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**ANALYSIS OF THE USER INTERFACE OF THE STUDENT
PORTAL STUDENT.TALTECH.EE AND CREATION OF A
PROTOTYPE OF ADDITIONAL FUNCTIONALITY**

Bachelor's Thesis

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Magistrikraad

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TALLINNA TEHNIKAÜLIKOOL
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**TUDENGI PORTAALI STUDENT.TALTECH.EE
KASUTAJALIIDESE ANALÜÜS JA
LISAFUNKTSIONAALSUSE PROTOTÜÜBI LOOMINE**

Bakalaureusetöö

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Tallinn 2024

Author's Declaration of Originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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Abstract

The aim of the following bachelor's thesis is to analyze the user-friendliness of the user interface of the student portal `student.taltech.ee` and to design additional functionality elements for the user interface of the student portal in order to allow students a better overview of their study situation and reduce the workload of the dean's office by reducing questions about public education information. The purpose of the user interface analysis of the student portal is to find out whether the user interface design is a possible limitation to user-friendliness, which can reduce the use of the application by students and the effective transmission of information.

The problems that occur are related to the students' lack of knowledge of their own study information. From the information that can be found in the study information system `ÕIS` or from the study rules, such as the number of mandatory subject points each semester and the financial debt arising if they are missing. In addition, it is not known whether the design of the user interface of the student portal is user-friendly enough to be suitable for daily use by students and whether there are restrictions that prevent the effective transmission of information to students.

As a result of the work, the shortcomings of the user interface design of the student portal and its suitability for use by students will be known. In addition, the basics of student portal style and user-friendly user interface design will be introduced. In addition, a calculator element is designed for the student portal, which calculates the students' missing course points and the related financial debt. In order to make information on the progress of their studies available to students, the element of study modules is also designed. Changes will also be made to the subjects of my semester and the elements of my curriculum to provide additional information.

The thesis is written in English and is 30 pages long, including 16 chapters, 7 figures and 0 tables.

Annotatsioon

Tudengi portaali student.taltech.ee kasutajaliidese analüüs ja lisafunktsionaalsuse prototüübi loomine

Järgneva bakalaureusetöö eesmärgiks on analüüsida tudengiportaali student.taltech.ee kasutaja liidese kasutajasõbralikkust ja disainida tudengiportaali kasutaja liidesele lisa funktsionaalsuse elemendid, et võimaldada tudengitele paremat ülevaadet nende õppe olukorrast ja vähendada deканаadi töökoormust, vähendades küsimusi avaliku õppe info kohta. Tudengiportaali kasutajaliidese analüüsi eesmärgiks on teada saada kas kasutajaliidese disain on võimalikud piirangud kasutajasõbralikkusele, mis võib vähendada rakenduse kasutust tudengite poolt ja efektiivset info edastust.

Esinevateks probleemideks on tudengite teadmatust nende enda õppe informatsioonist. Informatsioonist, mis on leitav õppe informatsiooni süsteemis ÕIS või õppetöö reeglitest, nagu kohustuslik õppeaine punktide arv iga semester ja nende puudu jäämisel tekkiv rahaline võlg. Lisaks teadmatust, kas tudengiportaali kasutajaliidese disain on piisavalt kasutajasõbralik, et see sobiks tudengitele igapäevaseks kasutamiseks ja kas on piirangud, mis takistavad tudengitele efektiivse informatsiooni edastuse.

Töö tulemusena saadakse teada tudengiportaali kasutajaliidese disaini puudujäägid ja sobilikkus tudengitele kasutuseks. Peale selle tutvutakse tudengiportaali stiili ja kasutaja sõbraliku kasutajaliidese disaini põhitõdedega. Lisaks disainitakse tudengiportalile kalkulaator element, mis arvutab tudeni puudujäävad õppe aine punktid ja sellega seotud rahalise võla. Tudengitele nende õppe progressi informatsiooni kättesaadavaks muutmiseks, disainitakse ka õppe moodulite element. Tehakse muudatusi ka minu semestri ained ja minu õppekava elementidele lisa informatsiooni pakkumiseks.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 30 leheküljel, 16 peatükki, 7 joonist, 0 tabelit.

List of Abbreviations and Terms

ÕIS	ÕppeInfoSüsteem(Learning information system)
ECTS	the European Credit Transfer System
HTML	HyperText Markup Language
CSS	Cascading Style Sheets
HID	Human Interface Device
CUI	Character User Interface
UI	User Interface
HTML5	Hypertext Markup Language 5
EAP	Euroopa AinePunkt(European academic credit)

Table of Contents

1	Introduction	9
2	Researching User Interface Design Principles	11
2.1	Introduction To User Interfaces	11
2.2	Design Principles	13
2.2.1	Interaction Design Principles	14
2.2.2	Visual Design Principles	16
2.2.3	Information Architecture	18
3	Analyzing Student Portals User Interface	20
3.1	Interaction Design Analysis	21
3.2	Visual Design Analysis	23
3.3	Information Architecture Analysis	25
3.4	Analysis Conclusion	26
4	Creating Prototypes Of Additional User Interface elements	28
4.1	Curriculum Modules Element	29
4.1.1	Interaction Design	30
4.1.2	Visual Design	30
4.1.3	Information Architecture	31
4.1.4	Dynamic Design	31
4.1.5	Curriculum Modules Element In React	32
4.2	Information Module	33
4.2.1	Design Principles	33
4.2.2	Dynamic Design	33
4.2.3	Information Module Element In React	34
4.3	Semester Curriculum Module	35
4.3.1	Design Principles	35
4.3.2	Semester Curriculum Module Element In React	35
4.4	Price Calculator Module Element	36
4.4.1	Interaction Design Principles	36
4.4.2	Visual Design Principles	37
4.4.3	Information Architecture Principles	37
4.4.4	Dynamic Design	38
4.4.5	Price Calculator Element In React	38

5	Feedback	40
5.1	User Feedback	40
5.2	Client Feedback	41
6	Summary	43
7	Kokkuvõte	45
	References	47
	Appendix 1 – Non-Exclusive License for Reproduction and Publication of a Graduation Thesis	50

List of Figures

1	Figma prototype	29
2	Study program completion element	30
3	Study program completion element in a mobile displayport	32
4	My curriculum element	33
5	My curriculum element mobile version	34
6	My semester courses element	35
7	Calculator element	36

List of Tables

1. Introduction

The Taltech student portal is an application that provides students with information about their education and university activities. The portal gives the perception that it is made for students to be a way to quickly check their timetable, news and other relevant information. With plans of additional functionality implementations on the horizon a question if the user interface design of this application is as user friendly as it is implied to be arises. In the case of the student portal truly being an simple and comfortable way to quickly get attuned with educational information, many other problems could be solved by providing students with answers to frequently asked questions and reminding students of areas that need immediate attention.

The problem that was brought to attention was that many students go to or call the deans office with questions about their educational progress, rules and other information that is actually available to them in the ÕIS portal or Taltech-s website. For students the most likely reason is that the information is not as visible as it would seem. Now if that information would be provided in a place that was meant to be checked often by the student, then perhaps the students would be more informed. As the student portal student.taltech.ee is intended to fill that position it seems as the perfect place to create a solution to this problem. So an additional question to find an answer to is if the design of the user interface of the student portal meets intended use requirements? Furthermore what even are those requirements?

The following specific problems were discussed to be solved.

- Students are not aware of the rules of required ECTS credits and suffer unpredictable financial debt due to uninformed choices with their semester study plan.
- Students ask the deans office information that is available for the students, but they are not able to find it. The information that is asked most often is about the completeness of their study program and the number of semesters they have learned.
- The deans office has to go through a list of students manually to check if their semester subject plan is saved and submitted.

In this bachelor thesis the requirements of good user interface design principles are going to be researched and based on the collected knowledge an analysis of the student portals user interfaces design will be provided. The main limitations and problems of this application

will hopefully be found and can be referenced in future development. The objective of the research and analysis is to make sure the student portals user interface is as simple and regularly usable as it is seemingly meant to be. Furthermore the analysis and research should provide an understanding of how to design new elements for the student portal and fit into it seamlessly. To solve the previously specified problems some additional user interface elements are going to be designed for the application. Firstly a calculator to display possible dept to the user. For information about the progress of a student in their curriculum a element that displays the students curriculum modules and the progress in each of those modules. Furthermore for two elements more information and functionality is going to be added. Specifically for my semester courses element a token of if the plan is submitted or not is going to be added and for my curriculum element additional information elements are to be added. The main goal here is for the created prototype elements to be with a sufficient design for the user and customer in addition the code is to be easily implemented and used in the application. For feedback a small sample of users are going to be presented with a survey that contains questions about the prototype elements and the result is going to be published in this paper. Iterations of the elements are also going to be provided to the customer and requirements will be taken into account.

The work process will be divided into three main parts. Where the first part will be focusing on research on the best practices and parts of user interface design. For the second part using the previously gathered information an analysis of the student portals user interface is going to be made and a conclusion on if the student portals user interfaces design follows the principles and meets the expected requirements of a regularly usable application that provides the user information effectively. In the third part prototype elements will be designed using HTML, CSS, Typescript possibly in the react framework and the development process and decisions will be described. Finally as a part of the third section feedback on the elements will be described based on the user responses.

