Syllabus

CPUE - FL

Certified Professional for Usability Engineering and User Experience Design

Foundation Level

Version 3.4 EN

User Experience Quality Certification Center

UXQCC

Revision history of German-language version

Version	Date	Remark
3.4	01/25/2020	Corrections
3.3	01/15/2019	Revisions
3.1	05/10/2017	Corrections
3.0	02/25/2017	Focus on practical applicability increased. Update of psychology of perception
2.02	02/17/2016	Update
1.9	11/24/2015	Update
1.8	07/28/2014	Comprehensive update
1.7	05/16/2012	Update
1.6	12/21/2011	Update
1.5	11/28/2011	Update
1.0	04/18/2011	New review
1.0 BETA	02/11/2011	Beta version

Scientific Advisory Board

The scientific advisory boards of UXQCC consist of renowned scientists, representatives of relevant organizations and companies that are involved in user experience and usability-relevant topics. The advisory board supports the further development of the syllabus in terms of didactics and content. This ensures that the contents are up-to-date, relevant and applicable from a scientific and practical point of view. The current members of the advisory board can be found in website https://www.uxqcc.com).

Introduction to this Syllabus

1) Purpose of this Document

This syllabus defines the Foundation Level of the certification program for the *Certified Professional for Usability and User Experience Engineering* of the User Experience Quality Certification Center (UXQCC). The UXQCC provides this syllabus to accredited training providers who will derive examination questions in their local language and create the corresponding courseware required. The syllabus will also help candidates in their preparation for the certification examination.

2) The UXQCC "Certified Professional for Usability Engineering and User Experience Design ", Foundation Level

	Objectives
Obtain new key qualifications	Software products or websites have to fulfill the goals and tasks intended for them. The ability to implement usability and user experience is a key competence which facilitates the creation of software applications that are tailored to the target group(s) and that are enjoyable for the users.
	Benefit
Increase your customers' satisfaction	The fulfillment of performance expectations and their perception by the customers leads to increased customer satisfaction. The enhanced user experience and usability of software, Internet and mobile applications reduces the discrepancy between expected and perceived performance and thus strengthens customer loyalty.
Minimize follow-up costs	Usability measures must be taken long before the launch or relaunch of a website or the market launch of a software product. This avoids damage to the image or loss of customers or visitors and reduces the costs for subsequent rework and corrections.
Competitive advantage	The acquisition of the target groups is not just facilitated by the user-friendliness of the products and services, but this also distinguishes the providers' products and services from those of their competitors. Today, it is often not the application that is first on the market that is successful, but the one that is perceived by the customers as user-friendly.
Build confidence	The users' needs are taken seriously and they feel more comfortable with the software offering. This boosts the positive attitude towards the provider and the brand and ensures improved customer loyalty.

	Focus
Man-machine-interfaces	Understanding perception processes, ergonomics and explaining the differences between online and offline behavior. Human characteristics and effects on UX design.
User-centered design	Gestalt principles for software products, GUI design, Storyboards, paper mock-ups, prototyping, wireframes, card sorting or personas.
Standards, norms and legal regulations	Overview of the most important usability-relevant standards, norms ISO) and the W3C guidelines for barrier-free access to the WWW.
Usability and User Experience Design Lifecycle	Process-oriented approach to ensure the subsequent usability of a system. Optimization of the development processes.
Evaluation/ techniques	Usability testing, techniques and procedures for usability data elicitation.
Exercises	Exercises and periods of reflection to make theoretical knowledge applicable in practice.

The Foundation Level of the certification program for the *Certified Professional for Usability Engineering and User Experience Design* addresses all persons and professional fields that are involved in the development of software, mobile or internet applications. These are primarily software developers, GUI programmers, SCRUM masters, project managers and project team members, organizers, managers, employees of the specialist departments, IT auditors, quality assurance officers and the persons in charge of software quality management.

Some basic experience in the development of technical products, especially software, is required. The Foundation Level-certificate is a precondition for taking the certificate exams for the Advanced Level Usability and User Experience Professional.

