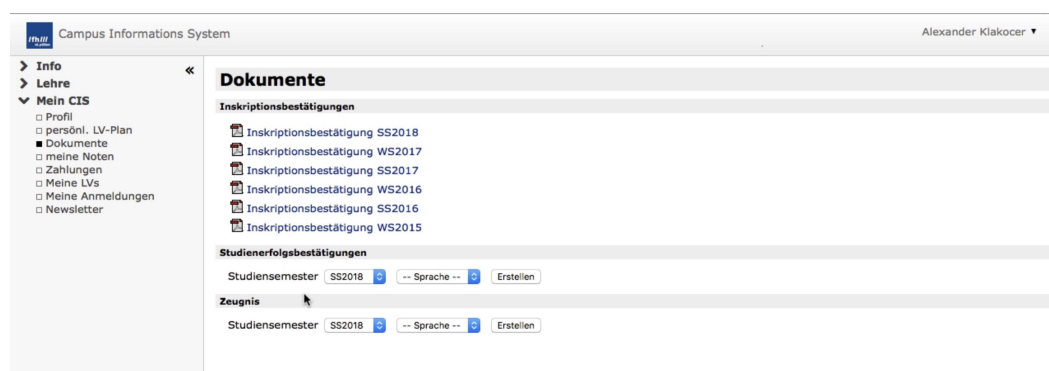
5.1.2 FH Complete

Fig. 5.3: The Documents section in FH Complete feels like software on a PC instead of a web service.

FH Complete appeared visually very unpleasant and reminded the participants of a Windows 95 application. Besides that, the organisation of the documents section was well perceived and easy to understand. There is a list of links for the "Inskriptions-bestätigungen" of each semester and "Erfolgsbestätigungen", and Certificates can be created for a selected semester. After the creation, the document is downloaded directly. FH Complete needs no complex list system like in TISS. The system is easy to understand and use, while still offering everything students need. The only feature not available or not visible is the validation mechanism we discussed in 5.1.1. There was only one issue we spotted: while "Inskriptionsbestätigungen" are listed for each semester, the other documents had to be created. The only settings available are semester and language. This is not consistent since "Inskriptionsbestätigungen" could be created the same way, which would lead to more consistent operability. In general, the structure of the system is so easy to understand that neither students we talked to, nor the experts we invited had problems understanding it. We think this is a superior approach and could be applied in TISS as well.

5.1.3 U:Space

U:Space (Figure 4.12) combines a modern visual layout with the simple information architecture of FH Complete. It is designed in such a simple way that it was considered as bare. The experts liked the fact that all documents are directly available, without having to be created first. The documents are ordered in two sections called "General documents" and "Semester-specific documents". While the first includes documents that accumulate information like "Transcript of records", the latter let students select a semester and then offers all documents available for the selected semester.

Because of the excellent structure, the available space of the page is not used well, and too much whitespace is visible. An idea to avoid this was to create icons for the documents instead of link lists. Well-chosen icon symbols for the documents could also help to differentiate the documents at a glance instead of having to read all the links.

In general U:Space is the most appealing solution since it offers the best structure with a modern layout. However, the bare link lists could be improved with more eye-catching icons that use the available space.

5.2 Course overview

In this section, students have an overview of what courses they are in. Depending on the system, the functionality can be extended by lectures they already passed or lectures they want to visit. Here, we compared all seven systems we had access to since this is one of the core functionalities of an SIS.

5.2.1 OSIRIS

The course overview in OSIRIS is placed on the page "Progress" 4.17 where students can see what courses they have achieved, which they have to achieve and what they do right now.

Our attendees found the visual design of OSIRIS the most appealing out of all systems. The first detail that got their attention was the progress indicator, which helps to get a feeling on how much of the curriculum is already absolved. They liked the idea as much as we did and would like to see a similar visualisation in every system. However, after a first positive impression, they found some issues with the system. They did not like that only half of the screen is used when not selecting a course to

see details, but they were also aware that this design decision could help to have a better overview of the navigation. Nevertheless, they would like to change this so that the whole screen is used at all times. They also agreed that they do not like the Burger Menu, which is used by OSIRIS in the mobile and desktop version as well. While on mobile it can be argued to be there to save space, there is no reason to have it on the desktop version. Our participants argued that they never know where the menu appears when clicking on the burger button, which is not entirely accurate in this case since the menu is always visible and only extends when the button is clicked. Nevertheless, there are pros and cons when using this kind of menu style, which we discussed in chapter 3.1.2.

Another issue they noticed is that it is not possible to distinguish which courses are visited by a student right now and which are not. The only way to do so is to click the courses one by one. A better approach would be to colour the courses according to the status or add icons to indicate it.

The participants mentioned that they were missing a proper information hierarchy and better use of typography in order to support structures and to make the orientation on the page more accessible.

They did not like that only one colour (green) is used instead of using colour codes for a better indication of connections. For example, the only two green coloured elements on the page 4.17 have no connection. So either they should have different colours or green should be used more, so it is clear that it is an accent colour.

In summary, OSIRIS has an excellent appearance at first glance, which makes students feel comfortable with the software and therefore improves usability [11], but on a closer look, there are some issues with hierarchy, typography and colour coding that should be addressed.

5.2.2 LPIS

The first impression of LPIS the experts had was that it does not look good. They ranked it the least good looking system. The first column in the table contains a number, an acronym and the semester description. Since all of them are uncomfortable to read one of our participants described it as "such bullshit, no one wants to read this". The same goes for the second column with an acronym and a number. The relevant content is placed in the third column, but the attendees mentioned that it seemed like the lecturer is the most essential information, since they are set in bold and on the first line while the course title is below in regular font.

Other issues we noticed were that the order is by registration date and can not be changed and that only registered courses are displayed while other systems manage wishlists and unregistered courses. To make matters worse there is a button labelled "ABmelden" (unregister), which we think this is there because it is beside the button

Fig. 5.4: LPIS is uncomfortable to read

"Anmeldung" (register) which has a similar appearance as the buttons could get confused. Instead of thinking of a better layout that helps to distinguish between the buttons, they decided to put a capital letter in the word. We think the layout has some significant weaknesses and needs a rework from the ground up for better usability.

5.2.3 myStudies

One participant described myStudies of the ETH Zurich as "Fitting for what I would imagine of the ETH" which is because it appeared highly structured and fitted into a grid. The content of the page is not entirely self-explanatory, so explanations are needed in some places. Furthermore, there is a button "Fragen" which translates to "questions", but it is unclear what questions this refers to. This could include general questions, or specific ones about dates, content and others. Another uncertainty we had was if it was possible to unregister for several courses at once or if there is a possibility to unregister for selected courses as well. Because we had no direct access to the system, we did not know how to interact with the system and could not evaluate if the given information on the page is useful.

Anyhow, the used structure helps to get along with the system, while some buttons could be named and placed better. The used design appears to be aged but is not bad either. A modernised design would still be appropriate.

Fig. 5.5: The registration page in myStudies of the ETH Zurich

5.2.4 TISS

In this category, TISS appears as one of the most versatile and customizable solutions yet again. It allows to create self-defined categories, so students can sort their courses independent of their completion states such as having already passed a course, visiting it right now or wanting to visit it in the future. While it offers lots of functionality, it also makes it complicated to use. When students want to move a course from one category to another, they have to select the arrows below *actions* and then they are asked to select the category they want to move it to. When they want to change the order in a category, they have to use the up and down arrows at the left-hand side column and bring an element into position step by step. The implementation appears to be very static and could use some dynamic approaches like the drag and drop mechanism that was implemented in a prototype by S. Hayden in his work [14].

TISS uses many acronyms that are not always clear. For example "Abges." could mean several things such as "Abgesichert" (secured) or "Abgesegnet" (approved) but actually refers to "Abgeschlossen" (completed). A *thumbs up* appears in this column if the course is completed. The participants suggested placing the grade here instead
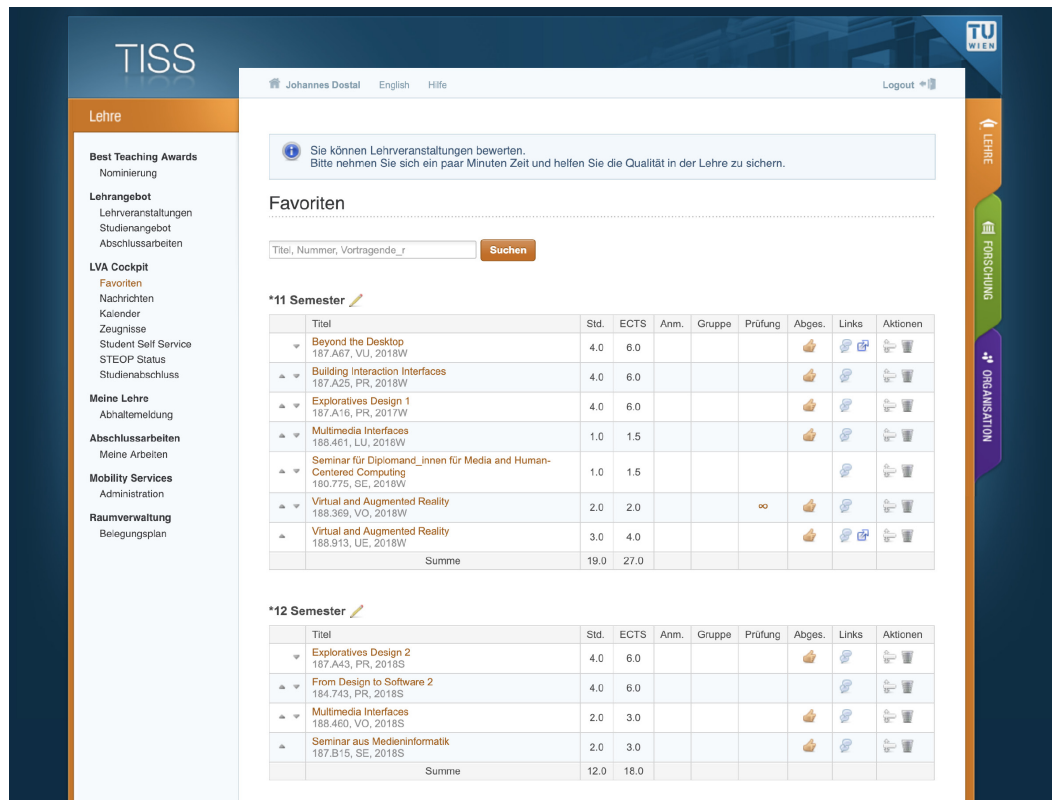
Fig. 5.6: The Favorites page in TISS where students can organise the courses they visit, visited or want to visit in different self defined categories.

so that students can see at a glance how they were graded. They also missed an indicator for the current state of the course. They would like to see if a student is currently registered for the course or an exam, or if they already passed the course. This information is already available but does not seem to be intuitive since they did not recognise it. There is a Registration column one can see if students can enrol and how many places are left. If they already enrolled, a checkmark appears instead. The same goes for exams in a separate column, and the passed column indicates if a course is already completed. We think this could be simplified; instead of using three separate columns, a single one could do well with carefully chosen indicators. At least two columns could be enough for the information available.

A small detail they recognised was the infinity symbol for available places, which is, in fact, not true. They were wondering if there was no better way to symbolise that enough places were available.

The experts also thought that completed courses should be listed in a separate category automatically, which brings us to the idea of smart filters where students can create categories that include all passed courses or all courses they still want to visit automatically. Since they spotted the link to Tuwel[1] they asked why this

---

[1] the e-learning platform of the TU Wien based on Moodle

functionality is not integrated into TISS. This was also a general question for the other SISs which always have such functionality separated into external platforms like Moodle or Brightspace.

Another issue they spotted is the search box, which searches for courses in the course catalogue instead of filtering the courses in the Favorites section. Which is not intuitive. The general search should be placed in the course catalogue section instead.

The courses saved to Favorites are always the last offered date of the course. So if a student registers to a course and takes longer to complete it, they do not see the correct version of the course automatically and have to change it every time. The participants mentioned they would like the system to save which version was selected so that students always see the version relevant to them.

The experts generally liked the flexibility offered by TISS but suggested creating better default settings and more natural and contemporary interaction with drag and drop mechanics. For the default settings, three default categories with smart filters could be applied. A wishlist, a current courses section and passed courses section. This would also render a column for completed or subscribed information unnecessary.

5.2.5 FH Complete

Fig. 5.7: My Courses of FH Complete

While our guests like structured content, they had to admit that this site is structured too much with several indentations and different shades of grey. Again, the grey gives an impression of Windows 95. What they liked was the possibility to fold content in and out, so details about a course are only shown when needed while keeping orientation at the page.