2. Researching User Interface Design Principles

A user interface is a point of contact between a user and a device of some sort. The interaction between a device and a user is made possible by this and is accompanied by multiple layers and multi sensory user interfaces. For example using a mobile device like a smartphone people are able to alter the device via touchscreen that takes a physical action and turns that into a digital signal that is able to be understood by the device, but users are also receiving feedback on actions on said device via the screen. Yet if humans are presented with machine code on the screen it isn't very helpful is it? So the device has programs in place to convert and structure information to a human readable format. Presenting users with images and buttons, texts and a plethora of other elements. Thus a multi layered interface and previously mentioned multi sensory interface described in the example as touch and visual. [1]

2.1 Introduction To User Interfaces

Previously looked at user interface definition has quite the large scope and would be impractical to analyze in the context of this study. Next a look at how user interfaces are generally categorized and what fits the bill in the case of the student portal. As mentioned before, user interfaces are composed of one or many layers so beginning with those. First thing that pops into mind is hardware. Computer mice are used to interact with a computer and that fits the definition. So here's the first layer. Hardware - Users interact with computers via physical devices. Devices that take physical inputs from a user and/or give physical outputs. What a hardware user interface does is convert something into a signal or vice versa. So that a user or a device can interpret it. Examples of these devices are computer mice, keyboards, monitors and so on. Now this is all fine and dandy but it's impractical designing or giving people new hardware to interact with a website better. The thing that can be changed is software so the second layer is. Software - As hardware user interfaces deal with the physical, software deals in the digital. Devices need to understand what users are conveying to them via the hardware interface. And humans need to be able to make sense of the signals that the devices are conveying back to us. So developers write out the descriptions of how users want to sense and what our outputs should be interpreted as. For example a press on a keyboard needs a piece of software to understand that you are conveying a specific key. Examples of these software's are human interface device (HID) drivers. In our case software user interfaces do fit the best at the moment. Still it's not specific enough.

Digging deeper user interfaces are further divided by the human senses they interact with. So let's list them out. Tactile User Interface - This is focused on touch and movement like a computer mouse or a touch screen. Visual User Interface - This, as the name suggests is tied to sight and examples of it are monitors and screens of all kinds. Auditory User Interface - These are responsible for acting on our auditory systems and deal with sound. An example of this is headphones or a microphone. Olfactory User Interface - This is a more niche user interface that deals with conveying a sense of smell. Examples of this type of interface exist but are not relevant in the context of the student portal, this is not really relevant. Equilibra User Interface - This is a user interface that is bound to our sense of balance. Equilibra User Interfaces are rising in popularity in the field of virtual reality and some research areas but are not applicable to our case. Gustatory User Interface - Again quite the niche area of user interfaces regarding taste. Very difficult to implement and limited to very specific use cases. Use cases that do not include a website for visualizing academic information so a skip for this one.[1, 2]

The conclusion here is that when interacting with a website two sensory user interfaces are used. For the user to see what they are doing and visualize information that is given. They use a visual user interface. Furthermore to navigate and input data via keyboard, mouse or a touchscreen which falls under the tactile user interface category. A user interface that works with multiple senses is called a Composite User Interface or a CUI. This is generally subdivided into standard, virtual and augmented CUIs. Because the student portal is a standard composite user interface, the latter is going to be ignored and focus will be put on the standard subcategory. Some of the more popular standard composite user interfaces are Graphical User Interface - A graphical user interface is composed of different graphical elements that are displayed to the user. Often these elements are interactive and can be manipulated by the user via a tactile user interface. These elements vary in functionality and combine to serve an experience to a user. Command line user interface - Command line user interfaces are more expressed in text and less in interactive graphical elements. Users must interact by typing commands and are then presented with relevant content. These user interfaces were widely popular before the introduction of modern computer mice. Voice user interface - In a voice user interface system the input from a user is given by voice commands. Feedback from a device can vary from a visual user interface and/or many others in combination. Voice user interfaces have been in use for a long time but have gained steam in popularity with the integration of Siri, Google assistant and Alexa to everyday devices.[3]

By now a conclusion can be made on what this document is going to be focusing on. In the case of the student portal that is being looked at, it is composed of a Composite user interface that includes a visual user interface and a tactile user interface. Known more

commonly as a graphical user interface. The functionality of this user interface is depicted as software. Where the structure and elements are represented as HTML and the design of those elements presented by css. Interaction between the user and the elements however is dealt with by javascript.

2.2 Design Principles

Previously, the basic elements that are worked with, were discussed. HTML, CSS and some code to make it all interactive. These elements can be manipulated to make a user interface but it is necessary for it to also be good and user friendly. But what does that even mean? How to compare and quantify “good” in a user interface? Fortunately graphical user interfaces have been around for quite a while so some feedback from users exists and smart people have been able to put forth some basic principles to follow. In this case there are some specific focuses but let’s put them aside for now and continue with the basics first. To start from the beginning, the purpose of a user interface is to make it possible for a user to interact with a machine, in the case of this document a website. So designing a UI it is necessary to anticipate what a user might want to do and ensure that our provided elements make it possible to execute those actions and are easy to understand and access. The design of a UI can be divided into three parts. Interaction design - As the name suggests this part of the design is focused on the interactive properties of the user interface. Visual design - This part is more concentrated on the aesthetics of a user interface. This consists of used colors but also the placement of images, usage of fonts and other elements. To help guide the focus of the user to where it’s needed. Information architecture - By this it is meant how content is organized, structured and labeled. Here it is important to keep in mind the context and the user so that pieces can be fit together in a consistent manner that makes it easy to find information and create a full picture of the information.[4, 5]

These are the basic building blocks of a UI and an in depth look will be had at them one by one later. But there are some general principles to keep in mind with all of them. User centered - First of all the goal is to keep the user experience as good as possible. Its a priority to know the target audience and take that into account. The preferences, tendencies and skill level of users should always be kept in mind. In the context of this project information is provided to students. The general age range of people from 18 to late 20s with people being well acquainted with modern websites, thus a good skill level and preference towards commonly used structures and elements. It can also be assumed that our audiences have a lower attention span so good responsiveness and transfer of information is a must. It is also a consideration that the audience requires a multi language interface. Translated content should be provided.[4, 5]

Consistency and predictability - It is a known fact that people are more comfortable with things that are familiar to them. This is also true in designing user interfaces. Using blocks that are commonly used elsewhere makes a user interface familiar to the user and makes it easier to find and interact with it. It is assumed that when creating an interface element position should be set to places where they can most commonly be found. For example a navigation block of a website is most commonly found at the top of the page right after a name and logo so it would come without saying that changing that custom would bring inconvenience. There are of course some exceptions, but it's a good rule of thumb to follow.[4, 5]

Accessibility - Accessibility is the user interface's ability to be used by everybody. This means people who are older, younger or with disabilities are able to use an application. There are many principles to keep in mind when thinking about web accessibility. In this case some of the main points are going to be mentioned. Firstly the HTML code itself should compile correctly and completely to mitigate mishaps. Next all of the interactive elements of the user interface should be able to be used with the help of a keyboard using the tab and enter key. In addition when navigating the application via the keyboard the interactive elements should give feedback on if the element is active or not. Another thing to keep in mind is to give a keyboard user a possibility to skip over some of the more heavy interactive elements like the navigation bar, to save the user time and effort. It is also important to give the page a short and descriptive label. For people who use screen readers a correct language should be provided in the beginning of HTML. Following up with more correct HTML, it is necessary that all of the headers, sub headers, table headers, required input fields and descriptive elements are correctly written. When providing images in a user interface an alternative description for screen readers should also be used. The overall labeling should be simple and concrete so as to be understood by the elderly and the young alike.[6]

2.2.1 Interaction Design Principles

Here a more in depth look at some of the principles of interaction design will be had. To notice and apply good patterns to our application. As mentioned before, interaction design itself is focused on the interactions between a user and technology. This includes pressing buttons, creating elements, highlighting and inputting content. To simplify, it deals with actions that a user can take in a specific environment. [7]

Defining possible actions - This is more of a precursor to design but a necessary step to understand what actions can be expected, it either being a part of functionality or not. Defining possible actions means exactly what it sounds like. Imagining everything a user

can and could do. Everything from pushing buttons to inputting text. It's important to also define possible actions that a user can perform that are not in accordance with an interface's functionality. For example copying text or inputting invalid information.[8, 9, 10]

Clues and cues - If possible a user should be given clues to what effects an action has. Some good examples of this are texts on buttons or hover effects with previews. It's also necessary to slightly cue if an action is possible by for example changing an interactive element's color or hue. If a functionality consists of making certain elements active then they should stand out from the rest so that it is clear with which elements actions are performed.[8, 9, 10]

Anticipate errors - Errors are some of the most uncomfortable things to happen for both user and developer. They bring uncertainty and fear. It's self-explanatory to try to mitigate and anticipate that, so it's a must to put in place defaults and constraint inputs to functionalities requirements. But some failures can not be mitigated and so it is important to let the user know what happened and what actions the device was able to complete. This means error messages to a user should be human readable, clear and visible.[8, 9, 10]

Feedback and responsiveness - For each action there is an equal and opposite reaction. People are accustomed to getting feedback on our actions within a physical world. So to sense that our action has been acknowledged by the system, an interface should do the same. This feedback can be subtle like a change of color of an element or a loading index. In the modern age people have gotten accustomed to the virtue of fast response times of our modern systems. A user can lose interest or get frustrated fast so a good response time should be taken into account in most cases these days. A general measure to keep in mind is that immediate response is less than 0.1 second, lagging response is 0.1-1 second, interrupted response is 1-10 seconds and disrupted response is more than 10 seconds.[8, 9, 10]

Properties of elements - It might seem obvious but elements that compose a design should be thought out. Input fields should be big enough to write and read from and buttons big enough that the user has no trouble hitting them. The geometry and properties of elements should give a hint if they are able to be interacted with. As mentioned before elements should also be consistent and resemble elements a user is already familiar with. [8, 9, 10]

Simple stupid - People's short term memory can keep up with about 9 things and that's on a good day. Keep elements in chunks of five or seven so as not to overwhelm the user's mind. It's also crucial to keep in mind that simplicity is key. Try to keep the interface as

simple as possible but not so that it impairs the functionality. [8, 9, 10]

To summarize, interaction design principles are responsible for designing the parts of user interface elements that the user can interact with. When planning the interface the developer should think about all the actions possible with each interactive element to mitigate possible unexpected outcomes and to make using the elements as useful as possible to the user. The elements should give feedback and clues of the outcome of an action, to lessen the users uncertainty and give them confidence. As always errors should be taken into account and possible mishaps in the code should be presented, in human readable format, to the user when they happen to prevent confusion. The properties of elements should be logical and user centered, that means that size, color and fonts should make elements actually usable. And finally as with many things simplicity is key and the designers should create elements that don't overwhelm the user and make the website do as much of the users work as possible for them.