For the success of usability and user experience projects, it is important that all participants can rely on a *common terminology* and a *common understanding of key concepts*. Otherwise, misunderstandings can arise if identical terms are not associated with the same concepts.

Basic knowledge ensures that definitions and fundamental knowledge are acquired both about the humans (e.g., perception, mental models, error) and about the techniques for developing interactive systems (e.g., interaction styles, modelling methods, dialog design). An important part of the Foundation Level syllabus are generally applicable standards and norms.

Another focus of the syllabus is the development process, in particular the different commonly used methods for software development. Here it becomes clear in the sense of the terms usability and user experience design that ergonomics does not arise in specific areas or is only proven in the end, e.g. with the help of user surveys, but that a complete engineering procedure must be in place, which ranges from requirements engineering, prototyping and UX specifications to implementation and evaluation as well as the required usability tests.

In addition to knowledge, the applicability of knowledge is trained through hands-on exercises. Certified persons will be able to apply the most important methods in the field of usability and user experience design in practice.

For Foundation Level trainings, it is important to ensure that appropriate examples and exercises are included to supplement the theoretical knowledge in practical application.

3) Learning Objectives / Cognitive Levels of Knowledge

Each section of this syllabus has a cognitive level associated with it:

K1 Knowledge/cognitive skills: Knowledge of concrete details such as terms, definitions, facts, data, rules, principles, theories, characteristics, criteria, processes; learners can retrieve and reproduce knowledge.

K2 Understanding: Candidates can explain or summarize facts in their own words; give examples, understand connections, interpret tasks. This includes being able to transfer content from one type of presentation to another (e.g., words to a graphic), explain and summarize content and finally derive future developments from content.

<u>Selected parts at Foundation Level:</u>

K3 Apply: Candidates can apply what they have learned in new situations and use abstractions unsolicited, or make their own abstractions. Ability to apply the acquired knowledge in new concrete situations, e.g. by applying certain rules, principles, theories etc. Example: An Information Technology student should be able to program different sorting algorithms in an Assembler language, or a Mathematics student should be able to perform a mathematical proof according to the valid rules.

<u>Not part of the Foundation Level:</u>

K4 Analyze: Candidates can break down a problem into its constituent parts and thus understand its structure; they can identify contradictions, recognize relationships and deduce conclusions, and distinguish between facts and interpretations. This includes, for example, identifying the individual elements, determining the relationships between them and recognizing the design principles. The "Analyze" level requires a higher level of competency than understanding and applying, because it presupposes that both the content and the structure of the learning material have been understood. Example: the learning activity of art history students to determine the style-determining elements of a painting and to assign them to a specific art-historical period would belong to this level.

K5 Synthesis: Candidates can build a new structure from several elements or create a new meaning, propose new approaches, develop new schemes or sound hypotheses.

K6 Assessment: Assessment: Candidates can assess the value of ideas and materials and can use them to weigh up and select alternatives, make decisions and justify them, and consciously transfer knowledge to others, for example through work plans.

4) Certification Examination

The Foundation Level Certificate examination will be based on this syllabus. Answers to examination questions may require the use of material based on more than one section of this syllabus. All sections of the syllabus may be included in the examination.

The format of the examination is multiple choice.

Examinations can be taken immediately after an accredited training course or seminar, but also independently (e.g., at an examination center). The UXQCC-accredited examination providers are listed on their homepage in the internet (www.uxqcc.com).

5) Accreditation

Training providers whose training materials are structured according to this syllabus must be recognized and accredited by UXQCC.

6) Level of Detail

The aim of the syllabus is to allow for internationally consistent training and examination. To achieve this goal, this syllabus comprises the following components:

- General learning objectives, which describe the intention of the Foundation Level

- Content to be taught, with a description and, where necessary, References to further literature
- Learning objectives for each knowledge area, describing the observable cognitive outcome of the training and the mindset that participants are to achieve
- A list of terms that the participants must be able to recall and understand
- A description of the key concepts to be taught, including sources such as accepted technical literature, norms or standards

The syllabus is not a complete description of the knowledge areas "Usability" and "User Experience". It merely reflects the necessary scope and level of detail relevant for the learning objectives of the Foundation Level training.