The experts liked the fact that a calendar with all relevant dates is provided in the

system, as shown in Figure 4.9. However, they did not know that these dates are not always correct and reliable as the student who gave us access to the system told.
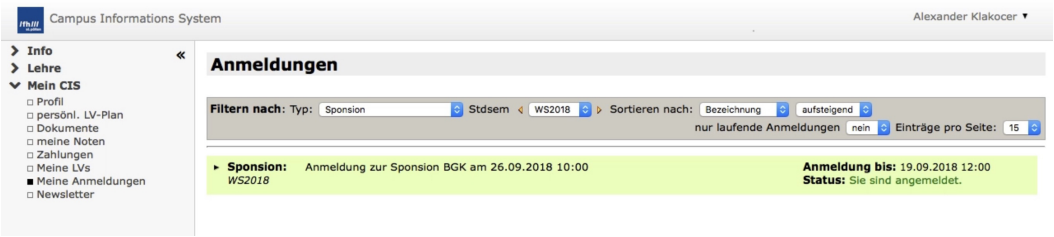
Fig. 5.8: The registration page of FH Complete

On the registration screen for courses 5.8 it was not entirely clear whether or not students were already registered for courses that were shown, or if registration was possible. It seemed that both are possible, so both registered courses and courses open for registration were available. Unfortunately, the items for registration are ordered in many subcategories, and only one category can be shown at a time. That means that if a student wants to see where they are registered at a glance, it is not possible. They have to check all categories one by one. The same goes for signing up for a course as well. The way these categories are ordered is also too complicated, according to our attendees. Several filter criteria have to be applied in order to get a proper search result. Furthermore, they did not like the naming "filter by" and would prefer something like "show" instead.

5.2.6 SLCM

Fig. 5.9: Course results in SLCM

The content in the course results page of SLCM was put into a table, despite not all of it fits. This results in a hack where rows of the table are misused for heading lines. The real content of the table should only be the last four columns while the first two columns should be represented as categories for separate tables. This leads to another unpleasant side effect, where an average grade is calculated and placed into the first row of the table labelled as "total grade". We think this is the wrong place and wrong naming for an average grade. It should be placed below or above the table and be named properly according to the average calculation. In the current layout "everything is 2,95" as one of the experts described it (Figure 5.9).

Another issue that appears because of the table hack is a lot of white space at the wrong places. While whitespace can be helpful for orientation and drawing attention to relevant content, it has to be placed consciously as described in Section 3.1.

The same issue appears on the course registration screen of SLCM (figure 4.21) where even more space is wasted due to a layout based on a table. While grids are a useful tool to format pages and organise content, stuffing text into a table is not the same and results in unused space, all this while making the content appear asymmetrical. Inside the table, there is another issue with line breaks; in some rows, one line break is used in one column while in other rows this is not necessary. This leads to rows with different heights and makes the overall appearance cluttered. Since we can assume that there are one to two lines in each row, a fixed spacing with height-centred text would appear tidier.

The experts were also wondering why there was a black bar at the bottom for the PDF download. A simple button would do better without destroying the layout of the page. It is not clear which parts of the bar are clickable and which are not.

On the course registration screen (Figure 4.21) our guests spotted the icon at the bottom of the page beside the filter symbol, which had no clear meaning to them: So either this item is not useful, or the chosen icon is inappropriate. On the same screen, they mentioned that the displayed information is probably not of interest for students and other information like for what curricula the course can be used would have more relevance. Since this is dependent on the university and not the SIS, this is not a big problem since we were looking at a demo system. The filter system seems to have the potential for improvement. While we can see that it is filtered by "open for registration" the selected course cannot be registered for, replying with "You are not allowed to take this course".The filter system seems to filter only the courses that are not enrollable at all, while courses that can be enrolled in are visible to everyone. We would advise improving the filter, so only courses are visible that can be enrolled in by students.

Despite the problems found, like the misused tables and unrecognisable symbols, the applicants liked the overall concept of SLCM and mentioned it is one of the best solutions they have seen.

5.2.7 U:Space

Fig. 5.10: Course and examination registration overview in U:Space

The experts liked the appearance of U:Space at first glance and described it with saying that "this looks good". What they did not like was that the information above the real content took up lots of space, so students with less screen space have to scroll to see the actual content.

When they had a look at one element of the current courses, they spotted some issues. In the English version, the last line is still in German, and it is not clear what "InteressentInnen" (Interested persons) refers to. They were also wondering how free spots could be a negative number. Since we know that it is usual to overbook courses, this behaviour can be explained. Nevertheless, we do not think it should be displayed this way. The green checkmark at the left of an item was misinterpreted as a flyout arrow by one participant. Even if the others recognised it as checkmark correctly, the real meaning of it was not understood. They thought it means that the student passed the course successfully when it was supposed to mean the student *registered* or *completed* it rather than having passed it. A red X means that the

student was not able to register for the course, while a grey X means that the student cancelled the course. So we see the registration status instead of the completion status we expected. Another student told us that they were confused by this as well. One expert mentioned that he does not like the blue border line of elements because this way, there are two lines between elements. He would like to differentiate two elements with different shades. He argues that this way, screen space would be saved while the system becomes less visually cluttered. It would also be sufficient to use two rows for an element that can be extended for more information.

There is an eye-icon the top right corner of each element, which allows displaying details of the course. The experts did not like this symbol because they think it is inappropriate for that purpose. They prefer the mechanic used in FH Complete 5.2.5, where an element is just extended to see all the details.

What they liked about the system is the ordering by current and passed courses, even if they did not like the name "Archive" for passed courses. What they were missing was an opportunity to register for courses on this page. To do so the small link at the top of the page to u:find has to be used, where students can search for courses in an outdated view. As far as we know, a new solution for this is in the works.

While U:Space is visually appealing and structured, it needs some improvement on details. Especially the main content should appear closer to the top and icons should be used more carefully.

5.3 Study Progress

Some SISs offer explicit study progress information, where students can see what they have already achieved and what needs to be done still. In other systems, this information was noticeably missing. We compared the systems U:Space, ETH MyStudy and LPIS, which offer this functionality through TISS, which only provides a screen where students can see what is related to a curriculum. OSIRIS has the functionality integrated into the course overview section (Section 5.2.1, which was perceived well, so no additional evaluation is necessary.

5.3.1 MyStudies

The spreadsheet character of this view looks very soothing according to our guests. It is well structured and helps students find the desired information inside the table. All information has a well-defined place, and nothing distracts from it. A drawback that comes with this structure is the "cold and static" feeling. One participant compared it with a bank statement.

While the structure was perceived well, typography could be better. There are several
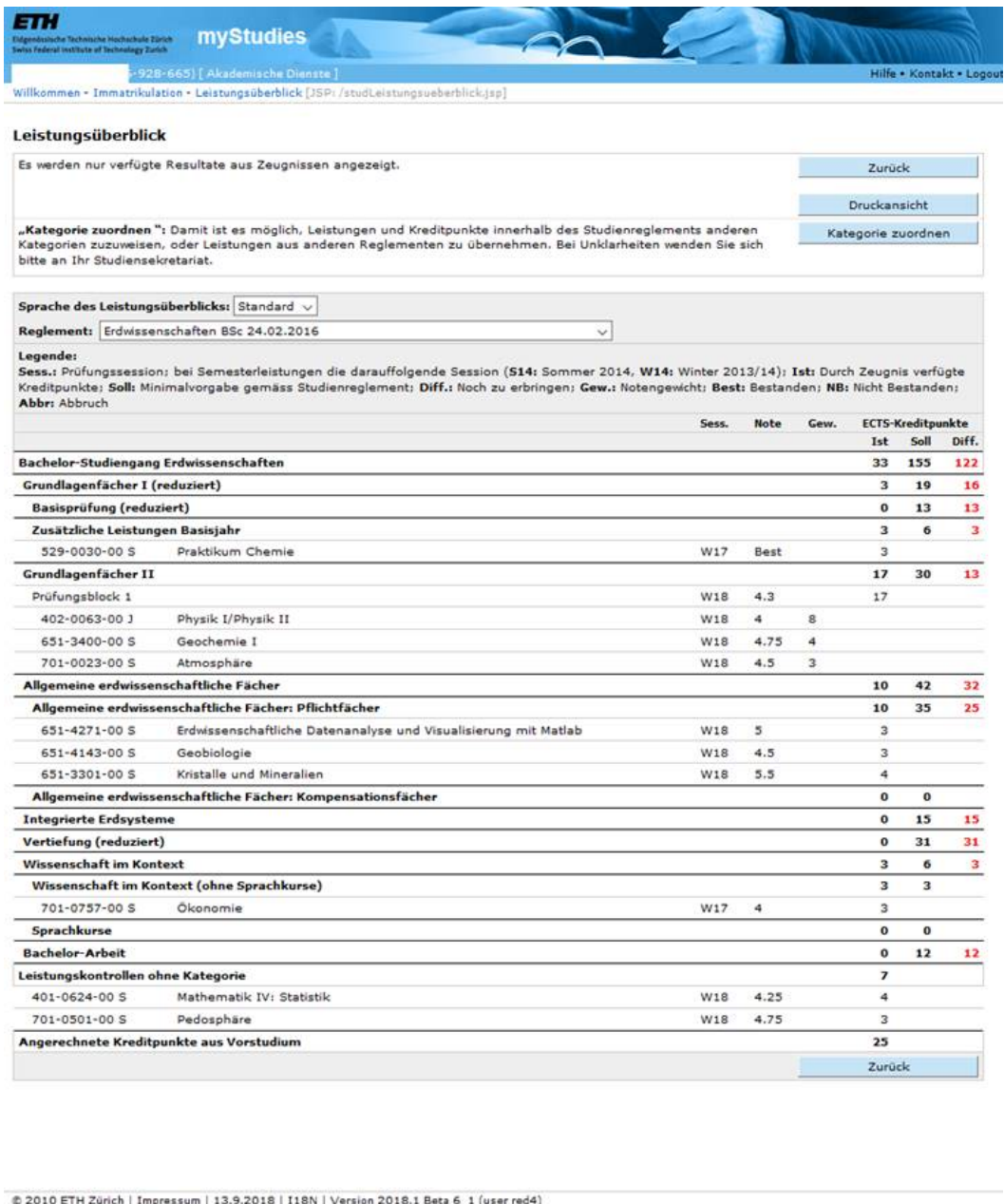
Fig. 5.11: Personal study progress in MyStudies

indentations in the first column, and a lot of bold bars are used to separate between categories. They could be replaced with coloured rows for headers and separate colours for information. We think it should be possible to design a suitable colour scheme.

Another useful feature is the target and actual difference display for credits. This makes it easier to grasp what needs to be done still.

While the chosen layout is fitting for the information displayed, it also appears very static and could use a friendlier look. The table could be reformatted, indentations should be removed and bold bars replaced with coloured rows.

5.3.2 LPIS

Fig. 5.12: The Curriculum organization place in LPIS

In the curriculum organisation area of LPIS, a table is used to format the content. This approach fits the given context but has room for improvements on the design side. We found five different indentations in the first column, which does not help in keeping an overview and makes everything appear less comfortable. These indentations should help to represent the hierarchy, but the experts think that proper set typography would do better without the indentations. Different sized and bold fonts can help with this, and colour schemes should be used to enhance the structure. Since students have five inaugurals for a course, LPIS offers a feature where students can see how many examination inaugurals they have left for a course. While this was perceived as handy, our guests also mentioned that this is somewhat "arrogant" because it implies that students will not pass an exam on the first try. What was also recognised as useful was the possibility to register for missing courses directly from this page.

In general, LPIS monitors the study progress well, but the credits for the courses are missing, which is why students can hardly evaluate the effort on this page. Since grades are shown as well, it was mentioned that the page is similar to a certificates page but expanded by yet to be done courses. For comparison have a look at the certificates site in Figure 5.13.