2.2.2 Visual Design Principles

When talking about visual design most things that make up the visual design of an interface come to mind. Looking at previous interaction design content, a few principles had visual properties incorporated in them. Due to the inherent nature of a graphical interface anything can have visual properties, but when talking about interactive design, the properties that can affect the interactivity are in focus, while when talking about visual design the focus is on the direct visual effectiveness and comfort. Next a look will be taken at some good principles to keep in mind when analyzing visual design. Visual properties in themselves are very subjective and so let's keep them light and open ended.[11, 12, 13]

Consistency - before the mentioned consistency was as being familiar to the user, with elements being recognisable as both external and internal blocks. In visual design this is equally important but by consistency it is actually meant that the whole design should be consistent. The design should come together as a whole with some shared general properties. But in some places it is also important to slightly divert from those properties to bring focus to where it's required. But the overall style and design should feel like everything fits together.[14, 15, 16, 17]

Structure - when representing visual structure it's a good idea to follow the gestalt principles of design. These are patterns that stem from psychology that describe how the human brain recognizes patterns and groups elements. The topic of gestalt psychology is complex and widely used in designing user interfaces but keeping it simple only the more important elements are brought out. Similarity, people perceive elements that look

similar to have a connection. Either similar use cases or function so they often group them together. Grouping, elements that have less space between them or are enclosed together are considered as a group by our minds. Closure, the brain is exceptionally good at making out patterns and filling in blanks with what it thinks fits the bill. For example a person can follow a dotted line and understand it as a whole. An example of a use case is in a scroll-able environment, showing the user a part of an element to indicate there is more content. Figure-ground relationship. Humans are accustomed to perceiving 3D space. Users instinctively differentiate between elements in the foreground and those in the background. Design can manipulate these effects by size, clearness and location. [14, 15, 16, 17, 18]

Space - for both creating structure and increasing readability It's necessary to give some space to elements. This should be unrecognizable from the general design while still being able to divide groups and provide a pause for a user to be able to focus. [14, 15, 16, 17]

Hierarchy - One of the most important principles of visual design is to provide hierarchy. No-matter the context human brains thirst for the comparison of priority. One way to achieve this is by visually enunciating elements in a systematic manner.[14, 15, 16, 17]

Balance - This principle is responsible for the perceived balance of the elements on an interface. When imagining size and darkness for example. The design of the page should have weight symmetry on a central vertical line. Leverage can also be applied on a horizontal axis. This should give a perception that there is equal distribution.[14, 15, 16, 17]

Contrast - As it implies, focuses on making items stand out. By emphasizing differences in size, color, direction, and other characteristics the user's focus should be drawn to points of interest. It should be kept in mind that too much contrast will make an interface tiring on the eyes. [14, 15, 16, 17]

Scale - Size can also be used to convey an element's importance. Furthermore interest and depth can be portrayed by demonstrating how each item relates to each other based on size.[14, 15, 16, 17]

Dominance - It is important to have a base for a design hierarchy. There should be a focal point with other elements being subordinate in importance. In other words it should be clear what's the main content. This is often done through scaling and contrasting based on size, color, position, shape, etc.[14, 15, 16, 17]

Similarity - It is a good idea to create recurring styles and continuity throughout a design without direct duplication. This gives a design consistency and the user clear visual cues. It also brings an interface together as a whole.[14, 15, 16, 17]

The visual design principles represent the visual aspect of the user interface elements design. One of the main principles is consistency. Which stands for a common theme amongst all the elements in the user interface. Equally important is the structure. The structure should clearly outline elements and group them together based on their purpose. With visual properties like size, location, color and other contrasting aspects, elements can be given a hierarchy and the user's focus can be drawn to specific parts of the user interface that are important. With all that we mentioned it a balance should also be kept between the horizontal and vertical center lines. Furthermore a similarity in style should be kept to make it clear that the elements are a part of the same user interface and of course for them to be visually appealing.

2.2.3 Information Architecture

One of the goals of a user interface is to provide content and convey information. The part that targets an effective way of doing so is called information architecture. The core intention of information architecture is to structure, organize and label information in such a way that it is easy for a user to find information and achieve the desired goal. The necessity for this field can be described by an example. Let's imagine an online store with a wide variety of products. It is in the interest of that store to make finding a suitable product for the customer as easy as possible to increase profits. So it is important to make a model that describes the rules for how information about the product should be maintained, interlinked, accessed and presented. To make modeling easier let's conceptualize a piece of information in context as a package, this can contain anything from text, image, video or numerical values. To label and organize attributes are needed, which can be anything from physical to abstract. Dividing up information into packages with attributes is necessary to start to look at how they can be used in combination with information architecture. Next let's have a look at some components of information architecture.[19, 20]

Organization systems - these systems account for how information is categorized and structured. Here lies information like titles, author names, shoe size, fabric and color.[19, 21]

Labeling systems - Labeling covers the way information is represented, for example what kind of terminology is used as description. If the context is a professional article about "noses", descriptive labels like "nasal cavity" should be used in addition to just "noses".[19,

21, 22]

Navigation systems - This is responsible for how users move between packages of information when they are presented with them. For example a next page button or a hyperlink.[19, 21]

Searching systems - As it implies searching systems deal with how information packets are searched for . For example this can be a search bar or a list.[19, 21]

Now that the subsystems have been discussed, what makes Information architecture, how to actually design a model? Well it's sad to say but there is no simple set of rules to follow and it really depends. There is a great book called "Information Architecture" that describes the best practices. Taking into account the simplified goal of structuring, organizing and labeling information so that it is easy for a user to consume, and to try to do so within an information ecology. In this context the information ecology contains three main aspects which are context, content and users. For context research should be made and business goals, funding, technology, resources, constraints and so fourth should be written down. Furthermore, content plans for users should be collected and analyzed. That means knowing data types, documents, content itself and its volume. As for the users, based on what our desired audience is and their needs, make necessary personas. Understand of the nature of their information seeking psychology, tasks and needs should be taken into account. it's a good idea to keep in mind their experience as well. With all the information gathered up previously mentioned systems can start to be applied . Organizing content in a way that is logical to the user and meets their needs. Labeling content in a suitable way. Creating a navigation system that's appropriate in our information ecology and making a searching system that meets the necessary criteria. Analyzing student portals user interface.[19, 21, 23]

Information architecture is different from other design aspects due to it not having discrete principles to follow. As it implies it is responsible for conveying information to the user. The different parts of information architecture describe different tasks. But the main objective is to take into account the users, bounds of the context and the content itself when creating labeling, navigation, organizing and searching systems. When creating these systems a designer should try to find the most efficient solutions while prioritizing and making accommodations while at the same time not compromising the final goal.

3. Analyzing Student Portals User Interface

User centered - First a look if its design is focused on its users. For this it is needed to define the context. This means who will be using it, what will they be using it for, and under what conditions will they be using it? As mentioned before the user base consists of students in the age range of mostly 18 to 30. They will use it to get an overview of their current academic information. As for the conditions, they can vary a lot. On a quick overview it is discerned that the design is based on a single page application with relatively simple design. All of the important information is concentrated onto a single page and a well organized main menu on the very top of the page for further information, which is a commonly used element in other web applications and thus is easy for the user to understand. The calendar element is also made in a standard way which implies its functionality. taking a look at the information that is presented. It's clear that the first element is a calendar that displays lectures and other events, with their location, duration, name and description. This is well thought out due to it being checked most often. The second information module is a mail feed which can also be checked quite often so it's good to see that as one of the first things on the page. All of the above also applies when looking at the mobile view-port sizes. A dynamic application means that the design takes into account the various conditions its users are going to use it. As a complex survey of this application is not in the content for this study, the assessment of how user centered the design of this application is will have to be done by the author of this study. As the author I can say that focus on the user has taken into account very well in this case.

Consistency and predictability - The other important general principal is being consistent and predictable with the design. As mentioned before the upper menu element is designed in a way that is commonly used in other similar applications. Furthermore looking at the calendar element it also imitates elements with similar functions. A good example of this is google calendar. Focusing towards the email feed a good comparison to the original Outlook mail feed can be seen. With the initials of the sender being focused in a circle and the address as the first line of information, followed by the title of the mail. My semester courses element is more original when it comes to design. The closest element to when it comes to functionality is the semester courses plan element in ÖIS portal. Between these elements the only similarity is the separator lines. Next, looking at the news feed all of the catchy news thumbnails have had to be left out to save view-port space, but the design has incorporated the beginning of the article which in conjunction with the general style is commonly used in simple news feed elements. Now the element with a summary of nearby

places to eat and their corresponding menus. This element contains a lot of information but is structured in a standard way that hints at what it is. A common menu style with a name on the left with a line of points continuing to the right until a price. A common location icon hinting at location information and a clock icon for the opening hours. The following element is a quick overview of the student academic information.