7) How this Syllabus is Organized

The syllabus consists of 3 main chapters. Each chapter heading indicates the K-Level of the learning objective(s) that the chapter is intended to cover and specifies the minimum amount of teaching time that must be devoted to that chapter in an accredited course.

Example for main heading:

2	Man-Machine Interface (K2)	390 minutes

This heading shows that Chapter 2 has learning objectives of K1 (higher learning objectives imply the learning objectives of lower levels) and K2 (but not K3), and that 390 minutes are scheduled to teach the material in the chapter.
Within each chapter there are a number of sections. For each section the learning objectives and the amount of time required are specified. If no time is indicated for a section, then it is already included in the time specified for the chapter.

Syllabus Structure

Recommended total training time: 2.5 days, 1200 minutes (20 hours)

Day 1 (480 minutes)

1 Principles of Usability (K1) — 90 minutes

1.1 Necessity and benefits of usability (K1, 4 LOs, 90 minutes)

2 Man-Machine Interface (K3) — 390 minutes

2.1 Software ergonomics and design philosophies (K1, 3 LOs, 45 minutes)

2.2 Human information processing and impact on the User Experience (K3, 9 LOs, 260 minutes)

2.3 Standards, norms and style guides (K2, 6 LOs, 85 minutes)

Day 2 (480 minutes)

3 Usability and User Experience Design – Part 1 (K3) — 480 minutes

3.1 Usability Engineering, fundamentals (K2, 5 LOs, 100 minutes)

3.2 Analysis and concept phase (K2 und K3, 5 LOs, 180 minutes)

3.3 Design phase (K2 und K3, 5 LOs, 50 minutes)

3.4 Prototyping phase (K2 und K3, 5 LOs, 150 minutes)

Day 3 (240 minutes)

3 Usability and User Experience Design - Part 2 (- K3) — 240 minutes

3.5. Evaluation phase (K2 und K3, 2 LOs, 240 minutes)

The Syllabus in Detail

1 Principles of Usability (K1) — 90 minutes

1.1. Necessity and benefits of usability (K2) – 4 LOs (90 minutes)

LO-1.1.1	Classify and define Usability (K1)
LO-1.1.2	Show the benefit for the user as well as the economic benefit of Usability for providers (K1)
LO-1.1.3	Use examples to describe the problems that result from insufficient Usability (K2)
LO-1.1.4	Definition of User Experience (UX) (K1)

1.1 Necessity of Usability (K2) — 90 minutes

1.1.1 Classify and define Usability (K1) — 40 minutes

Terms
context of use, efficiency, error, memorability, perspective taking, quality in use, satisfaction, suitability for learning, usability

Usability ensures that products and applications are easy to use. Functions contained in them should be easy to learn, understand and use.

Today, usability is a decisive factor in the development and design of software and Internet applications. In many cases, functionalities are available in systems, but cannot be used or cannot be used correctly by the user because they are complicated to use or because they cannot be found.

According to the International Organization for Standardization (ISO), usability is "the extent to which a product can be used by certain users to reach specific objectives within a specific context of use with effectiveness, efficiency and satisfaction.“ [TA08, S. 4]. This places the usability and suitability of a system in the user context into a specific context of use.

Jakob Nielsen states the following target qualities as benchmarks for the quality of user interaction with a system:

- **Suitability for learning**: The system should be as easy to learn as possible. Unnecessary training and familiarization effort is reduced.
- **Efficiency**: The system should be time efficient to use and facilitate a high level of productivity.

- **Memorability**: The operation of the system should be easy to memorize, so that the system can be reused when returning at a later date without the need to relearn.
- **Errors**: The system should have a low error rate.
- **Satisfaction:** The system should give the user a feeling of satisfaction. This means that with their abilities users should be able to easily fulfil their needs and wishes in relation to the system.

Despite all the demands, the design must not be neglected too much. Example: Visitors of a website decide within the first 50 milliseconds whether they like it or not. This decision "like" or "dislike" is made unconsciously. If they leave the website for this reason, all usability measures no not even come into effect. Furthermore, the aesthetics of a website also contributes to its usability, because it promotes the well-being of the users and thus increases their satisfaction.