Notenliste für Studium [BaWiSo-12 ∨] [anzeigen]

Veranstaltung / Prüfung	SSt. ECTS	Note	Studium
LVP Wirtschaft im rechtlichen Kontext - Wirtschaftsprivatrecht I Perner, Univ.Prof. Dr. Stefan	2 4	sehr gut 03.10.2018	BaWiSo-12
LVP Accounting & Management Control II Riegler, Univ.Prof. Dr. Christian	3 6	sehr gut 29.06.2018	BaWiSo-12
PI/LVP Fremdsprachliche Wirtschaftskommunikation I - Englisch Lutzky, Dr. Ursula	2 4	gut 18.06.2018	BaWiSo-12
PI Finanzierung Nettekoven, Ass.prof. Dipl.-Ing.Dr. Michaela	2 4	sehr gut 15.06.2018	BaWiSo-12
PI Kleine Gespräche - Große Wirkung! - Small Talk für Kontakte und Karriere Hardt, Mag.Mag. Michael MA	1	sehr gut 17.05.2018	BaWiSo-12
LVP Zukunftsfähiges Wirtschaften I Novy, ao.Univ.Prof. Dr. Andreas	2 4	sehr gut 11.05.2018	BaWiSo-12
LVP Accounting & Management Control II Riegler, Univ.Prof. Dr. Christian	3 6	nicht genügend 08.05.2018	BaWiSo-12
PI/LVP Freies Wahlfach Cordoba-Gomez, Sonja	- 6	sehr gut 05.03.2018	BaWiSo-12

Fig. 5.13: Collected Certificates in LPIS

5.3.3 U:Space

U:Space has a tidy interface and contains well-structured content. The functionality to unfold a list entry to see the details for each module was perceived well. Besides that, we spotted some issues with details. For example, the Requirements column shows "siehe Curriculum" (see curriculum) in the German version but nothing in the English version. The traffic light indicator at the right-hand side is not explained, and it is not entirely clear what it means. While we guessed that red means nothing achieved yet, yellow means started, and green indicates completion of the module. We cannot be sure about it since there is also a module marked green, where the student has archived only 5,5 out of 8 credits, so according to our thesis it should be yellow. Furthermore, the traffic light indicator design is not an inclusive design, since people with colour weakness would not be able to differentiate between green and red (Section 3.2). What we liked about the traffic light indicator is the effort to visualise the progress of the studies, which is otherwise only done in OSIRIS 5.2.1. What was missing in this view was a general way of monitoring the study progress like in OSIRIS. In U:Space only the progress of the separate modules is shown, but not all of them have to be achieved for study graduation.

A concern that was voiced is that this module view forces students to study after a fixed plan instead of freely chosen interests. Of course, this is still possible to some degree, since students can choose between the modules. Even so, this concern is a more general one, which applies to all universities.

While the overall concept of the Record of examinations page in U:Space is one of the best, there are some issues with the Requirements column and the progress traffic light indicator. They could be easily fixed if so desired.

Record of examinations

The record of examinations shows your examination results and study progress based on the structure of your curriculum. You can change the allocation of examination results in the record of examinations.

Overview of all curricula

All degree programmes

Contact StudienServiceCenter (SSC) / StudienServiceStelle (SSS)

| Den Prüfungspass durchsuchen | NAVIGIEREN |

❓ HILFE

⌄ A 066 856 Master's degree programme Cartography and Geographic Information Science UG2002 from 19.05.2017

⌄ *Cartography and Geographic Information Science UG2002*

	Requirements ⓘ	ECTS	Grade ⓘ
› Modul MK1.1. Geodatenerfassung und - verwaltung		2/15	○○●
› Modul MK 1.2. Analyse und Modellierung in der Geoinformation		4/15	○●○
› Modul MK 1.3. Kartographische Gestaltungs- und Entwurfslehre		15/15	1	○○●
⌄ Modul MK 1.4. Geo-Multimedia		15/15	1	○○●

Results acc. to curriculum	Completed examinations ⓘ	ECTS	Grade	
🔲 MK 1.4. Geo-Multimedia	2017W 15.02.2018 PS Webmapping (Course Nr. 290064 , winterterm 2017)	4.5	2	👁
	2018S 28.06.2018 PS Animation and 3D-Visualization (Course Nr. 290188 , summerte...	4.5	1	👁
	2018W 06.02.2019 PS Multimediatechnology and Geocommunication (Course Nr. 290...	6	1	👁

		ECTS	Grade	
› Masterarbeit Privatissimum		0/26		●○○
› Modul MK 1.5. Wahlmodul V		0/15		●○○
› Modul MK 1.6. Wahlmodul VI		0/15		●○○
› Final Exam		0/		●○○
› Modul MK 2. Spezielle Themen der Kartographie und Geoinformation		8/8	1	○○●
› Modul MK 3. Exkursionen		5.5/8	1	○○●
› Modul MK 4. Seminare		0/14		●○○
› Interessensmodul		3/		○●○
› not yet associated with a module		/	1	○○○

› A 033 579 Bachelor's degree programme International Development UG2002 from 01.10.2011 to 31.07.2017

› A 033 655 Bachelor's degree programme Geography UG2002 from 01.10.2011 to 18.05.2017

› A 033 676 Bachelor's degree programme Physics UG2002 from 01.10.2011 to 28.10.2011

Fig. 5.14: Record of examinations in U:Space

5.3.4 TISS

TISS offers no dedicated progress view over the studies. There are only the study programme view (Figure 4.8) and the Favourites section (Figure 5.6). They support students organising their studies, but that does not replace the functionality of a dedicated study progress view as we know it from U:Space, LPIS and MyStudies. To confirm that they have completed their studies, students have to check against their curriculum, which is available in a separated page.

In the workshop, we had a closer look at the study program page and compared it to the dedicated study progress pages.
It was not immediately apparent to the experts why some lectures are displayed twice, which is because they are either offered by different lecturers or in different semesters.

The *STEOP* labels confused them as well, which are for the "Studieneingangs- und Orientierungsphase" (Study entrance and orientation phase). Courses with this label must be done first while courses with the precondition *STEOP* can only be registered when all STEOP courses are passed. The STEOP system is even more complicated since some of the STEOP courses are mandatory while students can still choose between others. There is no indicator between when students can choose or what is mandatory. This information can be found in the external curriculum again. The experts criticised why such important information was not reflected in the system properly. The symbol for the STEOP is not chosen well according to the experts. The same goes for the precondition, where it is not clear what the checkmark behind the text stands for. It could mean it is required, is already fulfilled or needs to be done. A solution with colour schemes and simple text in the precondition could do better. In general, the visualisation for the STEOP functionality needs to be improved, and more information about it is necessary.

Another issue our guests spotted was the structure with a lot of headers with little to nothing below them. While the well-structured hierarchy was perceived positively, the amount of space taken by headers should be reduced.

Since this is a basic information page accessible to everyone, the information in it is not user specific. Students have to search for their study program every time they want to look up some information. The workshop participants criticised this being necessary for students despite the system knowing what they are studying. It should be easy to display a shortcut to the study information relevant for a student. Furthermore, information on what should be done next or what courses are necessary but not passed yet could be helpful.

While the given information in TISS is somewhat helpful, the functionality of the other systems we looked at was noticeably missing and should be added. A good overview of what parts of the studies are already achieved and what is still necessary should be part of every SIS and be added to TISS as well.

5.4 Dashboard

Since most current landing pages or dashboards are insufficient in our opinion, we asked the UX-Experts what such a Dashboard could look like. They were already familiar with the most relevant functionalities through the comparison of other functionalities. Furthermore, we told them about other features we did not discuss earlier like the calendar or messages. We also had a brief look at the current solutions, where only OSIRIS (Figure 5.15) and SAP SLCM (Figure 4.20) offer useful content at the Landing page. OSIRIS shows reminders about important actions to be done and news on the landing page. The latter could be replaced with notifications

from lecturers, which are probably more relevant than general news. SLCM for SAP displays some relevant facts about the sub-pages on tiles at the dashboard, but the *visualizations* are only numbers and could be done better. Also, directly visible information like upcoming dates and notifications are missing and should be placed on the dashboard instead of a link.
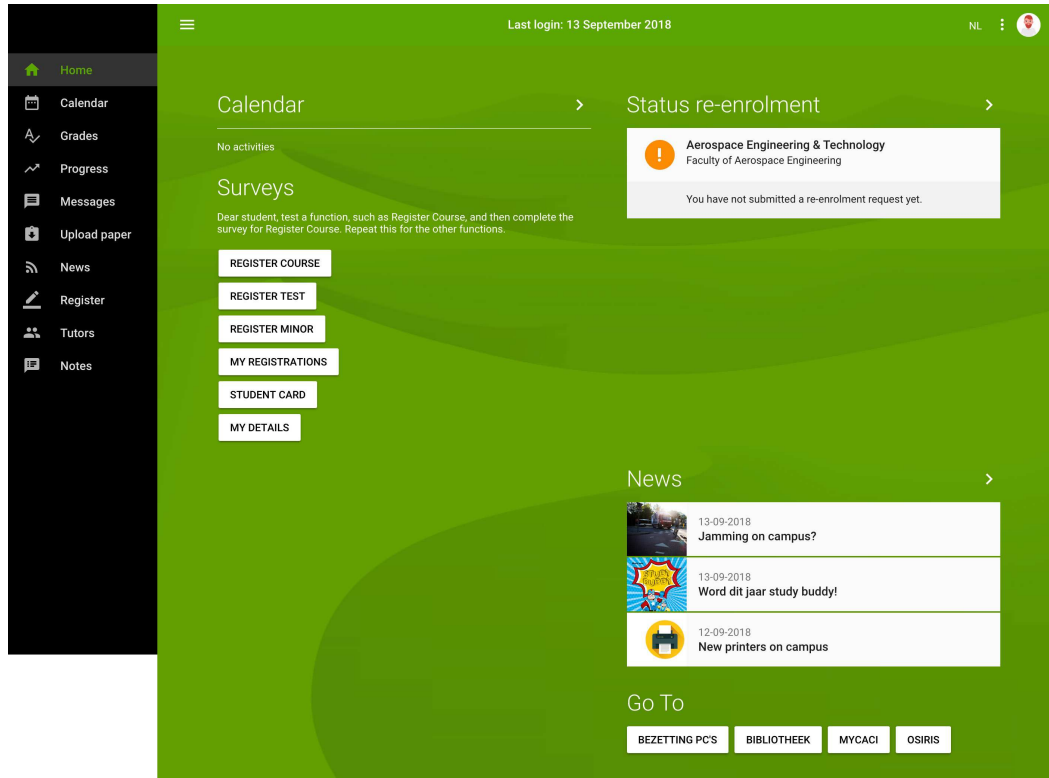
Fig. 5.15: Dashboard in OSIRIS

According to the Experts, information about the courses and critical information are most relevant and should be visible in the dashboard. Furthermore, the system should be able to distinguish between information that is relevant right now and information that is not needed. The relevant information should be visible on the dashboard while other information should not. The dates for today should be displayed here as well, and maybe dates for exams in the current week. Not too many dates should be displayed, to not distract from the most relevant information. We think a date-based calendar view like in OSIRIS (Figure 4.16) is the most useful format for upcoming dates. A full calendar view as we know it from most other systems would only be necessary for more school like Institutes, but we want to concentrate on Universities only.

The question was raised on who can send students information that appears on the dashboard. When lecturers send them updates, they would like the students to confirm that they have read them.

The most relevant issue with a context-based Dashboard would be to decide what information should appear on it and at what time intervals. Maybe an event based

appearance and deletion could be helpful as well for some information, so when students see them once, they disappear from the dashboard. There was also the idea that everything that happened since the last login is displayed, but that could be too much since not all students regularly look at the SIS.

Another question was how to visualise different kinds of notifications. Some of them are fitting for standard text notifications while others like changes of dates, rooms and times of lectures could directly be integrated with the calendar but would have to be highlighted somehow. For some information, a post-it like visualisation could be used, but not too much skeuomorphism must be used. The comments of the system should be compatible with a synchronisation standard like iCal so students can sync them with their personal notes application. The post-it idea could be extended by a feature where students can write notifications to themselves. While some of the experts liked this idea, others mentioned that there are separate apps for this and a dashboard of an SIS should not replace all apps used by a student.

It was an essential point that the dashboard should give students peace of mind, so if there is no notification at the dashboard, they can be sure that they forgot nothing. Of course, this is hard to archive since all lecturers have to use the mechanic, or better all mechanics have to be implemented in a way that makes sure that all relevant information appears on the dashboard as well.

When we asked the Experts about how they would display the currently visited courses of students, they said that they would put them into a list, since a student does not visit many courses at a time. For each list entry, a name, link to a detail page and quick-links for available registrations should be sufficient.

Another idea that could be relevant were quick action buttons that appear when a student has to sign up for something right now or has to perform another action like a confirmation.

A general progress view like in OSIRIS (Figure 4.17) could also be placed on the dashboard. While it is not changing all the time, it can help a student to feel confident with what they have achieved, and a link to the details can be integrated into the *progress circle* as well.

Students could also be reminded of deadlines like payments hand ins and exams.