Accessibility - As i don't have access to the source code of the student portal. Elements do seem to be rendered correctly. Using the keyboard all of the interactive elements seem to be accessible. Furthermore all of the elements have feedback when being active. One element in the calendar called "choose option" has a less visible focus when active. No skippable object is provided though to get over the navigation bar as far as I could find. The page title displayed in the browser tab should also be better. Currency being quite long and could be made shorter. The language property of the root HTML element seems to be correctly applied. As far as I could tell, all of the correct HTML tags have been used. In many aspects style book elements are being used but these natively use the HTML5 elements so it can be considered as correct. Labels and descriptions themselves are also relevant, short and decisive.

An overview of the general principles of user interface design is as follows. When it comes to the question if the design is user centered or not, the answer inclines towards yes. The application itself is a mostly a single page design that by its simplicity is suitable for a wide range of users. For daily users the most informative elements like the calendar and mail list are the topmost elements, which is very thought out. The mobile version of the interface also condenses information down very nicely and makes it usable when on the move between classes. The only thing that could be improved is the responsiveness which is lacking but each element has a great loading indicator that informs the user. The elements are also commonly used in different Taltech applications. The calendar element has similar aspects to other commonly used elements with similar functionality and the mail element imitates the outlook mail feed. Overall my opinion is that all the general principles of user interface design are accommodated for.

3.1 Interaction Design Analysis

Clues and cues - diving deeper into the elements that users can interact with, most of the elements have a good cue functionality. The menu elements and hyperlinks get underlined when a user hovers over it. The email section has elements that change their background color and give a clue of what it does by changing the date of the email to text "go to email inbox to read". As a note the components of the news element also forwards to an external application and it would be for the users benefit to give them a clue of that action.

The theme of the background changing color continues within the application. The only element that differs is the contacts list. The first contact changes color if a user hovers over it but the others don't. This could be a design flaw. Looking at the calendar element, the events themselves could have an on hover cue or the information itself could be shown on hover but this could also be a design choice.

Errors - Now for errors, as a user I have not come across many application failures. It is clear that errors do not prevent the usage of this website. Further and deeper analysis is difficult. One bug does come to mind though. Sometimes when an auto login occurs the page fails to authenticate and the content does not appear, this is fixed by reloading the page. But if I remember correctly on the right upper side some error messages do appear telling the user that everything is not working correctly. The login process also seems to be in order and everything is accounted for. So as a conclusion errors are few and far apart and well handled overall.

Feedback and responsiveness - when reloading the application a few times and checking the load time, it turns out that the average load time is about 0.36 seconds. This by standards is considered lagging. But this isn't the full story, the average time for the full application functionality is about 3.6 seconds. This could be considered as a disrupted response but this is a single page application with many different elements requesting data so an exception can be made. The loading of the elements is dealt with pretty well. There is a loading of sorts giving feedback of what's going on to a user. All of this is also subjective and partially related to my own internet speed.

Properties of elements - Looking at the different elements it is clear that they are really well thought out. The font and size is readable, the colors don't hide text. The only negative thing that could annoy a user is the calendar element, when scrolling up and down it can be a little fidgety, it would not take that much space to extend the vertical size of that element to completely remove the need to be able to scroll. But one could argue that it's to save space.

Simple stupid - When looking at a single page application then simplicity is already a given. As far as depth goes there's not much to this application. Still the design has taken into account the limits of the users memory. No more than four elements can be in focus at the same time. Furthermore the application only contains about eight main content elements.

Summarizing the interactive design of the Taltech student portal, with most elements the actions of the users are cued in. The only element that stands out is the contacts list where

there is an inconsistency with the feedback on user interaction. The errors themselves are fortunately few between and all of the unexpected results I could find are forwarded to the user. The big shortage that was found was responsiveness. The overall responsiveness of the application was not inherently bad in my results but some of the individual elements did have a responsiveness that is considered a problem. Otherwise all of the elements had logical properties, neither the size, color or location hindered the interaction of the application.

3.2 Visual Design Analysis

Consistency and similarity- Taking a look at the styling of the application. The first thing that can be seen is the navigation menu. The color fades from red to purple to blue. This color pallet continues within the application. Each main content element has a title with a thick colored line underneath. With most elements, if they are selected the background changes color to red. This is consistent with all elements except contacts where the background turns to dark blue. Which is a good design decision due to red and blue having too large of a contrast.

Structure - when it comes to structure there has been no problems differentiating between content elements, it's clear that the structure is well designed. Here is a quick look over the basics of gestalt principles. Firstly, similarity. Looking around it is visible that all of the sub elements in the content elements are consistently the same in style, size and color. Secondly, grouping. The sub elements are clearly grouped together. There are thin but visible borders around each element, furthermore the parts of elements have little to no space between them which suggest they belong to the same element. Thirdly, closure. The structure of elements in the application is so that when the end of one element can be seen, an-other's beginning is visible. From this a user can easily deduce that there is more content. Fourth, Figure-ground relationship. There is a visible depth difference between the content elements and the background. This is achieved with a stubble tone change between foreground and background and a shade under the borders of elements that imitate a shadow.

Space - The design has done a good job giving space to elements. There is a clear line of space dividing the applications user interface in half horizontally. Moreover each element has space in beginning and the end.

Hierarchy - In the case of this user interface the elements that suggest more importance are set to the left of the vertical spacing. Calendar, semester, library, food and curriculum elements are made more important with size. Internal to the elements, with size and

color the title is enunciated and in the case of curriculum plan, the main information is punctuated.

Balance - The balance of the application seems to be well designed as well. The elements on the left are larger than the ones on the right, but balanced with denser information clusters on the right. In addition the parts on the left expand to the right beyond the vertical middle line giving elements on the left leverage.

Contrast - There is no definite contrast given to any element. But internally elements that are selected are given focus with color. In addition titles and in the case of the calendar element the column headers that represent the weekdays have a strong color difference compared to the surroundings. There is implied contrast in the curriculum information section. Where information is made visibly larger and surrounded with color to give it contrast and importance.

Scale - The largest element by size is by far the calendar element. And by width all the other elements on the left side of the interface trump the ones on the right side. So it can be deduced that the designers have wanted to draw attention to those elements.

Dominance - There is clear dominance on the application with the left side being in the focus. The largest of left side elements is the calendar which is responsible for showing the user his or her timetable and events. Which is a good idea due to it being checked most often. Emails, news and contacts are more of a subordinate, there when you need them but not the main focus at all times. Other elements in focus like the menu and users' subjects are also more notable and so have given more room.

Visually the student portal design follows the basic principles pretty well. The style uses the taltech style book consistently, having a continuous color pallet and element styling. The structure has clear and visible borders and a dimensional difference is created by a shadow along the border. The application is divided by an imaginary vertical line with elements on the left being slightly larger. Balance between the two sides is created with darker colors and information density. Hierarchy is given by the elements by size and location. Contrast is given to sub elements to provide focus to titles, labels and headers along with other subjects of importance. The scale of elements is consistent and visually appealing making everything visible. Space is provided evenly and in moderation.

3.3 Information Architecture Analysis

Navigation Systems - As information architecture goes, for a single page application at least, there is no need for a complex navigation system. But in a way a navigation system is provided. Not for the application itself but for external content. At the very top of the user interface two navigation bars are presented. The first is simply a list of reference links to related websites. The second navigation is organized as a taxonomy system. With both first and second organization done by subject matter. Searching systems - When it comes to searching systems. One exists for contacts. There are two bars to access the searching function. One on the very top right of the application and the other at the contacts element. Contacts can be searched by name, room, phone number or department. The search function takes multiple inputs and the searchable labels are relevant to the user. Which means the design has taken into account the users and the context. Labeling systems - The main content labeling system in my opinion is well designed. The titles or labels in this context have a good size and color difference. That makes it clear they are titles but at the same time don't take that much space. The used terms are clear in what they portray. As for navigation system labels, they are consistent and simple. Used terminology is based on subject matter that is familiar to the user and the underlying content is evident. In all the labeling system design is well made with the user in mind and constant style where labels create a single level hierarchy and clear wording that describes content well. Organization systems - In the case of our student portal there is not really an organization system in place. There is a navigation system referring to external sources but nothing is organized by it internally. The organization that is present has a hierarchy based on what is presented to the user first. But the system is described in length at the visual design analysis structure part.

Fortunately many aspects of information architecture are minimal at best in the case of the student portal. Navigationally we are provided with a navigation bar with some extra references to external information. Although a lot of content is presented, the information is organized well and can be easily understood. The only element that includes searching is the contacts list. The search is further referred to a searching page with different options to search with and organize the results by. The labeling of information is user centered, academically relevant and understandable by students. On mobile the labels are concentrated and none of them take too much space. As a single page application the organization system that is present is based on location. The elements deemed to be more important are presented first. Here the calendar and mail feed are set as the most important being the first elements at the top of the page.