Ultimately, the creator of the website or software application must decide for himself what purpose the product serves. Last but not least, websites for marketing purposes, for example, prefer design over functionality. Usability always has to adapt to the respective context of effect in order to achieve its goals.

A high degree of usability in development is achieved through an iterative process - the Usability Lifecycle. Through the repeated and continually improved analysis and involvement of the target group in the usability tests and their evaluation, products with increased user-friendliness are created. New technologies, such as mobile devices and services, require a continuing review and extension of the methods applied in the development of usable products.

The usability of a system depends largely on the characteristics of the users. Imagine a software for managing music. A professional DJ, for example, has completely different expectations regarding the management of his music than a hairdresser, who only needs some background music in the salon. A private user who wants to manage his music on his PC but wants to be able to play it via his stereo system has completely different needs. The "context of use", i.e. the environment and the requirements arising from the needs of the user, have a significant influence on the design of software.

The term "perspective taking" comes from psychology and describes the ability to understand a certain situation from another person's perspective. This ability develops already in childhood and is developed to varying degrees in different persons. For good usability it is particularly important that the need for perspective-taking is recognized, that the perspectives of others are analyzed and that the results are then actually implemented.

References
Nielsen [1]
Krug [14]
Richter, Flückiger [15]

1.1.2	Show the benefit for users as well as the economic benefit of Usability for providers (K2)	20 minutes

Terms
competitive advantages, cost reduction, increase in productivity

Today, applications must meet customer expectations and be easy and intuitive to use and understand.

Generally speaking, usability is an extremely effective tool to reduce costs. Usability helps the developers to create simpler products. Simpler products are in turn easier to sell and easier for the customer to handle.

In principle, usability tests are an effective way to save time during the development and implementation of software websites and reduce the pressure on the development team. The test can be used to determine in advance which criteria are important for the user and which are less important. In addition, the test serves to identify potential weaknesses and errors at an early stage, which could cause major problems in a later development phase. The earlier an error is detected, the less effort is required to fix it.

The use of usability engineering - an iterative process for enhancing the usability of products - generates a multitude of monetary and non-monetary usability benefits. These can be quantified for three basic areas:

- Increase in productivity
- Reduction of incurred costs
- Improved competitiveness

This is made possible by:

- Target group-oriented development right from the start; saves later reworking
- The avoidance of unnecessary design iterations
- Avoiding the development of unnecessary functions
- Early clarification and communication possibilities about the design with the client
- Satisfied customers

- Future training costs for users are reduced.
- Usability test results can help to make strategic business decisions on whether and how to continue with the development

- More efficient solutions
- Reduced training effort through easy-to-use solutions
- Reduced support and call center effort for easy-to-use solutions
- Fewer user errors for easy-to-use solutions and therefore less effort for troubleshooting

- Optimal mapping of the required workflows in the software system in relation to the users' needs makes customers more satisfied.
- Focus is on the actual user needs (and not only the buyers' expectations which may be vague).
- Inclusion of relevant industrial norms and standards

- Development of target-oriented, innovative solutions based on knowledge of the real needs of users
- Application of interdisciplinary knowledge and interdisciplinary methods
- Incorporation of experience and know-how from other domains
- Techniques for increasing the potential of innovations with the involvement of users or on the basis of expert knowledge

1.1.3	Use examples to describe the problems that result from poor usability (K2)	15 minutes

Terms
target group relevance

Unfortunately, usability is often a potential candidate for being dropped from the project budget. Similar to documentation or quality assurance, usability is regarded as a "nice to have" feature in the development process and is therefore also considered of secondary importance by the management.

Good usability contributes directly to the success or failure of a software application or website. In e-commerce in particular, it has a direct impact on the turnover of the shops. If central shop functionalities such as the shopping cart or the way to the checkout are not found, or if products in the product range are insufficiently described or hidden, this will lead to a loss of sales.

A more dangerous effect is caused by usability problems in medical devices. for example, whose incorrect setting can lead to damage for the patient. Even in stressful situations, switches and buttons in aircraft cockpits must be easily accessible and operable, and status displays must be quickly and directly identifiable.