While our guests agreed that only relevant information should be visible on the dashboard, it was hard to define what is relevant information and what is not. While there should be a reasonable standard, the possibility to change what is appropriate would surely be welcomed by some students.

One of our guests mentioned that maybe information outside the course management could be interesting for students as well. He named the Canteen menu as an example. We think this is not necessary for an SIS since there are other platforms for such information like *Studo* [85], and this information is not necessary to pass the studies
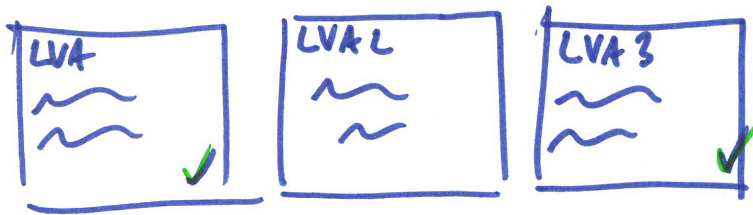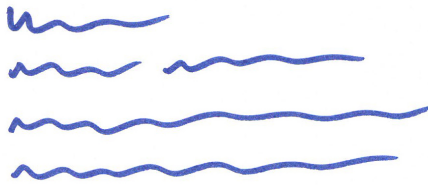
Fig. 5.16: A quick sketch drawn by one of the workshop participants

either. We also think this is a reasonable division criterion for other content; whether it helps students to pass their courses or not.

Something else that was missed by students and experts as well was the possibility to coordinate the next semester with friends. It often happens that students want to visit the same lectures as their friends, but it is hard for them to communicate about it. We think this could be a useful feature, but the dashboard is the wrong place for this.

5.5 Conclusion

During the workshop, the experts approved our first impressions about the systems for the most part. They found many problems, but suggestions for improvements were not always available. In general, we think that we focused too much on what is not good and less on how to improve it or what aspects of the system already have a good solution. This problem probably occurred because we had a very homogeneous group of four UX Experts, who have high expectations and an eye for detail. Since the experts agreed with another most of the time, we think it would be better to

invite students who use the system besides the experts, to have different viewpoints on the systems. This way, we would have different opinions that lead to a more in-depth discussion about the design decisions and functional solutions.

When we discussed the ideas for the dashboard, we focused on new features and how they should work. We could have drawn a bit more attention to the existing solutions, especially on OSIRIS and SLCM, which offer some of the functionalities we brainstormed.

For future workshops, we thought about some different approaches that are worth considering. First, we would only compare three to four selected systems in each category, which should be as different as possible, since it often happened that the compared solutions were very similar. Another idea was to compare self-created wireframes that are based on the existing solutions. This way, small design decisions would not distract from the whole solution. Of course, this would mean to neglect significant parts of the design decisions, which is not the aim of this particular work but could be in the interest of Kristina Heidinger's Thesis [59]. A completely different approach for such a workshop would be to think up a new SIS from the ground up. However, we think this would lead to the same problems that already exist, rather than new innovative approaches. Even to take one existing solution and try to improve it would not be as successful as to compare different approaches, since we observed that the experts were inspired by some features of different systems, even if they did not always mention them while being focused on some issues.

In general, the workshop gave us some valuable insights into the design decisions of the existing solutions but delivered not as many improvement suggestions as we had hoped for. The comparative nature of this workshop can be helpful for design improvements, especially for already well-working systems in order to improve them even further. Contrary, to improve systems that need a redesign from the ground up, we think this method would not be useful, and other approaches should be chosen.

In conclusion, we can confirm that the insights gathered are valuable for our goal of designing a new SIS Dashboard and were considered during the design process.

Concept for a context sensitive Dashboard

> *It takes a lot of hard work to make something simple, to truly understand the underlying challenges and come up with elegant solutions.*
>
> — **Steve Jobs**
> (CEO Apple Inc.)

During the evaluation and comparison of existing SIS, as well as the interviews with students and SIS-developers, we got a deep insight into possible functionalities of such a system. We figured out that most systems lack a helpful landing page after login, or the available solution could be improved. Therefore we decided to create the concept for a dashboard that can be used by any SIS after some design modifications.

Based on our insights we extracted the most used and anticipated functionalities of the SISs and found them to be (in order of importance) *upcoming dates*, *Notifications*, *currently visited courses* and the *personal study progress*. In a process of drawing several sketches, as seen in Figure 6.1, we came up with the first suggestion for each of them. We combined them into one screen that represents our idea of a possible dashboard (Figure 6.2). This first concept was discussed with four colleagues and the advisor of this thesis, which allowed us to improve many details in an iterative process.

As soon as we were satisfied with the concept and external persons had no critique points on the concept, we created a high fidelity prototype with the app *Sketch* based on the Material Design Guidelines with some modifications. During the design process, three colleagues gave ongoing feedback on details so that improvements could be included directly.

Since most students want to see crucial information on the go, we opted for a mobile-first approach and designed the mobile views first. Since space on a mobile device is limited, we decided to split the four categories into four different screens and keep clarity this way. For switching between the four categories, there is a navigation bar at the bottom of the screen as well as the possibility to scroll through the categories. This means when no more items for a category are available, the next
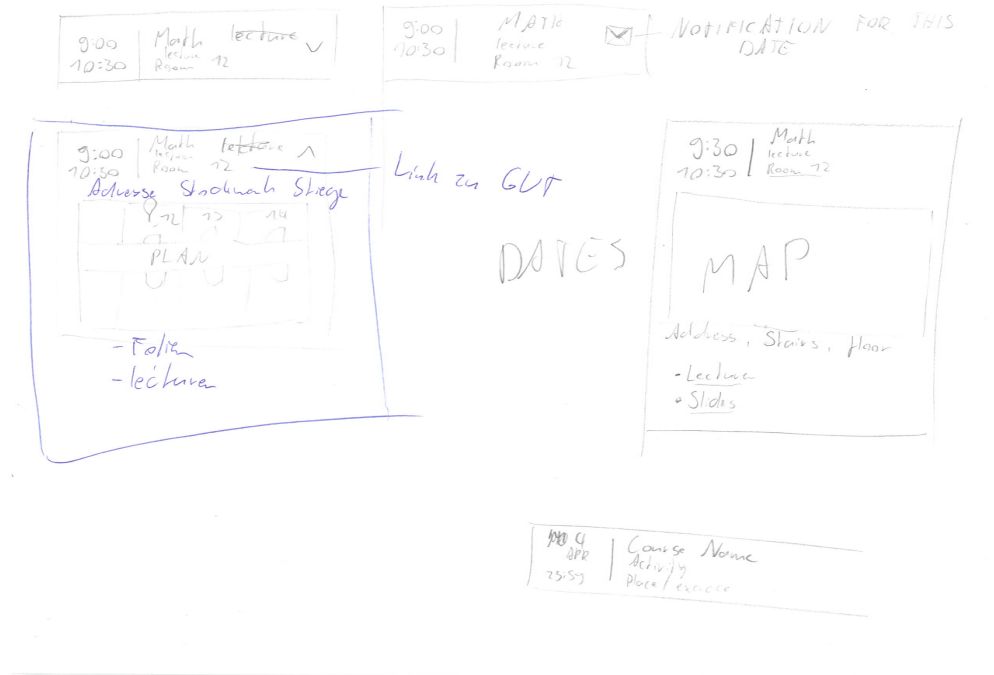
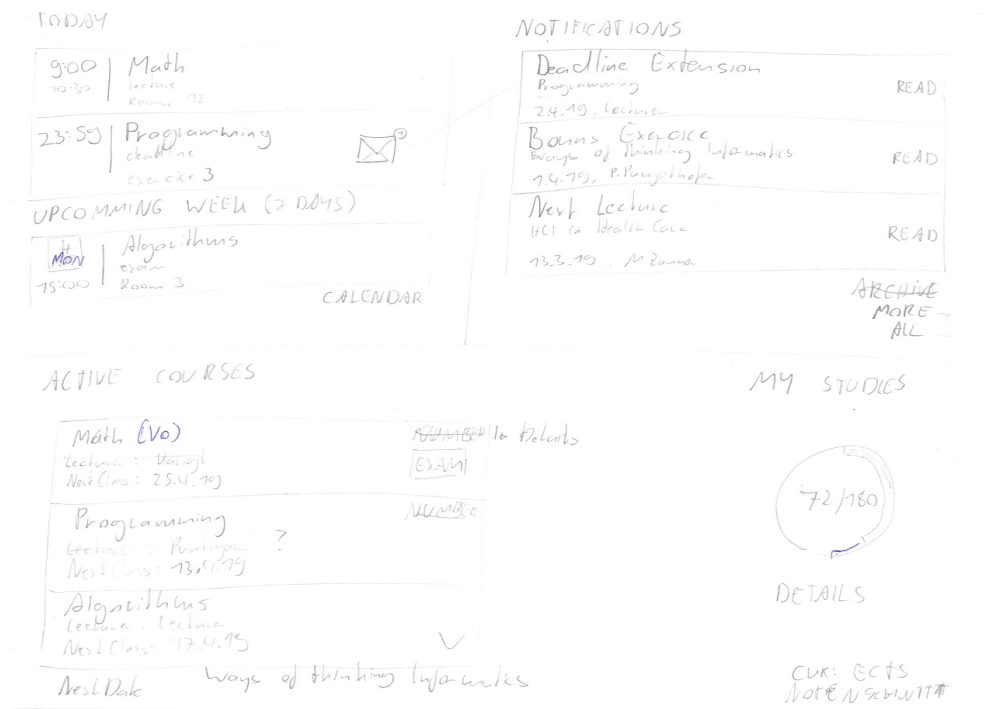**Fig. 6.1:** One of many detail sketches to find a good solution on how to illustrate a feature.

Fig. 6.2: A quick sketch to discuss our ideas of a dashboard.

category will be displayed after a small optical transition. In the desktop version (Figure 6.3), there is enough space to fit all information into one screen, which allows finding the desired information even faster.

Now, we will have a closer look at the four functionalities. We will discuss how they work in detail and how they were designed.

6.1 Dates

Since our concept of dates and how they are handled is based on a special technical implementation, let us explain this premise first. All students from different universities and different study programs described the same issue with the usage of the current solution of their institution. The displayed dates do not represent the actual dates of when courses take place. This is because the dates displayed are based on room reservations, which are not always course dates for students. Therefore, we suggest separating actual course dates from the room reservations. Furthermore, we would like to assign each date to their own entity. This would allow us to implement some handy features for the dates. While information about the place of a date is already available, it could be complemented by information about the lecturer of a single date (often courses are held by different lecturers, and students told us they would like to know who is holding the next class). Also, lecture materials like slides can be assigned to single dates, so students know which slides are for the upcoming class and can access them quickly in the dashboard. Moreover, notifications can be assigned to a single date and not the whole course, which allows students to allocate information easier.