3.4 Analysis Conclusion

Taking into account everything that has been looked at, a conclusion can be made. First the general principles. When it comes to if the interface is user centered or not, the analysis concludes that it is. For the wide age group this application is intended for the developers have made a great decision to make it a single page website. This makes it easily usable for a range of age groups. The elements are ordered in a way that the most often checked information by students is the first thing they see when visiting and the design has also taken into account smart device browsing to handle the multitudes of conditions it will be used in. The elements used in the application mimic others with similar functions and their purpose is easily deduced. There is a constant Taltech style sheet that the student portal follows and elements have consistent design in a way that elements are distinguishable. All in all the user interface is consistent and predictable. When it comes to interaction design, again it deserves some praise. All of the interactive components have cues of them being interactive. Except for the event elements inside the calendar component, which only hint at being interactive by changing the cursor. There's also a small inconsistency with the contacts being intractable but this is most likely a part of design and department contacts not having an information page. When it comes to errors there are few and far between, definitely nothing that would hinder a user from interacting with the interface. The feedback and responsiveness is fine when looking at the element's interactivity, but the author's results for load times for the whole application could be better. Now for the visual design analysis, where some good examples again are seen of the user interface design principles. The overall style is constant and consistent. There is a clear color scheme that continues throughout the application. The structure is clearly defined and each element can be easily distinguished. There is a depth difference between groups and the background and there is a good continuity with the positioning of the elements. Elements have given a good amount of space in between them and there is a difference between primary and secondary elements expressed in size. Balance is created with size and density and although contrast is not given to any specific element, there is focus led to different parts of elements internally. The dominance inclines towards the elements on the left side of the application. By scale the most dominant element is the calendar component which is one of the first elements that the user sees and checked by users most often. As for information architecture design, there is not a lot to it. The navigation system that refers to additional external information is organized well and everything needed is easily found. The searching function for contacts takes user relative information as input and gives the user a variety of options to search by and filter those results. In this case the terminology is quite straightforward and the titles convey their message in an understandable and user centered way. As for organization systems the application has gone for a single page first see hierarchy, with the most important information first, which is thoughtful. To sum

everything up, except for some minor kinks there is no obvious hindrance to users using this application. The application provides a convenient place to check both everyday and semester based information and has a good looking and well functioning user interface. Based on everything as the author, I think that it would be an ideal place to provide students additional information about the studies and a great reference point for the dean's office to use.

4. Creating Prototypes Of Additional User Interface elements

One of the goals is to make the additional prototype elements easy to integrate into the student portal. It is important then to use the same framework as the project that it is to be integrated into. Due to recent attacks towards Taltechs ÖIS platform, a lot of the information about the student portal, was not able to be shared to me by the development team. By using firefox web development tools I found out that the student portal was built with the React framework. This was later confirmed by the development team. Sadly I was unaware of other tools like Tailwind or packages that might be in use.

Based on the problems these elements need to solve. It was decided that two new additional elements were to be created. First an element that would show the students curriculum modules and the mandatory and elective subjects that they consist of. Secondly a calculator that would automatically take into account the ECTS amount of the students curriculum if the curriculum was active. If the student had not yet saved a curriculum plan or had other plans when it came to the amount of ECTS he or she would like to take into account, there would be a manual input field for that as well. The calculator's output would show the student their ECTS deficit and the corresponding debt in euros at the end of the coming or active semester and the semester after that. In addition to the new elements, some changes to the existing elements were also planned. Some additional information was to be added to the My curriculum tab of the student portal. Specifically two more Information sub elements that would be able to show the number of semesters the student has studied and what kind of funding source is active for the student. To the My semester subjects tab a clear indication of if the semester subjects plan has been saved or not is to be added. Furthermore a sum of the combined semester subjects plan ECTS-s is to be added.

With an understanding of what elements are going to be added and what changes need to be done to the existing ones, the next step was to start the design. As discovered in the theory, it's very important to make a sketch or a wire-frame to make the development process smoother and easier. For this I decided to use the well known design application called Figma. As a first overview of the prototype, it wasn't anything too detailed. It can be found in the attachment section of this written document (see illustration 1). The design underlined the location and the size of the elements. It also provided a simple color theme and what the elements should structurally look like. This first sketch was provided to the mediator between me and the deans office. The look and function of the elements were

confirmed to be sufficient except for some small changes that were later applied.

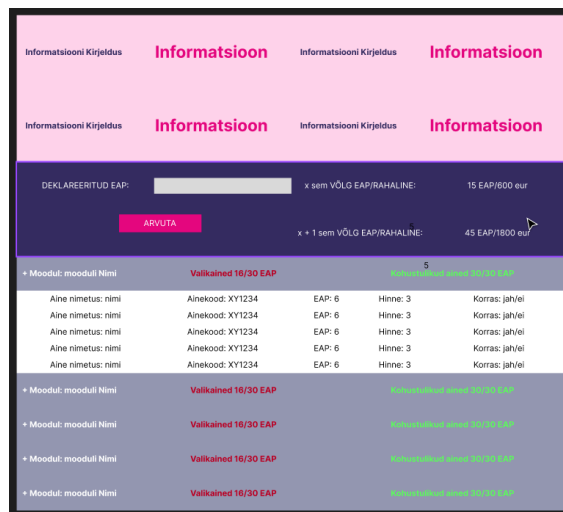


Figure 1. Figma prototype

4.1 Curriculum Modules Element

The first element I started with was the curriculum modules element (see illustration 2). The purpose of this element was to give the student more information about their whole curriculum plan and which subjects each one consisted of in both mandatory and elective subjects. Furthermore it would have to give a clear overview of the completion progression of each module. As learned from the theoretical part a good idea is to provide the user with familiar elements and information. Thus when it came to adding the curriculum modules element I used the existing curriculum modules element from Taltech ÕIS portal as a template. The curriculum modules element contains a list of all the students curriculum modules. Each module contains a lot of information as a table and so to make things more readable and compact, a module was made to be a collapsible element. In the closed position the module shows the module name, the modules mandatory subjects ECTS sum and the students currently obtained ECTS sum in the mandatory part of that module and the amount of required elective subjects ECTS and the currently owned elective subjects ECTS-s. When a module is open it also shows two corresponding tables of the mandatory subjects in that module and the elective subjects in that module. The columns in each of the tables provide information about a subject that is represented as a row in that table. The columns show information as follows. The name of the subject, the code of the subject, the amount the subject is worth, the grade that a student has achieved in that subject if one exists, the name of the subject lecturer, an indicator if the subject results are final and a note related to the subject's result. Furthermore under both of the tables there is a summary of the required curriculum points, currently held curriculum points and the difference between the two.

Oppe moodulid							
Moodul: Example Module		Kohustuslikud ained: 15/27			Valikained: 15/27		
Kohustuslikud ained:							
Aine nimetus	Aine kood	EAP	Hinne	Kuupäev	Õppejõud	Korras	Märkus
Example subject	Exa001	9	1	12/12/12	Si Examplesalot	jah	Example note is very good as an example
Example subject	Exa001	9	1	12/12/12	Si Examplesalot	jah	Example note is very good as an example
Example subject	Exa001	9	1	12/12/12	Si Examplesalot	jah	Example note is very good as an example
Kokku vaja: 15 EAP		Kokku olemas: 27 EAP		Hälve: 12 EAP			
Valikained:							
Aine nimetus	Aine kood	EAP	Hinne	Kuupäev	Õppejõud	Korras	Märkus
Example subject	Exa001	9	1	12/12/12	Si Examplesalot	jah	Example note is very good as an example
Example subject	Exa001	9	1	12/12/12	Si Examplesalot	jah	Example note is very good as an example
Example subject	Exa001	9	1	12/12/12	Si Examplesalot	jah	Example note is very good as an example
Kokku vaja: 15 EAP		Kokku olemas: 27 EAP		Hälve: 12 EAP			

Figure 2. Study program completion element

4.1.1 Interaction Design

When it came to interaction design principles that we had an overview in the theoretical part of this document, not a lot could be incorporated. When planning there really was only one interaction to take into account. That would be the module being collapsible. With a change of the cursor and a slight change in color we give the user a hint that the module is intractable. In addition we provide a small plus icon that changes on click. This is a well known icon to interact with for collapsible elements. The collapsible itself also already has a great responsiveness. The opening and closing transition time has a slight value for a more natural feel. The responsiveness itself is under 0.1 seconds. Taking into account simplicity the table itself is divided into 8 columns. The amount of modules or subjects in the module cannot really be controlled without compromising functionality.

4.1.2 Visual Design

The visual design part of this module had a bit more to it. To make the module fit in with the student portal styling. I used a module header that looks the same as the module headers that the student portal originally used. A subtle box shadow is used in the portal that I also incorporated into the module. This creates a depth between the background and the module that emphasizes the element. The curriculum modules themselves also look the same except the information. And have limited space between to show that they belong to the same block. The curriculum module internal information has given an ample amount of space between each information block yet giving each column a border to increase readability. The interactive curriculum module was given a priority in hierarchy and the table of mandatory subjects is next in line to indicate importance. Contrast was given to the table names, column headers and table summarizing elements by making the text bold. To specify the table is the main content It takes up a large amount of space. This is because of the amount of information and to show there is no more depth to the module. Some of the summarizing information was made to dynamically change color to indicate if the module is complete or if it still lacks some curriculum points. In the module header both mandatory

and selective subject summaries are either green if the required curriculum points have been achieved or red if the opposite is true. The same color indication is applied to the curriculum points difference in the table summary part of the module.

4.1.3 Information Architecture

The information that was decided to be displayed to the user was largely based on the element of familiarity from the ÕIS portal. But a table structure is simple, familiar and easy to understand for all users. As previously mentioned the structure of the information is a table where each row is a subject and the columns present information about each subject as follows. The subject name, the subject code, the amount of curriculum points the subject is valued at, the grade a student has achieved in that subject, the date a grade has been added, the lecturer of the subject, an indicator of yes or no if the students result in a subject is accepted and final, and a note about the result from the lecturer. These columns are labeled in the topmost row with the same titles as in ÕIS portal. As the goal of this information is to provide the user an overview of what each module consists of and the progress a user has in each module some of the information displayed overlaps in function. The main constraint in our context is space. Some of the information is removed on smaller devices, but more on that in the dynamic design part later.

4.1.4 Dynamic Design

The student portal has a dynamic design so it would be comfortable to use on any device and that the information be accessible on the move. So it is important that the elements that are to be added are also dynamic (see illustration 3). Each intractable module header has a display type of flex and the progression elements themselves have margins set to a percentage of parent size. The internal tables are set with a display type of table. The size of text is a constant but the table itself is dynamic. As the display width gets smaller not all of the columns can fit and so some of the columns are removed. The following columns are removed progressively. Starting with the note as if a student has completed a subject it won't provide that much more information and it takes a lot of space. Next to go is the date as it has historical relevance which has less priority in showing progress. Now a lot of the information that can easily be removed is taken away and the column that takes the most space is the subject name itself. I decided to remove the name column because although it is the most human readable indicator of a subject. It does take a lot of space and the subject code can be used to identify a subject instead. The last column that gets removed is the "is okay". This choice was made because if a subject has a passing grade the index does not inform the student of anything more.