1.1.4	Definition of User Experience (UX) (K1)	15 minutes

Terms
Joy of Use, User Experience (UX)

User Experience - as a supplement to Usability - not only represents the user's experience with the product itself, but a holistic approach with all experiences that are in any way related to this product.

All experiences and associated feelings are included in the evaluation, from the desire to own this product to its final use. Thus, in addition to the actual usability of a product, factors such as trustworthiness, emotion or aesthetics are also taken into account. The use of a product should trigger a feeling of "Joy of Use". The meaning of user experience thus additionally sublimates the emotional appeal of the software.

User experience thus represents the experienced quality of the user's interaction with the contact point of the technical equipment.
Various factors are responsible for this, the most important of which are psychological. Humans judge machines in the same way as they would judge other humans. Therefore, software is generally rejected as soon as it triggers emotions such as "Am I too stupid to understand? "

References
Cooper [18]

2 Man-Machine Interface (K2) 390 minutes

2.1 Software ergonomics (K2) – 3 LOs (45 minutes)

LO-2.1.1	Describe the procedure and areas of application of software ergonomics (K2)
LO-2.1.2	Describe universal design (K2)
LO-2.1.3	Explain the influence of social rules on the User Experience (K2)

2.2 Human information processing and impact on the User Experience (K3) – 9 LOs (260 minutes)

LO-2.2.1	Explain the biological principles of visual perception (K1)
LO-2.2.2	Differentiate between dynamic and static vision (K1)
LO-2.2.3	Demonstrate the anatomical-physiological limitations of human perception (K1)
LO-2.2.4	Estimate color associations and color effects (K1)
LO-2.2.5	Describe color vision impairments and understand their influence on usability (K2)
LO-2.2.6	Describe which environmental factors influence the usability (K1)
LO-2.2.7	Give an overview of the Gestalt principles and some examples of their effect on usability (K2)
LO-2.2.8	Explain mental models, reading and information processing (K2)
LO-2.2.9	Practical exercises and reflections of chapter 2.2 using real examples (K3)

2.3 Standards, norms and style guides (K2) – 4 LOs (85 minutes)

LO-2.3.1	Assessing the significance and benefits of standards (K1)
LO-2.3.2	Provide an overview of the usability-relevant norms ISO 9241, in particular EN ISO 9241-110 ("Principles of dialogue design") and of ISO/TR 16982 (K2)
LO-2.3.3	Describe the importance, application and benefits of style guides (K1)
LO-2.3.4	Provide an overview of the purpose and significance of standards based on "IEC 62366-1:2015 Medical Devices Part 1 Application of Usability Engineering to medical devices" (K1)
LO-2.3.5	Provide an overview of the Web Content Accessibility Guidelines (WCAG) 2.0 (now also available as ISO/IEC 40500!)

2.1 Software ergonomics (K2) 45 minutes

2.1.1. Describe the procedure and areas of application of software ergonomics (K2) 20 minutes

Terms
hardware ergonomics, HCI, MMI, software ergonomics, user interface

In terms of software ergonomics, man-machine interaction (MMI) can be limited to man-computer interaction or human-computer interaction (HCI). The latter term is equated with software ergonomics in the English-speaking world. However, HCI ultimately includes both software and hardware ergonomics.

While hardware ergonomics adapts tools (input and output devices) for human-computer interaction to the physiological characteristics of the human being, software ergonomics aims at adapting to the cognitive abilities of humans or their ability to process information. It describes and evaluates user interfaces for human-computer interaction.

Both focus on the user interface, which according to Herczek contains the following components and properties:

- The user interface with the input options of the user and the output options of the computer system
- The rules of the input and output operations via the user interface
- Systems supporting human-computer communication

With regard to software ergonomics, "input and output operations" does not mean the use of technical devices such as mouse or keyboard, but the software-related dialog design regarding menus, command dialogs or input forms. This is where the mutual influence (or interaction) between human and computer takes place. Software ergonomics provides guidelines for a user-oriented design of software and interactive systems.