In the date view, as depicted in Figure 6.4, we can see upcoming dates. Below *Today* we find dates for today that include all types of events that can be relevant for students like lectures, seminars, deadlines or exams. Each date item of *Today* includes a start-time (blue) and if it is an event over time like lectures and exams also and end-time (grey). A red time indicates a change from the original time, so students can recognise changes easier. The header is the name of the course and the first row below it describes what type of date it is. The last row contains information about the place if it is a deadline or the name of the assignment. On the right side of a unit, there can be a mail icon with a closed or open mail. The closed mail indicates that there is an unread message, while the open mail signals there is a notification assigned to this date, that was already. When moving the mouse over a date with an unread notification, the associated message in the Notification area will be highlighted so students can grasp at a glance at the corresponding message is. This works in the other direction as well, when moving the cursor above a notification result it highlightings the upcoming date, if available. A click on the notification symbol will also open the message, which is especially helpful for read messages that are not available at the dashboard. Instead of the closed mail icon, we also considered a ringing bell and instead of the opened mail a normal bell. However,

TU Bibliothek Your knowledge hub

Today

	Programming	
09:00 11:00	lecture Audimax	

	Algebra and Discrete Mathematics	
14:15 15:45	lecture Audimax	

	Formal Modeling	
23:59	deadline exercice 2	

Upcoming

	Algebra and Discrete Mathematics	
TUE 16 09:00	exam Audimax	

	Object-oriented modeling	
WED 17 23:59	deadline exercice 4	

CALENDAR

Progress

ECTS

82 open

71 achived

27 in progress

Average Grade: 1.23

DETAILS

Notifications

Deadline extension
Formal Modeling
02.04.2019, Podlipnig

Bonus Exercice
Ways of thinking Informatics
01.04.2019, Purgathofer

Guidelines
HCI in Health Care
29.03.2019, Zauner

Evaluation Multimedia Interfaces
Multimedia Interfaces
12.03.2019, Vonach

ALL NOTIFICATIONS

My Courses

Algebra and Discrete Mathematics
VO | Next Date: 15.04.2019

Formal Modeling
VU | Next Date: 08.05.2019

HCI in Healthcare
VU | Next Date: 27.04.2019

Multimedia Interfaces
LU | Next Date: 06.05.2019

Programming
UE | Next Date: 18.05.2019

FAVORITES

Home
Calendar
Grades
Progress
Notifications
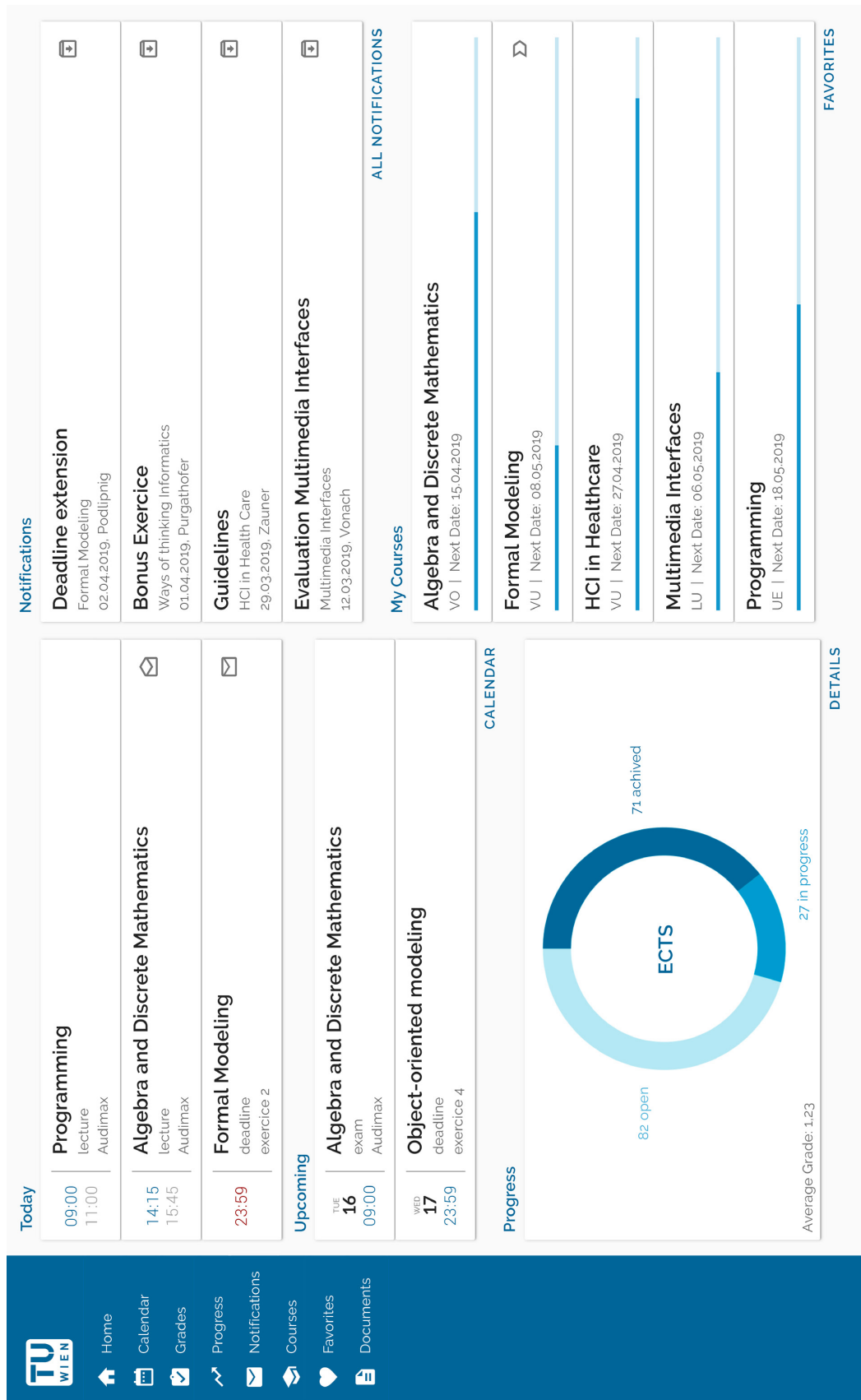Courses
Favorites
Documents

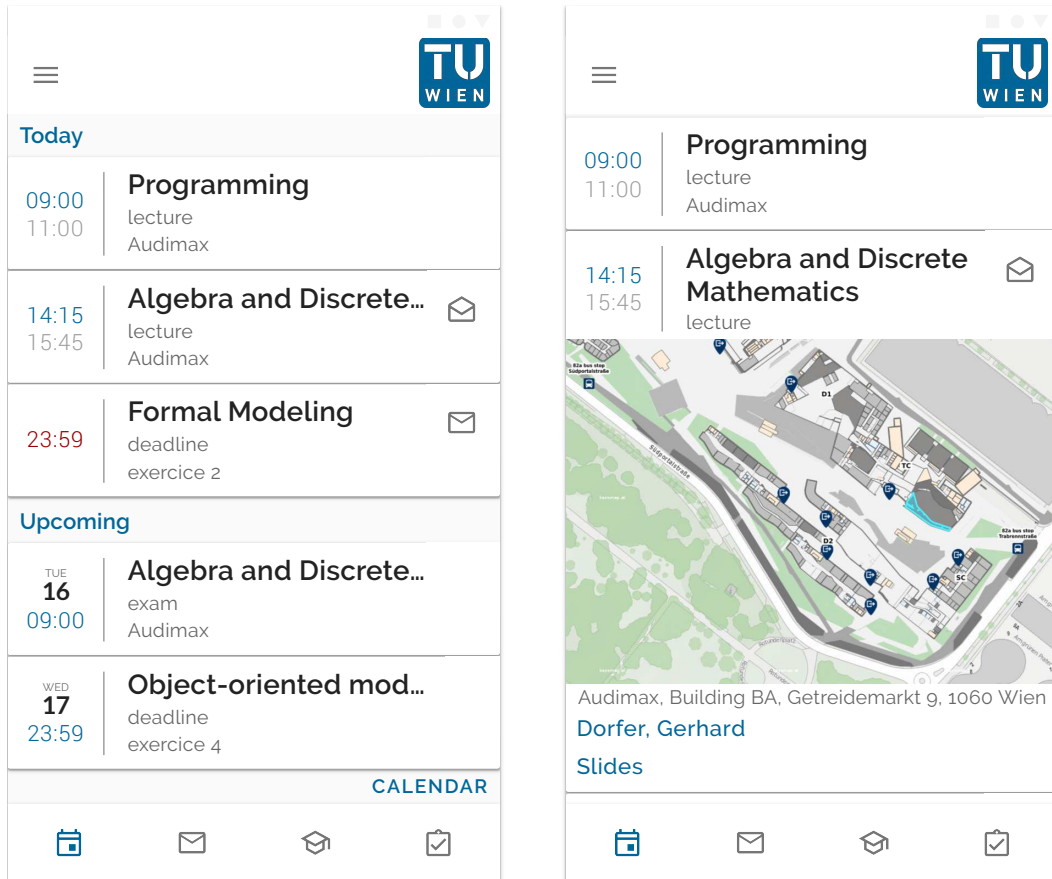**Fig. 6.3:** The final concept for the SIS desktop dashboard.

Fig. 6.4: Mobile view for upcoming dates and extended information for a date.

after the first user tests, we figured out that the bell confused many students, while the mail icon was understood by most of our participants. Furthermore, the fact that a mail can be depicted as opened or closed can better reflect if a message was read. When selecting a date item, it will be extended, and further information is displayed. Figure 6.4 depicts how this looks on the right. The map extends over the entire screen width, to allow a better orientation. It would also be an option to make it higher and to use even more screen space for it. The map itself should be interactive like the *WU Campus Plan* [69] we introduced in Section 4.1.4. It includes information about how to get to the room with real-time navigation and some facts about the room, such as its capacity. Additionally, below the map, the address is displayed which is easier to copy should someone need to.

Below the map and the address information, we see the lecturer of the selected date and a link to available resources like slides for quick access.

Beneath *Upcoming* only exams and deadlines for the next seven days are visible in order not to overload the screen with dates. The items used here are very similar in structure like the ones from *Today*. The only difference is the date that includes a weekday and calendar date plus the beginning time. Below the last item of a Sunday,

a simple separator will be displayed, so students can easier recognise where the next week starts.

We included some more details to recognise important information like the red time for the *Formal Modeling* deadline, that indicates that the time was changed. Additionally, a notification was sent but highlighting what was changed lets students grasp changes easier. For deadlines, we thought about deleting them if the task has already been submitted. However, we think that students could still have use for this information. Such as if they want to improve their submission. We came up with another idea, where deadlines that a student had already submitted something on would appear as green instead of black. This way, students who do not want to resubmit their work have peace of mind that they have already done everything, while other students are reminded that they can still improve their hand-in.

If students want to view dates, which come after the ones displayed, they can find them in the full calendar view. This is accessible with the button "Calendar" below the upcoming dates or in the menu.

Some students we talked to told us that they would like to see more than dates of today. Since only students of master programs told us they wanted this, and bachelor students liked it the way we designed it, we think there could be an option for those who want it while being subtly for those who do not. Also, some of our early reviewers asked for more options on the dashboard. We think such options could overload the dashboard, making it so that relevant information could be overseen easily.

6.2 Notifications

In the top right area of the dashboard, new notifications for a student are displayed. A notification is represented by its title, the course to which the message relates, the date and the author. Furthermore, there is an icon on the right, which allows users to put an unread notification into the archive[1] without reading it. This allows students to remove messages that are not in their interest even faster. For the mobile version, such actions can be done with a simple swipe gesture, as known from many mobile apps.

Students can find read notifications, and the ones directly put into the archive under the button "All Notifications" below the new notifications, or in the menu under the point "Notifications". It is also possible to find a read notification by using the mail icon of a date, or by searching it in the detail view of the course the message is

---

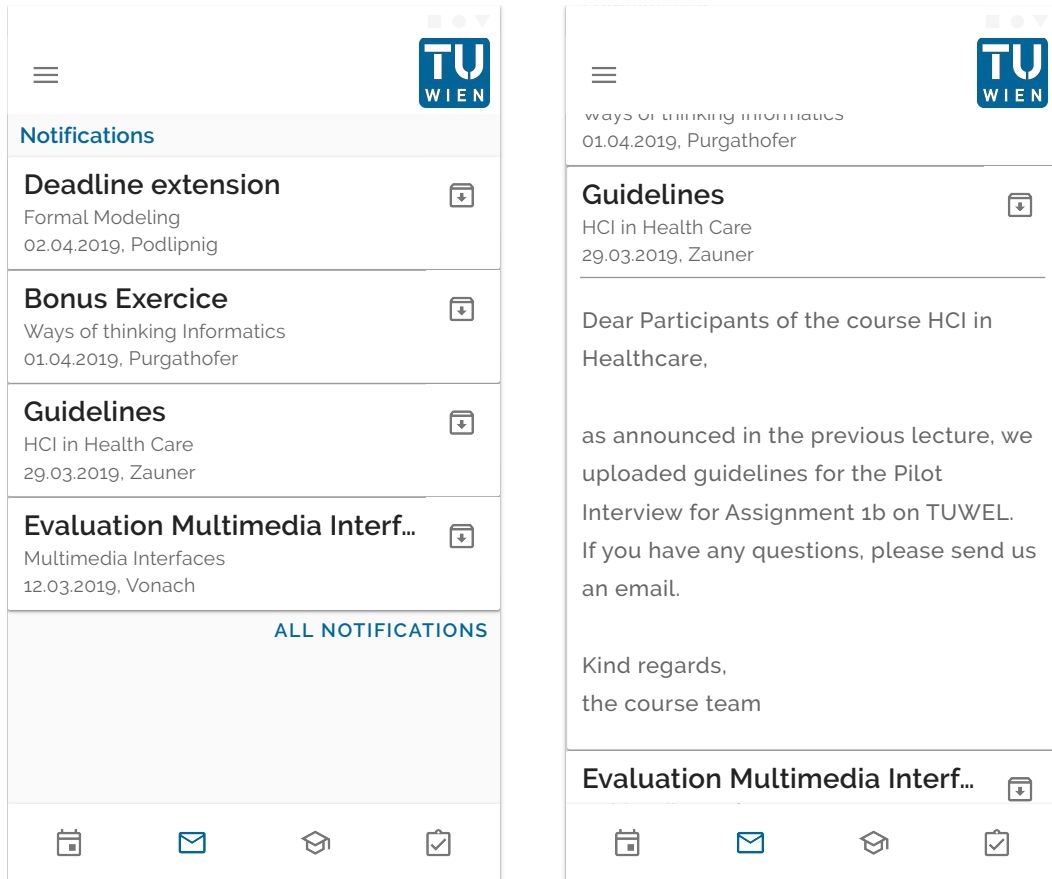[1]   The Place where all read Notifications go

Fig. 6.5: Mobile view for new notifications to the left and a selected notification to the right.

assigned to.