Õppe moodulid

Moodul: Kohustuslikud Valikained:
 Example ained: 15/27 15/27
 Module

Kohustuslikud ained:

Aine kood	EAP	Hinne	Õppejõud
Exa101	9	1	Sir Examplesalot
Exa101	9	1	Sir Examplesalot
Exa101	9	1	Sir Examplesalot

Kokku vaja: 15 EAP Kokku olemas: 27 EAP Hälve: 12 EAP

Valikained:

Aine kood	EAP	Hinne	Õppejõud
Exa101	9	1	Sir Examplesalot
Exa101	9	1	Sir Examplesalot
Exa101	9	1	Sir Examplesalot

Kokku vaja: 15 EAP Kokku olemas: 27 EAP Hälve: 12 EAP

Figure 3. Study program completion element in a mobile displayport

4.1.5 Curriculum Modules Element In React

In react i divided the curriculum module into four separate elements that all have their own CSS files. The elements were divided up in the following way. First we have a study module list that contains the root module collapsible and all of the curriculum modules as a list. The root module collapsible is disabled when a larger displayport width is present. The study modules list element calls out each of the study modules with the element study module. This element takes the following input arguments. A module name, required subjects required ECTS, required subjects current ECTS, elective subjects required ECTS, elective subjects current ECTS, a list of required subjects and a list of elective subjects. The study module element is responsible for the color indexed quick overview of the module progress. It also is made to be collapsible with the corresponding tables inside. The study module element calls two study table elements that have these required input arguments. An object that contains a boolean value as a string that indicates if the object contains information about elective or required subjects. The string value of the amount

of curriculum points required for that part of the module. Also a list of subject row prop objects. For each of the objects in the subject list row list a subject list row element is called that has the following string input fields. Subject name, subject code, ECTS amount, subject grade, date, lector, is okay and the note.

4.2 Information Module

The information module was only changed a little (see illustration 4). The main goal of modifying the information module was to give the user an overview and more information about their progress. For this I decided to add more information elements into the module. The information elements were made to be universal so that any information could be displayed. For an example two additional informational elements were added to the information module. The first was the number of semesters a student has studied and what type of financial source is currently active.



Figure 4. My curriculum element

4.2.1 Design Principles

The interaction part of this element is not really there. No buttons only displaying information. Visually I used the same looks as the information module uses in the current student portal. The important thing here was to make the information clear to see and large enough to draw focus. The student portal uses a bold styling on the first word of the information description which was also implemented to the new informational elements. The information itself is also made with a larger font weight to draw the eye to the important bits. There were also limited principles to consider when it came to information architecture. The only one to take into account was the labeling. Once again the information description was taken from the ÕIS portal as it is familiar and clear to the user and describes the information displayed most effectively.

4.2.2 Dynamic Design

In the current student portal the information module is dynamic. Two main styling properties change when the display port gets smaller. The font size itself gets smaller when

the display port width is less than 1200 pixels and the parallel flex-box styling collapses to a list of vertical elements. This was also incorporated into this version of the information module(see illustration 5).

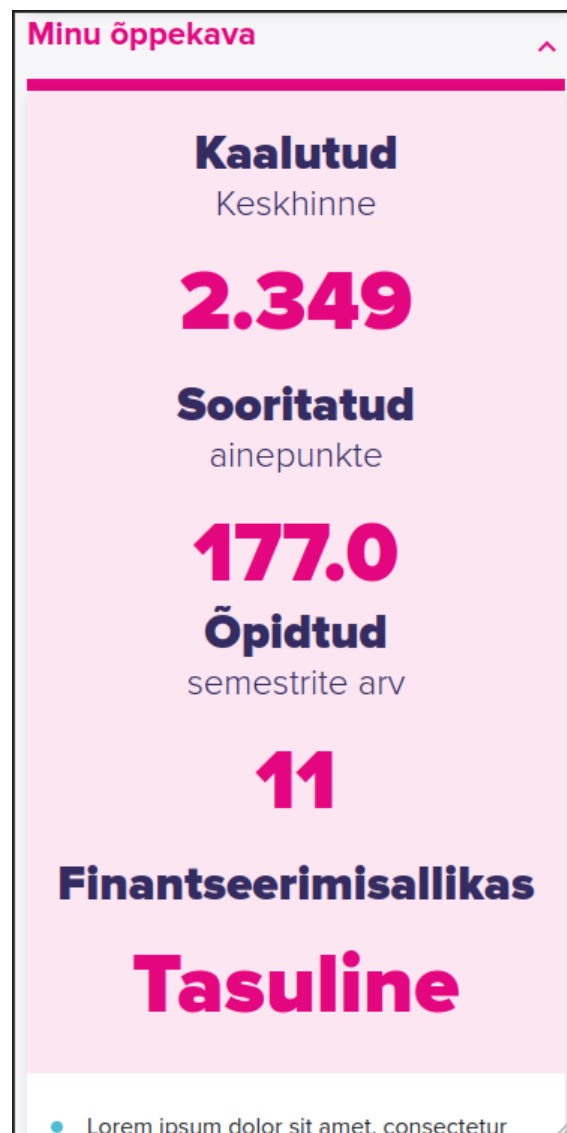


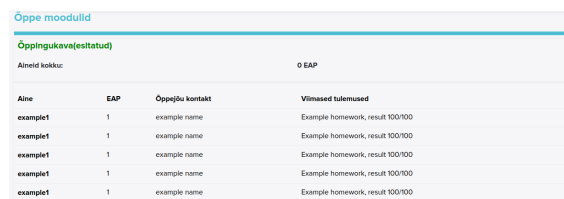
Figure 5. My curriculum element mobile version

4.2.3 Information Module Element In React

The main root element itself is called the information module which contains four instances of a sub element called information element. The information element takes two input arguments. The first argument is called element description that is a string value and is descriptive text that is displayed as a descriptive text. The second variable is also a string value that represents the information that is shown. The Information element displays the previously mentioned values and there is also a styling function that if more than two words are present in the descriptive text it makes the first word in a bold style.

4.3 Semester Curriculum Module

In this element (see illustration 6) the additional functionality was also limited. The main problem with the current semester curriculum module present in the student portal is that it does not sufficiently convey if the user's semester curriculum plan is saved and or created. In addition some information, for example the subject representing the thesis work, is not displayed in the current semester curriculum plan module. To consolidate these issues I added a text element that indicates if the curriculum plan exists and is saved both textually and also with a color change. With green text indicating that the plan exists and is saved and red text indicating that it's yet to be done.



Aine	EAP	Õppejõu kontakt	Viimased tulemused
example1	1	example name	Example homework, result 100/100
example1	1	example name	Example homework, result 100/100
example1	1	example name	Example homework, result 100/100
example1	1	example name	Example homework, result 100/100
example1	1	example name	Example homework, result 100/100

Figure 6. My semester courses element

4.3.1 Design Principles

Again the Interactive parts of this element don't really exist due to the element being mostly static. With visual design on the other hand there were some simple principles I kept in mind. The main being to make the text indicating if a curriculum plan is saved or not is clearly visible with the color changes. Thus no real background color change was made and the size and weight of the text was made appropriate. Architecturally no changes were made to the current information presented as a list of subjects and no additional labels were created.

4.3.2 Semester Curriculum Module Element In React

The curriculum module element requires a list of subjects. Each subject is an object that contains the following string variables. Name, ECTS credit amount, contact of the professor and the last results in the subject. There is a small function that displays an indication of if the user has a my semester courses plan saved or not. Displaying either a red text saying that the curriculum plan is not saved or a green text that reads that the semester curriculum plan is saved. The subjects themselves are in a HTML table element with each row being mapped to a subject in the aforementioned list.

4.4 Price Calculator Module Element

The reason for adding this element (see illustration 7) is to provide the user an overview of the current and coming debt based on the curriculum plan that is saved, or used. The element consists of two input elements, a button and two output fields. The first input field is automatically filled with the amount of the curriculum points of the students current curriculum plan. The input can also be changed by the user if they see it necessary. There is an extra input as a checkbox that can be made active if the user's case is special which negates the dept. The two output fields represent the debt at the end of the coming semester and the cumulative debt at the end of the second next semester. The calculator logic is based on information found on taltech-s rules of organization of studies page. It currently works for students that have a free financial source. It works on the calculation of finding the difference between the students current ECTS credit points and the required ECTS credits based on the formula that is the amount of semesters studied times thirty witch is the amount of credits a student is required to achieve to not pay, minus six witch is a buffer that taltech has set. Both of the outputs display both the credit and the corresponding sum of money that the student will be in debt. The second next semester debt value does not take into account any other value other than the automatic sum of the students curriculum plan ECTS credits or the overwritten input by the user. Thus it often shows a debt. The price calculator also has an indicator if the curriculum plan for the current semester is saved or not. Furthermore the outputs have an extra indication of bad situations.



Figure 7. Calculator element

4.4.1 Interaction Design Principles

Unlike the other added elements the calculator has some more interactive parts to it. The module itself as all the others has a collapsible element on the module header. The possible actions related to this element is a user inputting to the input fields and pressing the calculate button. The input field is restricted to numerical values which mitigates errors concerning the calculation process. Both the input fields give the user feedback when being active. With the numerical input fields having a change in color in the border and the checkbox changing depth on hover. The calculate button also reacts to the user's

interaction with it. When the user is hovering over the button the button turns a lighter hue of color and also gives an apparent change in depth as well. As the calculator's functions might not be initially understood a question mark was added to the upper right side of the module. This question mark displays extra information about the functions and output of the element when the user hovers over it. As always all of the informative and input elements were made to be appropriate size to make it comfortable for the user to interact with the calculator.

4.4.2 Visual Design Principles

The clear difference between the previous elements and the calculator is that the background color is darker blue color. This is due to it being a smaller element and so a choice in darker color gives the element more weight to give balance with the other larger modules. In larger displayport width situations the calculator element was meant to be the set on the right side of the screen, and again the darker color was meant to give horizontal balance to the whole picture. The change of background color also meant to make the text readable the text was made white. When it came to grouping elements together I decided that a bordered solution would not be visually appealing so elements were grouped together by proximity. Yet the principle of space was not ignored. An intention to bring the users attention to the middle of the calculator was realised by the button with a clear contrast in color and size. There are some extra indicators before both the output and the curriculum plan element that are either red and a checkbox with a X that indicates non good values or green checkbox with a birdie to confirm a good value. The extra indicators were chosen due to the indicator colors that would make the text hard to read in the darker background.

4.4.3 Information Architecture Principles

The information that the calculator presents is labeled as informatively as was possible. Sadly for the size of the element the output value descriptions had to be given a not so descriptive value. The values that I decided on are "x-semester debt" and "x+1 semester debt". The x in the title might cause some confusion but I saw it as the most logical way to display the relationship between the two outputs. The output values themselves have both the ECTS debt values and the corresponding money values in euros. Both the ECTS and money values are also unitized. The input fields are also labeled with clear and simple values that depict the input areas and actions.

4.4.4 Dynamic Design

The dynamic part of the design was more difficult due to the size of the module. The main input fields were contained inside a container that has a display type grid to keep the structure stable. The descriptive elements are set to be parallel in the horizontal plane with the input fields and output values. The descriptive and value elements combined are set to be in a visually vertical list when the calculator is in a compressed width state. When the element is able to expand the calculator width is divided into half with the input set to the left side and the output elements to the right. The space between the elements is set by percentage of the parent size.

4.4.5 Price Calculator Element In React

In the case of the price calculator element everything is contained inside one React file. The element is called the price calculator. The following inputs are used within this element. Is a special case that is a boolean value and indicates if the student has documents submitted that mitigate ECTS dept. Is curriculum plan saved, that is a boolean value that shows if the students semester curriculum plan is confirmed or not. Curriculum plan ECTS sum, that is a numerical value and is the automatic ECTS credit sum of the students semester curriculum plan if one is confirmed, if the curriculum plan has not yet been confirmed it should be set to zero. The amount of semesters learned, that is a numerical value that is automatically inherited and is necessary for the calculator to find the required amount of ECTS credits. The current amount of ECTS that is a numerical value that is also inherited from an external database and represents the students current achieved ECTS credit sum. The required ECTS amount every semester is also a numerical value and is a set variable that changes the required ECTS credits the student must achieve every semester, this value is taken from the taltech rules. Provided margin for error that is a value set in taltech rules and is responsible for the total buffer of ECTS credits that the student is not liable to pay. Lastly, the cost of one ECTS credit in euros as a numerical value, that is also taken from the taltechs rules and is used to calculate the value of ECTS credit debt in euros. To make the element reactive some of these variables are locally using the react state as well. The React module also contains a few sub functions that I will now give a quick overview. There is the liability in ECTS function that returns the students liability based on the current sum of credits and the amount of semesters the user has studied. In the output the value is multiplied by the cost of a single ECTS credit point. The curriculum plan is saved notification function results in either a message indicating that the students curriculum plan for the semester is not certified or that it is based on the boolean value of the curriculum plan is saved. The last function is called ECTS liability icon that returns the

right icon with the corresponding color based on if the student has a ECTS credit liability.

5. Feedback

To better understand the requirements of the new elements and to validate the user friendliness of the created and modified user interface elements. Two feedback systems were set in place. Firstly iterations of the created elements were presented to the client periodically. with each iteration changes were made to fulfill the clients requests. The final objective was for the client to be satisfied with the elements. For further feedback the users were also included in a small survey that investigated if the elements function can be discerned by the user and what changes the users wished to be made. The following paragraphs describe the results and course of the systems.

5.1 User Feedback

To get feedback on the created extra user interface elements a survey was provided to the intended users. The users consisted of active students of Taltech. The sample size of students were kept small due to it needing to provide simple feedback. The final number of participants was six. The questionnaire consisted of fourteen questions, where the first three questions found out what faculty the student is studying, if they had used the student portal and what problems have occurred when they have used the student portal. Out of the six participants two were from the Estonian marine academy, two were from the school of engineering and two were from the school of business and governance. Surprisingly two of the students had not used the student portal at all, this could be improved with extra advertisement towards students. The main problems that had occurred amongst the users were that the application response time was slow, specially the logging in process. The users also had problems navigating the page which came as a big surprise to me. The next questions were about the newly created prototype elements. With the people being provided with a picture of an element and then asked a question. Two questions, what the element seemed to represent and if any changes would be made by them were asked about for each of the elements. If the user wished to change anything was also asked about each of the elements mobile version. The first element was the curriculum modules element. All of the respondents recognized the element to have the correct functionality. When it came to anything the users would change some information like the date, “is okay” index and the table summary elements were seen as unnecessary or needed a different wording. One of the subjects brought out that the quick overview of the required and held ECTS credits that is located in the module header had a weird location. The problems that came up with the “My curriculum” element are as follows. The largest problem was the structure of the

information, the informational elements within it should have more space between them and be located in more of a structured table. The space was also a problem in the mobile version but besides that and a personal typo the users were happy. The “My semester ” element appeared to have some problems also with personal typos. One of the students said they would prefer different colors and another mentioned that on the larger display-port the subject could include information about it being required or not. On the mobile version the previous results column was seen as unnecessary. Now the calculator being a new concept two students were not able to discern its function. This could be helped by the tool-tip in the actual interface. Sadly this was not possible in a picture format. When asking the subjects about what they would change or don’t understand the main problems the tool-tip would not solve was spacing between the input field and calculate button and the labeling of the output information. The labeling of $x + 1$ semester was confusing for one of the students. These are some of the problems that came out in the feedback from users. These problems can be solved in further iterations and will be used to make the interface elements more user friendly.

5.2 Client Feedback

Throughout the design process the client was presented with iterations of the new user interface prototype elements. The initial prototype was a wire frame of the general look of the elements. The feedback of this first presentation was that the study program modules element should provide a overview of each modules completion even if a module is in its collapsed state. Furthermore the tokens of module completeness should be more expressive in if they are completed or not. In the next iteration the modules were added with textual tokens of completion of both the required and elective subjects part of the module and the tokens were made either red or green based on if the required amount of ECTS credits were achieved. The next versions of the user interface elements were made in the react framework. With the first of the version made in react some issues also aroused. For example it seemed necessary for both the calculator and my semester subjects element to have a more visible elements about submission of the semester subjects plan. For the my semester subjects element the semester subjects plan submission element was given a color index and for the calculator a textual element was added that also portrayed if the plan was submitted or not. In on of the later presentations a notice was also made about adding a colored index to the output elements of the calculator. Due to the background color being a darker color, it was decided that changing the color of the text would hinder its readability so a colored checkbox with either a x or a birddy was added to the front of each output element. This was later changed to a colored dot that was described in the Taltech style-book.

Within the final presentation the client was satisfied with the current elements. As they said the functionality of each element is clear and the provided information is easily found and perceived. Some things the client would change were the description about source of finance in the my curriculum to be made shorter, The tokens in the study program modules needed a better wording and checkbox description about special cases in the calculator element required a better descriptive element.

6. Summary

The purpose of this thesis was to analyse the user interface of the Taltech student portal's user interface and find out if it meets the requirements of being an effective way for users to access their educational information and so being an applicable place to solve other problems related to the students not being aware of their situation. To analyse the user interface of the student portal the author familiarized themselves with the principles of user interface design and the styling of the student portal. To make students more informed about their situations some extra user interface elements were designed in the react framework. The following prototype elements were created, a calculator for showing students their ECTS credit and corresponding financial dept, a study program structure element module by module to inform the student of their progress within the study program, extra functionality was added to the my curriculum and my semester subjects elements to further provide users of their academic situation.

In this document the author described the researched aspects of user interface design principles. The design principles fall into three larger categories. The interaction design principles are responsible in making the interactive user interface elements as user friendly and effective as possible. The visual design principles deal with the visual aspects of a user interface, focusing on the structure color size and hierarchy of elements. When it comes to providing content effectively to the user, information architecture principles are liable for making information easy to find and understand. In addition to the three there are some general ideas that should be kept in mind when designing a good user interface. A interface should always be user centered, available and usable by everybody and consistent and predictable in its design.

The analysis of Taltech's student portal went as follows. The author divided the analysis up to three parts with each corresponding to the subcategory of design principle. The overall conclusion to interactive design principles was positive with elements being user friendly to interact with. The main problem that accrued is that the responsiveness of the application itself and the sub-elements was lacking. Sometimes some errors would pop up when logging in and some the contacts element had inconsistent, on hover, feedback in its elements. The visual aspects of the user interface design were overwhelmingly good. The structure was logical and simple, the style was consistent and hierarchy and focus was drawn towards the right elements. The information architecture area was more simple than anticipated. Which is good for the functionality the student portal represents. The

navigational systems in place are clear and the one searching system in place takes into account all of the users needs. In the general principles the student portal also shined in its use of familiar elements and consistency. When it came to accessibility some improvements could be made to make it easier to navigate with a keyboard.