When a message is selected, it will be opened and the content of it will be shown as in figure 6.5. When closing it, the message will disappear from the dashboard and can be found in the notification collection (archive). To communicate this event, we suggest using a subtle animation where the notification shrinks while moving into the "All Notifications" button where it finally disappears. This type of animation is known from macOS, where it is called "Scale effect"[2] and used when minimising windows.

A possible problem with this approach could appear when a student never reads their messages. This would lead to an overloaded dashboard with outdated notifications. There are different approaches to handle such edge-cases. The easiest way would be to move unread messages after a while, for example, two weeks. Alternatively, when there are more than five unread notifications, the system would remove the oldest one. A combination of both approaches would also be possible, enabling a method that allows for more notifications.

---

[2]   The Scale effect is not used by default, not to confuse with the "Genuine effect" that is the default

Another Idea was to give Notifications priorities, while the one with the most important is the first to be displayed. This could be implemented in a way where notifications lose priority after a while and disappear when they are not relevant anymore. Even if we like this idea, we will not use it, since we think that not everyone understands a priority system, and lecturers could give their notifications inappropriate importance.

Edge cases that could be handled in different ways are system notifications to notify students that they have to pay their study fees or similar messages. We suggest using a specific notification type that is "sticky" and cannot be removed until the fee is paid. Alternatively, the notification could be excluded from the Notification system and placed more prominently at the top of the page.

6.3 Courses

Here, all courses are displayed that a student currently visits. This helps students to find information about courses fast and without searching for the course. The order of the displayed items is alphabetical since this kind of order is easy to understand for everyone and easy to operate. It would also be possible to use order heuristics, where the most used items are listed at the top. When doing so, it must be thoughtfully considered how to define "most used" since the relevance of courses can change during a semester. One click on an item will lead the student to the course detail information page, as known from most systems we have reviewed. A problem that comes with such a view is that students are not always subscribed to a course, since lectures do not need registration in order to visit them. We did not find an efficient system that allows keeping track of such lectures since it does not make sense to force students to register for them. Neither would it be useful to adapt the section manually since the same thing would happen as most students from the TU Wien face in the *Favorites* section where useless courses accumulate in different sections. What we think could work is a mechanic, where students can add lectures to this section, which can show a progress bar. As soon as the final exam for this lecture is passed, it should disappear from this listing automatically.

When having a look at a course entry in the list, there is the title of the course at the top. In the second raw, we see information about what type of course it is and when the next date for the course takes place. A date can mean a lecture, deadline or exam, for example. When moving the mouse courser above it, additional information about the date like the type of date and where or what it is should appear. In the mobile version, a simple click at the date will have the same effect. There are some details to consider, such as exams that a student is not registered to not being treated as a next

date. At the bottom of each item, there is a progress bar that indicates how much for a positive grade has already been achieved. This includes lectures, hand-ins and exams. To the right, an arrow indicates whether there is something a student can assign to, like an exercise or an exam. When clicking this icon, the system will load the course page with the corresponding action available. While we want this icon to signal that there is a possible action to be done, it is important not to pack all functionality into the dashboard so that it stays clean.
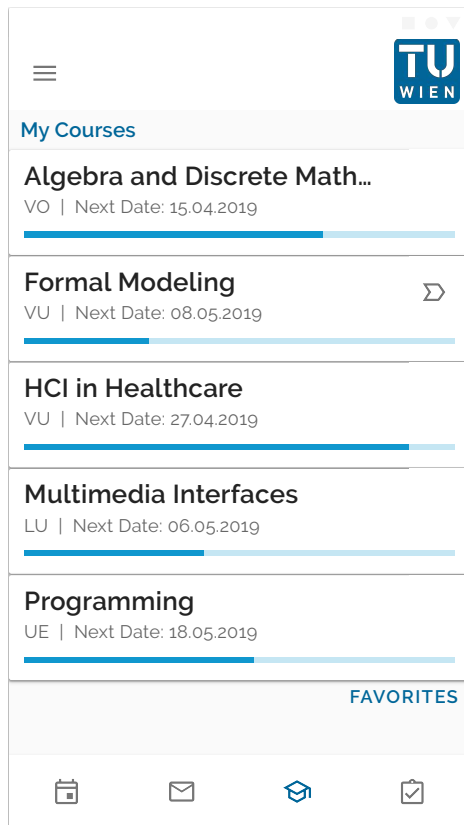

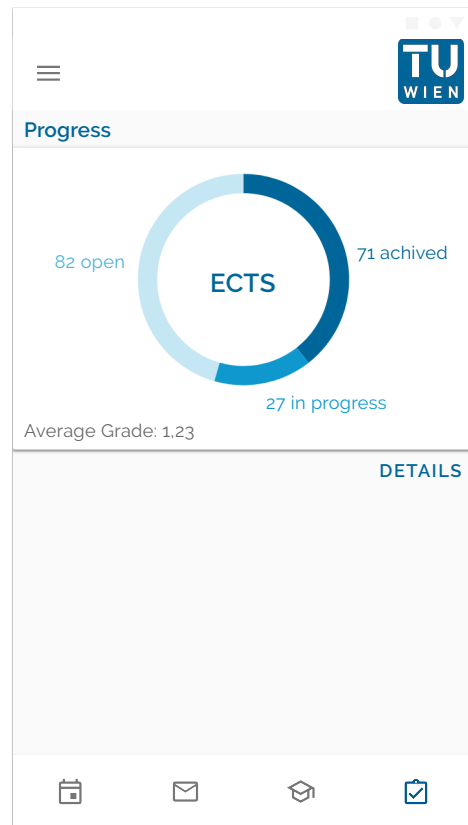**Fig. 6.6:** Mobile view for visited courses.

Fig. 6.7: Mobile view for personal study progress.

6.4 Progress

In the progress area, students can have a brief visualised summary of their study progress. In the circular chart, they can see how many credits they have already achieved, how many are in progress, and what is to be done. Additionally, we were told by students, that they would also like to know their current average grade. Even if this is not relevant for everyday studies, it gives students a good feeling about what they have achieved. Therefore, we added this information to the left, below the chart.

If someone wants to know more details about their progress, they can find them

under the "Details" button below the progress overview. This leads to a page similar to the one we know it from u:space 5.3.3.

6.5 Semester planning

While the four content areas introduced in the last sections provide all the everyday information a student needs, we had many discussions about a helping tool that supports students in planning their semester with colleagues. We still believe this would be very helpful, though something like that should only be available at the beginning of a semester. We would recommend a smart suggestion system, where the system makes suggestions based on a chosen curriculum and personal progress. Already registered courses should also be taken into account. Furthermore, utilities that allow students to coordinate their semester planning with friends would be helpful for many.

Since the focus of this work was only on a dashboard during the semester, we prepared no detailed suggestions for this area and left this up for further work.

6.6 Further wishes from students

Even if we covered all relevant information for students every day, some students we talked to requested additional features. We want to discuss them briefly and why we think they are not appropriate for a dashboard.

They asked for a quick lookup tool for people, like the address book already allows. Also, a grade overview in the progress area was requested and a way to download documents directly from the dashboard. Some students also requested the possibility to plan a semester and that they want to know what they still have to do. Other details they requested was information on how long they were studying or when they started to study.

In our opinion, these features are not relevant for everyday studies and would lead to too much clutter. Information about what a student still has to achieve is available in the details of progress, and a semester planning tool, a good idea, would only be useful before a semester starts.

6.7 Evaluation

After completing the concept for the dashboard, we wanted to find out how easy it was understood and how potential users perceived it. We prepared a questionnaire

that aimed to figure out if students find the intended information quickly, if the structure of the design is intuitive and if they are comfortable with the design. The questions were collected and discussed with three colleagues in order to make sure they fit for the purpose and do not bias the students. We ordered the questions randomly so that students could not find the answer to the question on the top left of the concept. This way we were able to observe if they really find the desired information or if they just read what is on the top left. This resulted in the following questions:

1. What notifications do you currently have?

2. How can you open/read a notification?

3. How can you archive a notification without reading it?

4. Where can you find read notifications?

5. How many credit points have you already done during your studies?

6. What is your average grade?

7. What grade do you have on a course you have already passed?

8. How many credit points do you need to complete your studies?

9. Which study modules do you need for your curriculum?

10. How many credit points do the courses you are currently attending include?

11. What exams do you have this week?

12. What dates do you have today?

13. Which deadlines do you have this week?

14. What does the mail icon beside a date mean? Moreover, what is the difference between an open and closed mail?

15. Where does the lecture "Algebra and Discrete Mathematics" take place?

16. How can you find your way to the Audimax if you do not know where it is?

17. How can you see all your dates?

18. How much of the course "HCI in Healthcare" have you already done?

19. When is the next date for the course "Algebra and Discrete Mathematics"?

20. What does the arrow next to the course "Formal Modelling" mean?

21. How can you navigate to another dashboard area in the mobile view?

22. Are you missing important information you would need for your real studies?

23. Would you prefer this solution over the one at your university?

24. Do you like the layout?

Based on these questions, eight user tests were accomplished with students from different universities and various fields of studies. We wanted to make sure that the results of the evaluation are meaningful and do not only apply to IT students.

During the test, the design concept of the desktop view was presented to the participants on a print, while they were asked to answer the questions. Of course, we also printed out the mobile view, which was presented to the participants when being asked about it.

Since we were not sure about the mail icon next to dates as well as the arrow next to Formal Modeling in the My Courses section, we prepared a second version with a bell instead of the mail icon and three dots in a row instead of the arrow. While four participants were shown the version with mail and arrow, the other four were confronted with the bell and dot version. This way, we wanted to include a little A/B test in the evaluation to find out which symbols are better understood and more intuitive.

Each user test took between 25 and 60 minutes. While all students preferred the concept over the solution they currently use (The students were either from the TU Wien (TISS), University of Vienna (U:Space), the Medical University of Vienna (CAMPUSonline) or the University of Applied Sciences Campus Vienna (FH Complete)), there were some minor details where their opinions differed, and the interviewed students liked different approaches better.

During the user test, we collected the answers students gave us and documented our observations about their behavior. While most of the time, our participants were able to answer the prepared questions correctly, it was crucial to us how easy it was for them to figure it out. It was interesting to see how some students used the dashboard as if they had already known it, while others took some time to get

familiar with the design. Now let us have a look at the answers in more detail and find out which parts of the concept could be improved.

1. **What notifications do you currently have?**
   Only three participants recognised the Notifications area at the first glace. The other five considered the mail or bell icon next to some dates as the notification. At a second glance, four of them recognised the Notification area as well. Only one student did not understand it. It seemed like he did not know the word "Notifications" since we evaluated in German.

2. **How can you open/read a notification?**
   All participants would try to click on the notification. This would be the proper interaction to open it.

3. **How can you archive a notification without reading it?**
   While seven participants understood the icon to do so, three of them were not sure if the symbol chosen was right. One of them also considered to swipe it away. We think this is a good idea and could be implemented in a real version of the software.
   Only one student would open and close the notification to move it into the archive.

4. **Where can you find read notifications?**
   Six participants would search for them below the notification area at the button "All Notifications" while two would use the "Notifications" entry point in the menu. Both actions would lead to the desired information. Furthermore, most of the students also found the other way after asking them for additional possibilities to find the notifications.

5. **How many credit points have you already done during your studies?**
   All eight students found the correct answer of 71 without a doubt.

6. **What is your average grade?**
   Again everyone found the correct answer immediately with 1,23.

7. **What grade do you have on a course you have already passed?**
   Four students would search for this information behind the menu entry "Grades". Only one would try the option "Details" below the Progress section. These are the two possibilities we intended. Two would try to click on the achieved area of the diagram or the label, which was not intended but could be realised as a handy feature. When they were asked what they would do if

this does not work, one would try the Details button while the other would select Grades in the menu. One participant would try the menu entry "Courses" first while Details and Grades were his second and third guess. This means that all students would have found the desired information quickly.

8. **How many credit points do you need to complete your studies?**
All students answered this question with 82 + 27 correctly.

9. **Which study modules do you need for your curriculum?**
While our intention was, that students find this information behind "Details" below the Progress area or in the Progress entry in the menu, only two students would try this at first. Five students would try to find this in the Menu entry "Courses", and one had no idea what was meant and how to find it. This student was from the TU Wien, where no such module is currently available. While most students would have found the information after a brief search, it seems like there is a potential error in the naming of the items in the menu.

10. **How many credit points do the courses you are currently attending include?**
All participants answered this question correctly with 27.

11. **What exams do you have this week?**
While five participants found the correct answer (Algebra and Discrete Mathematics) immediately, the other three took a short span of time before finding the correct answer.
They also told us that the information on this date being an exam is not emphasised enough.

12. **What dates do you have today?**
All students identified the three dates below "Today" correctly.

13. **Which deadlines do you have this week?**
Everyone found the two deadlines in the Dates section. However, one student was not sure if "upcoming" meant the entire next week.

14. **What does the mail icon beside a date mean? Moreover, what is the difference between an open and closed mail?**
The first four participants were asked about the bell symbol instead of the mail icon. None of them was able to guess the real reason for this symbol. They described it as an icon that looks alarming and reminded two of them of an alarm clock on their smartphone. They could not explain the difference between the ringing bell and the regular bell. After explaining the intention

of the symbol to them, one student immediately mentioned that a mail icon would be easier to understand, while the others liked the mail icon better after it was shown to them.

Of the students who were shown the mail icon, three understood the meaning while all understood the open and closed icon as read and not read. One of them preferred the bell icon since he thinks that the bell is more alarming than the mail icon for important news.

15. **Where does the lecture "Algebra and Discrete Mathematics" take place?**
All students were able to tell that the lecture takes place in the Audimax.

16. **How can you find your way to the Audimax if you do not know where it is?**
Everyone would try to click on the Audimax label, which leads to the expanded view for this date. This also includes the desired information about where to find the Audimax in an interactive map. Some of the students also liked the idea of additional information about the lecturer and the available slides for this date.

17. **How can you see all your dates?**
Four students found the Calendar entry in the menu first, one the Calendar link below upcoming dates and three found both links at once. This means the calendar is easy to find, and both links are useful.

18. **How much of the course "HCI in Healthcare" have you already done?**
All eight participants figured out that the course is almost done. One of them suggested colouring the progress bar in red if a student cannot pass the course for some reason, like missing a mandatory exam.

19. **When is the next date for the course "Algebra and Discrete Mathematics"?**
Four students found the next date at the Dates section while the other four found the "Next Date" Point in the My Courses section. The ones who looked at the Dates section first also found the Next Date information in My Courses. One of them mentioned that it is not entirely clear what Next Date includes since there are lectures, exams or deadlines.

20. **What does the arrow next to the course "Formal Modelling" mean?**
While no one could guess the meaning of the icon, they liked the reminder after an explanation. Three students liked the arrow better while three liked the three dots more. The other two mentioned that both icons are not suitable. One of them suggested symbolising a hand that is pressing on a button. He thinks this could better be interpreted as a call to action. After a quick google

search, we can confirm that such an icon is often used as a call to action and therefore better than the arrow or the dots.

21. **How can you navigate to another dashboard area in the mobile view?**
    Two students would try to scroll down, two would use the icons at the bottom of the screen and two would use the burger menu at the top. The last two were not asked this question. When asking them for other methods on how they could navigate between the screens, they also thought about swiping between the screens. However, generally speaking, the icons at the bottom of the screen followed by scrolling are the most mentioned guesses when counting the second guess of the students as well.

22. **Are you missing important information you would need for your real studies?**

23. **Would you prefer this solution over the one at your university?**
    While the participants mentioned some wishes, it came out that all relevant information for every day is already included in the dashboard. They asked for information about studying abroad, or for courses and exams. While the first is not relevant for a student every day, the latter is already available and the student who mentioned this figured this out by herself. Another wish was that there should not be several platforms where they have to search for information but one central tool. This is an entirely different matter. All other things mentioned were similar or had nothing to do with information on the dashboard. That leads us to the conclusion that no important information is missing on the dashboard.

24. **Do you like the layout?**
    The students generally liked the layout and mentioned clarity and simplicity. One asked to structure the four blocks stronger, so that their affiliation would be more natural to recognise — including a suggestion to achieve this with more whitespace between the categories. Another one would like to sort the categories on the dashboard herself. When asking her how she would order the categories, she mentioned that she would switch the position of courses and notifications.
    Two participants mentioned that there were many lines, and if it was possible to reduce them somehow. The circular chart that breaks the lines from the rest of the interface was perceived positively. In summary, the layout is well perceived, while some of the participants would change some minor details. However, all participants would prefer the concept over the system they are currently using.

6.8 Findings

The result of the evaluation shows that the concept is well done, but we still found some minor issues during the user tests that can be improved. The following issues were discovered during the evaluations and should be considered before implementing the concept in a real environment:

- It should be possible to swipe Notifications from the dashboard, so they go into the archive.

- The icon to put a notification into the archive is not understood well and should be changed.

- The three sections of the Progress circle diagram should be clickable to deliver detailed information about the section.

- The progress indicator does not work when a student already does master courses while not being finished with their bachelor studies. This could either be neglected, since students should not do this (but actually do this often at TU Wien), or the view could be switched between master and bachelor program.

- The naming for the entries in the menu is not always clear, as well as the order. This issue is examined in the work of Kristina Heidinger [59].

- In the Date section, it is necessary to distinguish between courses, exams and deadlines more easily. Colour coding could do so but also affects the simplicity of the layout.

- Colour coding could also be used to mark deadlines where the student has already done the hand in or to emphasise deadlines and exams that are coming up soon.

- Since it was not clear to the participants that upcoming in the dates section means the next seven days, this should be explained.

- When a current course is not passable for some reason like missing a deadline, it should be emphasised with colour coding as well. E.g. the progress bar could be red instead of blue.

- The "Next Date" information in My Courses is not understood well since students do not know what kind of dates are included. Either this can be

clarified with additional information when moving the mouse over the text, or it could be changed to "Next Lecture", and only lectures are displayed.

- The call to action icon next to Formal Modeling in My Courses should be changed to a hand that is pressing on a button.

- The four sections on the desktop should be stronger separated with more whitespace in between.

- The used font could be fitted to the corporate design of the university. In the Concept Material Design Fonts are used.

Conclusion 7

> *There is no real ending. It's just the place where you stop the story.*
>
> — **Frank Herbert**
> (American fiction writer)

In this Thesis, we explored different aspects from multiple sources, that are relevant for designing an SIS. This Includes research already done about SIS design, but available information about this topic is rare and not helpful when designing new aspects for an SIS. In literature about Visual Design, we learned a lot about how to design a website for the intended use case, which rules apply for an information system and how to emphasise the emotions of the users. This can be achieved by applying different rules, guidelines or using predefined frameworks. Also, the choice of colour may be relevant and is either related to emotions that should be represented or even more often, the corporate design of an institution. Furthermore, the usage of adequate typography is of central importance.

All these findings of visual design should be considered when designing an SIS or parts of it. However, other aspects cannot be neglected either. The information architecture has been treated briefly and is described in detail by Kristina Heidinger in her Thesis.

Design and interaction aesthetics are hard to measure, and it is even harder to create guidelines for them. However, it is good to think about aspects of how the usage of software should feel and to keep this in mind when creating one. This refers to aspects like how the interaction of software is designed, which can only be described in our concepts while testing. Evaluation of it would need high-level prototypes.

In an in-depth analysis of existing SISs, we were able to elaborate on many positive aspects. However, there are even more issues which leave room for improvement. Furthermore, the visual appearance of most of these systems can be considered as outdated and would need a refresh in order to look appealing to students. In general, all systems we considered did not provide the same user experience we know from commercial customer services and could be improved or renewed.

With the design concept for an SIS dashboard, we wanted to combine the gathered knowledge from theory with the insights we have collected from different SISs.

Therefore, we based the concept on the Google Material Design framework and used the corporate colours of the TU Wien. Other concepts we described like composition, gestalt laws or textures were also considered while designing the concept.

The evaluation of the dashboard concept proved our theory that the current systems could easily be improved. All participants of the evaluation liked our concept much more than the system they currently work with. We were able to discover some minor issues during the evaluation, which are easy to change in a concept phase.

7.1 Future Work

While we were able to prove that it is easy to improve on existing solutions, we did so only with a dashboard. In further work of Kristina Heidinger, we want to deliver this proof of concept for the whole system. This includes the Information Architecture as well as the design of other sites in the systems.

In further steps, the concepts have to be realised as real software for further testing. This would allow finding issues during real use. Once confident that the new concept works, the next step would be a pilot phase where some students use the system. In this phase, it would be possible to detect issues in operation before releasing the software for all students.

We are confident that our concept can help SIS operators to improve their systems and the user experience students face when using them.

Bibliography

[1]   Jason Beaird and James George. *The Principles of Beautiful Web Design*. SitePoint, 2014 (cit. on pp. 3, 7, 14, 15, 20, 21).

[2]   Martin Hahn. *Webdesign: das Handbuch zur Webgestaltung;[attraktive Websites gestalten: Layouts, Typografie, Farbe, Bilder; Website-Konzeption, Usability und Responsive Webdesign; mit vielen inspirierenden Website-Beispielen; DVD-ROM: Video-Lektionen zum modernen Webd*. Galileo Press, 2015 (cit. on pp. 3, 6, 8, 13, 15, 16, 20, 27).

[3]   Robert Bringhurst. *The elements of typographic style*. Hartley & Marks Point Roberts, WA, 2004 (cit. on p. 3).

[4]   Richard Rutter. *Web typography: a handbook for designing beautiful and effective responsive typography*. Ampersand Type, 2017 (cit. on pp. 3, 20).

[5]   Alison Black, Paul Luna, Ole Lund, and Sue Walker. *Information design*. Routledge, 2017 (cit. on p. 3).

[6]   Jonas Löwgren. „Toward an articulation of interaction esthetics". In: *New Review of Hypermedia and Multimedia* 15.2 (2009), pp. 129–146 (cit. on pp. 3, 24).

[7]   Paul Hekkert. „Design aesthetics: principles of pleasure in design". In: *Psychology science* 48.2 (2006), p. 157 (cit. on pp. 3, 23, 24).

[8]   Muhammad Asif and John Krogstie. „Mobile student information system". In: *Campus-Wide Information Systems* 28.1 (2011), pp. 5–15 (cit. on p. 3).

[10]   Patricio Esteban Ramírez-Correa, Francisco Javier Rondán-Cataluña, and Jorge Arenas-Gaitán. „Student information system satisfaction in higher education: the role of visual aesthetics". In: *Kybernetes* (2018) (cit. on pp. 3, 25).

[11]   Mohammed Thamir Atta and Romli Awanis. „The Impact of Information Quality and Usability on Intention to Use Student Information System". In: (2017) (cit. on pp. 3, 6, 23, 60).

[12]   David Benkő et al. „TISS Design Report". In: (2017) (cit. on pp. 4, 5, 29).

[13]   David Benkő and Stefan Sterz. „Richtlinien für die Gestaltung von TISS". In: (2018) (cit. on pp. 4, 5).

[14]   Simon Hayden. „Evaluierung von Designkonzepten für die Studienplanung". In: (2018) (cit. on pp. 4, 5, 62).

[15] William H DeLone and Ephraim R McLean. „Information systems success: The quest for the dependent variable". In: *Information systems research* 3.1 (1992), pp. 60–95 (cit. on p. 6).

[16] Moshe Zviran, Chanan Glezer, and Itay Avni. „User satisfaction from commercial web sites: The effect of design and use". In: *Information & management* 43.2 (2006), pp. 157–178 (cit. on p. 6).

[18] Alina Wheeler. *A Complete Guide to Creating, Building, and Maintaining Strong Brands*. Wiley, 2006 (cit. on p. 6).

[20] Jerry Cao and Cousins Carrie. *Web Design Trends 2018*. UXPin, 2018 (cit. on pp. 7, 8, 14).

[35] Kurt Koffka. *Principles of Gestalt psychology*. Routledge, 2013 (cit. on p. 12).

[36] Markus Dahm. *Grundlagen der Mensch-computer-interaktion*. Pearson Studium München, 2006 (cit. on pp. 12, 13).

[38] Mario Livio. *The golden ratio: The story of phi, the world's most astonishing number*. Broadway Books, 2008 (cit. on p. 13).

[39] William W Lee and Diana L Owens. *Multimedia-based instructional design: computer-based training, web-based training, distance broadcast training, performance-based solutions*. John Wiley & Sons, 2004 (cit. on p. 13).