Two additional elements were designed and two of the existing elements were altered to solve problems that students and the deans office have come across. The document describes the things that were taken into consideration when designing these elements. The code created was also described. A survey for the users was constructed and distributed to six participants, to get feedback on the created elements. The feedback resulted in possible restrictions on user friendliness but had also a positive information of users liking the elements. Multiple iterations of the elements were presented to the client and a most suitable design was agreed upon, with which the client was satisfied with.

7. Kokkuvõte

Lõputöö eesmärk oli analüüsida Taltech'i üliõpilasportaali kasutajaliidese kasutajaliidest ja välja selgitada, kas see vastab nõuetele, et olla kasutajatele tõhus viis oma haridustabele ligi pääseda ning olla seega sobiv koht muude õppetööga seotud probleemide lahendamiseks. õpilased ei ole oma olukorrast teadlikud. Üliõpilasportaali kasutajaliidese analüüsimiseks tutvus autor kasutajaliidese disaini põhimõtetega ja üliõpilasportaali stiiliga. Et õpilased oleksid oma olukordadest rohkem kursis, loodi reageerimisraamistikus mõned täiendavad kasutajaliidese elemendid. Loodi järgmised prototüüpelemendid, kalkulaator üliõpilastele EAP ainepunktide ja vastava finantsosa näitamiseks, õppekava ülesehituse elemendi moodul mooduli kaupa, et teavitada üliõpilast õppekavasisesest edasijõudmisest, minu õppekavasse lisati lisafunktsionaalsus ja minu õppekava. semestri ainete elemente, et pakkuda kasutajatele nende akadeemilist olukorda veelgi.

Käesolevas dokumendis kirjeldas autor kasutajaliidese disaini põhimõtete uuritud aspekte. Disainipõhimõtted jagunevad kolme suuremasse kategooriasse. Interaktsiooni kujundamise põhimõtted vastutavad selle eest, et interaktiivsed kasutajaliidese elemendid oleksid võimalikult kasutajasõbralikud ja tõhusad. Visuaalse disaini põhimõtted käsitlevad kasutajaliidese visuaalseid aspekte, keskendudes struktuuri värvi suurusele ja elementide hierarhiale. Kasutajale sisu tõhusaks pakkumiseks peavad teabearhitektuuri põhimõtted muutma teabe hõlpsasti leitavaks ja arusaadavaks. Lisaks kolmele on mõned üldised ideed, mida tuleks hea kasutajaliidese kujundamisel silmas pidada. Liides peaks alati olema kasutajakeskne, kõigile kättesaadav ja kasutatav ning oma disainilt järjepidev ja etteaimatav.

Taltech'i tudengiportaali analüüs läks järgmiselt. Autor jagas analüüsi kuni kolmeks osaks, millest igaüks vastas disainiprintsiibi alamkategooriale. Üldine järeldus interaktiivse disaini põhimõtete kohta oli positiivne, kuna elemendid olid kasutajasõbralikud. Peamine probleem, mis ilmnis, on see, et rakenduse enda ja alamelementide reageerimisvõime oli puudulik. Mõnikord ilmnisid sisselogimisel mõned vead ja mõne kontaktielemendi elemendi elementides oli hõljumisel ebajärjekindel tagasiside. Kasutajaliidese disaini visuaalsed aspektid olid valdavalt head. Ülesehitus oli loogiline ja lihtne, stiil järjepidev ning hierarhia ja fookus oli suunatud õigetele elementidele. Teabearhitektuuri ala oli oodatust lihtsam. Witch sobib hästi selle funktsionaalsusega, mida õpilasportaal esindab. Paigaldatud navigatsioonisüsteemid on selged ja üks paigas olev otsingusüsteem võtab arvesse kõiki kasutaja vajadusi. Üldpõhimõtetes säras üliõpilasportaali ka tuttavate elemen-

tide kasutamises ja järjepidevuses. Juurdepääsetavuses võiks teha mõningaid täiustusi, et muuta klaviatuuriga navigeerimine lihtsamaks.

Projekteeriti kaks täiendavat elementi ja muudeti kahte eemaldatavat elementi, et lahendada probleeme, millega üliõpilased ja dekanatuur on kokku puutunud. Dokumendis kirjeldatakse asju, mida nende elementide kujundamisel arvesse võeti. Samuti kirjeldati loodud koodi. Koostati kasutajate küsitlus, mis jagati kuuele osalejale, et saada tagasisidet loodud elementide kohta. Tagasiside tõi kaasa võimalikud piirangud kasutajasõbralikkusele, kuid andis ka positiivset teavet selle kohta, et elemendid meeldisid kasutajatele. Tellijale esitati mitu elementide iteratsiooni ja lepiti kokku sobivaim kujundus, millega klient rahule jäi.

References

- [1] Cameron Hashemi-Pour and Fred Churchville. *user interface (UI)*. [Accessed: 14-09-2023]. URL: <https://www.techtarget.com/searcharchitecture/definition/user-interface-UI>.
- [2] Adam Thomas. *What Is User Interface Design?* [Accessed: 14-09-2023]. URL: <https://builtin.com/articles/user-interface-design>.
- [3] Interaction Design Foundation. *Voice User Interfaces (VUI)*. [Accessed: 14-09-2023]. URL: <https://www.interaction-design.org/literature/topics/voice-user-interfaces>.
- [4] N. Uday Bhaskar et al. *General Principles of User Interface Design and Websites*. [Accessed: 14-09-2023]. URL: https://scholar.googleusercontent.com/scholar?q=cache:XNtbXa-uPmEJ:scholar.google.com/+User+Interface+Principles&hl=en&as_sdt=0,5.
- [5] Lawrence J. Najjar. *Principles of Educational Multimedia User Interface Design*. [Accessed: 14-09-2023]. URL: https://www.researchgate.net/publication/220457741_Principles_of_Educational_Multimedia_User_Interface_Design.
- [6] Mari-Ell Mets. *Kuidas rakendada 80/20 reeglit veebi ligipääsetavuses?* [Accessed: 10-05-2024]. URL: <https://blog.twn.ee/et/Kuidas-rakendada-80-20-reeglit-veebi-ligipaasetavuses>.
- [7] Bob Baxley. *Introducing Interaction Design*. [Accessed: 15-09-2023]. URL: <https://boxesandarrows.com/introducing-interaction-design/>.
- [8] Mikhail Mitra. *10 Most Important Interaction Design Principles*. [Accessed: 15-09-2023]. URL: <https://www.mantralabsglobal.com/blog/10-basic-principles-of-interaction-design/>.
- [9] Sachin Rekhi. *Don Norman's Principles of Interaction Design*. [Accessed: 15-09-2023]. URL: <https://medium.com/@sachinrekhi/don-normans-principles-of-interaction-design-51025a2c0f33>.
- [10] Euphemia Wong. *User Interface Design Guidelines: 10 Rules of Thumb*. [Accessed: 15-02-2024]. URL: <https://www.interaction-design.org/literature/article/user-interface-design-guidelines-10-rules-of-thumb>.

- [11] Tammy Guy. *Visual Design and Usability Yellow Brick Road*. [Accessed: 15-09-2023]. URL: <https://uxmag.com/articles/visual-design-and-usability-yellow-brick-road>.
- [12] Ritch Macefield. *UX Design Defined*. [Accessed: 16-09-2023]. URL: <https://www.uxmatters.com/mt/archives/2012/06/ux-design-defined.php>.
- [13] Patrick J. *Visual Design for the User Interface Part 1: Design Fundamentals*. [Accessed: 16-09-2023]. URL: <https://trantor.sheridanc.on.ca/sys32a1/manual/appendix/gui1.html>.
- [14] John Lovett. *design-overview*. [Accessed: 16-09-2023]. URL: <https://www.johnlovett.com/design-overview>.
- [15] Jaxon White. *Visual Design 101*. [Accessed: 16-09-2023]. URL: <https://medium.com/@action/visual-design-principles-101-c2660fbca862>.
- [16] Alina Midori Hernández. *Visual-Design Principles and UX Design Best Practices*. [Accessed: 16-09-2023]. URL: <https://www.uxmatters.com/mt/archives/2023/05/visual-design-principles-and-ux-design-best-practices.php>.
- [17] Teo Yu Siang. *The Key Elements Principles of Visual Design*. [Accessed: 16-09-2023]. URL: <https://www.interaction-design.org/literature/article/the-building-blocks-of-visual-design>.
- [18] Cameron Chapman. *Exploring the Gestalt Principles of Design*. [Accessed: 16-09-2023]. URL: <https://www.toptal.com/designers/ui/gestalt-principles-of-design>.
- [19] Stephanie Crawford. *How Information Architecture Works*. [Accessed: 18-09-2023]. URL: <https://computer.howstuffworks.com/information-architecture.htm#pt3>.
- [20] E. B. White. *3 Information Architecture*. [Accessed: 18-09-2023]. URL: <https://webstyleguide.com/wsg3/3-information-architecture/index.html>.
- [21] Peter Morville. *Information Architecture 3.0*. [Accessed: 18-09-2023]. URL: http://semanticstudios.com/information_architecture_30/.
- [22] Galaxy Consulting. *Information Architecture Components Labeling Systems*. [Accessed: 18-09-2023]. URL: <https://www.galaxyconsulting.net/7-blog/164-information-architecture-components-labeling-systems>.

- [23] Louis Rosenfeld, Peter Morville, and Jorge Arango. *Information Architecture For The Web And Beyond Fourth Edition*. [Accessed: 20-09-2023]. URL: https://e-edu.nbu.bg/pluginfile.php/62325/mod_resource/content/1/Information_Architecture_For_The_Web_And_Beyond_Fourth_Edition.pdf.

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