[42] Jerry Treder Marcin; Cao and Vince Ho. *Enterprise UX Industry Report 2017 to 2018*. UXPin, 2017 (cit. on p. 14).

[43] Herman Cerrato. „The meaning of colors". In: *Viitattu* 18 (2012), p. 2017 (cit. on p. 15).

[45] Jennifer Birch. „Worldwide prevalence of red-green color deficiency". In: *JOSA A* 29.3 (2012), pp. 313–320 (cit. on p. 16).

[47] Stephan Reichelt, Ralf Häussler, Gerald Fütterer, and Norbert Leister. „Depth cues in human visual perception and their realization in 3D displays". In: *Three-Dimensional Imaging, Visualization, and Display 2010 and Display Technologies and Applications for Defense, Security, and Avionics IV*. Vol. 7690. International Society for Optics and Photonics. 2010, 76900B (cit. on p. 16).

[52] Jason Santa Maria. *On web typography*. A Book Apart, 2014 (cit. on p. 20).

[53] Rayan Abdullah and Roger Hübner. *Pictograms, icons & signs: A guide to information graphics*. WW Norton, 2006 (cit. on p. 21).

[54] Jinyan Hu, Shaojing Song, and Yumei Gong. „Comparative performance analysis of web image compression". In: *Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI), 2017 10th International Congress on*. IEEE. 2017, pp. 1–5 (cit. on p. 21).

[55] Louis Rosenfeld and Peter Morville. *Information architecture for the world wide web*. " O'Reilly Media, Inc.", 2002 (cit. on pp. 22, 23).

[59] Kristina Heidinger. „Information Architecture of Student Information Systems (working title)". MA thesis. Karlsplatz 13, 1040 Wien: TU Wien, Dec. 2019 (cit. on pp. 23, 77, 95).

[60] Don Norman. „Emotion & design: attractive things work better". In: *interactions* 9.4 (2002), pp. 36–42 (cit. on p. 23).

[61] Donald A Norman. *Emotional design: Why we love (or hate) everyday things*. Basic Civitas Books, 2004 (cit. on p. 23).

[62] Jonas Löwgren. „Pliability as an experiential quality: Exploring the aesthetics of interaction design". In: *Artifact: Journal of Design Practice* 1.2 (2007), pp. 85–95 (cit. on p. 24).

[63] Roger Scruton. „The aesthetic understanding: Essays in the philosophy of art and culture". In: (1983) (cit. on p. 25).

[64] Ray Jackendoff. *Consciousness and the computational mind*. The MIT Press, 1987 (cit. on p. 25).

[70] Johannes Dostal, Rene Koller, Saskia Walker, and Daniela Stoll. „Problems and Hurdles of Freshly Starting Informatics Students at TU Wien: A User Research". In: (2017) (cit. on p. 34).

Web pages

[9] CACI. *OSIRIS*. 2018. URL: https://www.caci.nl/en/osiris (visited on Oct. 19, 2018) (cit. on pp. 3, 43–47).

[17] UX Booth. *How Visual Design Makes for Great UX*. 2018. URL: https://www.uxbooth.com/articles/how-visual-design-makes-for-great-ux/ (visited on Nov. 5, 2018) (cit. on p. 6).

[19] Mat and Kat. *Anatomy of a web page*. 2017. URL: https://www.iteracy.com/blog/post/anatomy-of-a-web-page (visited on Nov. 6, 2018) (cit. on p. 7).

[21] Philip Morris Tom May. *12 huge web design trends for 2018*. 2018. URL: https://www.creativebloq.com/features/web-design-trends (visited on Nov. 6, 2018) (cit. on pp. 7, 8).

[22] Lennart de Ridder. *9 cutting-edge web design trends for 2018*. 2018. URL: https://en.99designs.at/blog/trends/web-design-trends-2018/ (visited on Nov. 6, 2018) (cit. on pp. 7, 8).

[23] 960. *960 Grid System*. 2018. URL: https://960.gs/ (visited on Nov. 6, 2018) (cit. on p. 8).

[24] Unsemantic. *Unsemantic CSS Framework*. 2018. URL: https://unsemantic.com/ (visited on Nov. 6, 2018) (cit. on p. 8).

[25] Bootstrap. *Bootstrap*. 2018. URL: https://getbootstrap.com/ (visited on Nov. 6, 2018) (cit. on p. 8).

[26] Foundation. *Foundation*. 2018. URL: https://foundation.zurb.com/ (visited on Nov. 6, 2018) (cit. on p. 8).

[27] Statista. *Percentage of all global web pages served to mobile phones from 2009 to 2018*. 2018. URL: https://www.statista.com/statistics/241462/global-mobile-phone-website-traffic-share/ (visited on Nov. 9, 2018) (cit. on p. 8).

[28] Ethan Marcotte. *Responsive Web Design*. 2010. URL: https://alistapart.com/article/responsive-web-design (visited on Nov. 9, 2018) (cit. on p. 8).

[29] Ethan Marcotte. *Responsive Web Design*. 2010. URL: https://alistapart.com/article/responsive-web-design (visited on Nov. 9, 2018) (cit. on pp. 8, 17).

[30] Ethan Marcotte. *A Flexible Grid*. 2010. URL: https://alistapart.com/d/responsive-web-design/ex/ex-site-larger.html (visited on Nov. 9, 2018) (cit. on p. 9).

[31] James Foster. *Don't Be Afraid of the Hamburger: A/B Test*. 2014. URL: http://web.archive.org/web/20160918144439/http://exisweb.net:80/hamburger-is-ok (visited on Nov. 12, 2018) (cit. on p. 10).

[32] Aptimize. *The Ultimate Guide to the Hamburger Menu and Its Alternatives*. 2018. URL: https://uxplanet.org/the-ultimate-guide-to-the-hamburger-menu-and-its-alternatives-e2da8dc7f1db (visited on Nov. 12, 2018) (cit. on p. 10).

[33] Icora. *Icora*. 2018. URL: http://www.icora.com/ (visited on Nov. 6, 2018) (cit. on p. 11).

[34] Duplos. *Duplos*. 2018. URL: http://duplos.org/ (visited on Nov. 6, 2018) (cit. on p. 11).

[37] Sita Vriend. *Game design and Gestalt laws*. 2017. URL: http://www.tinker-entertainment.com/sitavriend/psychology-and-games/game-design-and-gestalt-laws/ (visited on Nov. 7, 2018) (cit. on p. 13).

[40] Polaris. *Polaris*. 2018. URL: https://polaris.shopify.com/ (visited on Nov. 8, 2018) (cit. on p. 14).

[41] Google. *Material*. 2018. URL: https://material.io/ (visited on Nov. 8, 2018) (cit. on pp. 14, 16, 43).

[44] Ran Enoch. *Paletton*. 2018. URL: http://paletton.com (visited on Nov. 30, 2018) (cit. on p. 16).

[46] TU Wien. *TU Wien*. 2018. URL: https://tutest.tuwien.ac.at/ (visited on Oct. 25, 2018) (cit. on p. 16).

[48] Apple. *Apple*. 2018. URL: https://www.apple.com (visited on Dec. 3, 2018) (cit. on p. 17).

[49] Oliver Reichenstein. *Web Design is 95% Typography*. 2006. URL: https://ia.net/topics/the-web-is-all-about-typography-period (visited on Dec. 7, 2018) (cit. on p. 17).

[50] Font Awesome. *Font Awesome*. 2018. URL: https://fontawesome.com/ (visited on Dec. 17, 2018) (cit. on p. 18).

[51] Wikimedia. *The river effect in justified text*. 2018. URL: https://commons.wikimedia.org/wiki/File:The_river_effect_in_justified_text.jpg (visited on Dec. 18, 2018) (cit. on p. 20).

[56] Alina Arhipova. *Information Architecture. Basics for Designers*. 2018. URL: https://tubikstudio.com/information-architecture-basics-for-designers/ (visited on Jan. 9, 2019) (cit. on p. 23).

[57]   UX Booth. *Complete Beginner's Guide to Information Architecture*. 2018. URL: https://www.uxbooth.com/articles/complete-beginners-guide-to-information-architecture/ (visited on Jan. 9, 2019) (cit. on p. 23).

[58]   Pia Klancar. *An Excellent Beginner's Guide To Information Architecture*. 2018. URL: https://careerfoundry.com/en/blog/ux-design/a-beginners-guide-to-information-architecture/ (visited on Jan. 9, 2019) (cit. on p. 23).

[65]   New York Times. *The New York Times*. 2019. URL: https://www.nytimes.com/ (visited on Jan. 5, 2019) (cit. on p. 26).

[66]   TU Wien. *Corporate Design Manual*. 2015. URL: https://www.tuwien.ac.at/fileadmin/t/tuwien/downloads/cd/CD_2015/TU_CD-Manual_2015.pdf (visited on Jan. 4, 2019) (cit. on p. 26).

[67]   Deanna deBara. *How to build a great corporate design for your business*. 2018. URL: https://en.99designs.at/blog/logo-branding/how-to-build-corporate-design/ (visited on Jan. 5, 2019) (cit. on p. 26).

[68]   TISS. *TISS*. 2019. URL: https://tiss.tuwien.ac.at/ (visited on Jan. 16, 2019) (cit. on pp. 29, 30, 35).

[69]   WU. *WU Campus Plan*. 2019. URL: https://campus.wu.ac.at (visited on Jan. 22, 2019) (cit. on pp. 30, 42, 83).

[71]   FH Technikum Wien. *FH Technikum Wien*. 2019. URL: https://www.technikum-wien.at/en/ (visited on Feb. 16, 2019) (cit. on p. 36).

[72]   FH St. Pölten. *FH St. Pölten*. 2019. URL: https://www.fhstp.ac.at (visited on Jan. 16, 2019) (cit. on p. 36).

[73]   University of Vienna. *U:space*. 2019. URL: https://uspace.univie.ac.at (visited on Jan. 16, 2019) (cit. on p. 38).

[74]   Catalysts. *U:Space*. 2019. URL: https://www.catalysts.cc/projects/uspace/ (visited on Mar. 15, 2019) (cit. on p. 38).

[75]   Vienna University of Economics and Business. *LPIS*. 2019. URL: https://www.wu.ac.at/studierende/tools-services/lpis/ (visited on Jan. 16, 2019) (cit. on p. 41).

[76]   SAP. *Die SAP-Lösungen für Hochschulen*. 2019. URL: https://www.sap.com/germany/documents/2015/10/4cc4de35-457c-0010-82c7-eda71af511fa.html (visited on Jan. 16, 2019) (cit. on p. 48).

[77]   SAP. *Fiori*. 2019. URL: https://www.sap.com/products/fiori.html (visited on Feb. 19, 2019) (cit. on p. 48).

[78]   SAP. *SAP Red Dot*. 2019. URL: https://news.sap.com/2015/09/sap-wins-prestigious-red-dot-award-design-concept/ (visited on Feb. 19, 2019) (cit. on p. 48).

[79]   Datenlotsen. *Datenlotsen*. 2019. URL: http://www.datenlotsen.de/ (visited on Mar. 21, 2019) (cit. on p. 52).

[80]   Moritz Resl. *Moritz Resl*. 2019. URL: https://process.studio/about/ (visited on Feb. 28, 2019) (cit. on p. 55).

[81]   Tom Haberfellner. *Tom Haberfellner*. 2019. URL: https://www.linkedin.com/in/tomizza/?originalSubdomain=at (visited on Feb. 28, 2019) (cit. on p. 55).

[82] Georg Kaindl. *Georg Kaindl*. 2019. URL: http://gkaindl.com/ (visited on Feb. 28, 2019) (cit. on p. 55).

[83] Peter Purgathofer. *Peter Purgathofer*. 2019. URL: http://igw.tuwien.ac.at/hci/people/ppurgathofer (visited on Feb. 28, 2019) (cit. on p. 55).

[84] Kate Kaplan. *Planning Effective UX Workshop Agendas*. 2017. URL: https://www.nngroup.com/articles/ux-workshop-agendas/ (visited on Jan. 16, 2019) (cit. on p. 55).

[85] Studo. *Studo*. 2019. URL: https://studo.co/ (visited on Mar. 13, 2019) (cit. on p. 75).

List of Figures

Colophon

This thesis was typeset with $\LaTeX 2_\varepsilon$. It uses the *Clean Thesis* style developed by Ricardo Langner. The design of the *Clean Thesis* style is inspired by user guide documents from Apple Inc.

Download the *Clean Thesis* style at `http://cleanthesis.der-ric.de/`.