The following interdisciplinary approaches must be included in the field of software ergonomics:

- **Biology**
  Biological fundamentals such as visual color and sensory perception, auditive perception of sounds or haptic perception - the active perception of an object by integrating all skin senses and bathyesthesia.
- **Psychology**

Application of theories of cognitive processes, Gestalt psychology and empirical analysis of user behavior

- **Sociology and anthropology**
  Interaction between technology, work and organization
- **Computer science**
  Application design and development of man-machine interfaces
- **Design**
  Design of the appearance of interactive applications

Formal guidelines for software ergonomics are defined in the Regulation for Computer Workplaces as well as in ISO 9241.

References
Herczeg [2]
ISO 9241 [10]

LO-2.1.2	Describe universal design (K2)	10 minutes

Terms
Universal design

Universal design (also known as universal usability) pursues the goal of designing products and services in such a way that they can be used by as many people as possible - regardless of age, capabilities and usage situation.

Principles in universal design:

- Principle 1: Equitable use
- Principle 2: Flexibility in use
- Principle 3: Simple and intuitive use
- Principle 4: Perceptible information
- Principle 5: Tolerance for error
- Principle 6: Low physical effort
- Principle 7: Size and space for approach and use

The differences between Europe and the USA are in some cases substantial. Universal design originates from the USA. In Europe the term "Design for All" is often used. "Design for All" as a European strategy means for this reason to integrate different groups of people without forcing a uniformity.

As far as they are needed, Universal design also includes assistive devices for specific groups of people with disabilities.

References

Center for Universal Design (CUD) [25]

LO-2.1.3	Explain the influence of social rules on the User Experience (K2)	15 minutes

Terms
Human–computer interaction (HCI), social rules

Humans are social beings. For every man-machine interaction this means that humans expect a certain social behavior from the machine. This can be described with the following sentence: "Software should behave like a good friend or girl-friend."

Good friends …

- … try to make suggestions on how to proceed if you don't know what to do now,
- … make sure that the other person never feels incompetent or stupid,
- … know the needs of their friend,
- … speak a language that is understandable,
- … suggest only what is required at the moment (and know what this could be),
- … do not ask nonsensical or incomprehensible questions.

The list can of course be extended as desired.

References
Weinschenk [17]
Cooper [18]

2.2	Human information processing and impact on the User Experience (K2)	260 minutes

LO-2.2.1	Explain the biological principles of visual perception (K1)	15 minutes

Terms
cones, fundamental colors, rods

The visual perception is not only determined by the physical condition of the eyes. In fact, the strongest influence comes from the processing by the executive system of the brain. Habits as well as psychological factors play a major role in this process.

Anatomy

- Main field of vision: approx. 30° around the optical axis
- Remaining area (up to 110°) is known as peripheral field of vision
- Foveal vision, approx. 1-2° around the optical axis. The foveal system of the human eye is the only part of the retina that permits 100% visual acuity.

Many objects located in the peripheral field of vision are not ssen but supplemented or substituted from memory on a best guess basis. On average, about 10% of what is "seen" is actually seen, about 90% of what we think we see is taken from memory.

The anatomy of the eye has profound implications for reading text. Text can only be read when it is looked at directly. During reading, the eye is fixated for a brief moment, then moved on in a rapid movement and fixated again. Reading takes place during these short fixations.

This has particular implications, for example, for the comparison of values on a screen. Only if these values can be captured during a single fixation, i.e. if they are very close together, can they be compared easily.

Primary colors
The sense of vision use two types of photoreceptor cells:

- Rods, which can only distinguish between leves of brightness (no colors!)
- Cones which are responsible for color perception

Rods function in twilight conditions. Cones need a higher light intensity than rods (daylight).

- 3 cone types (red, green, blue)
- 3 primary colors (red, green, blue)

- all visible colors are composed by mixtures from signals of the 3 types of cones.

References
Schubert & Eibl [4]
Hunzinker [22]
Aage & Møller [26]

LO-2.2.2	Differentiate between dynamic and static vision (K1)	15 minutes

Terms
dynamic vision, static vision

Differentiation between
- Static vision
- Dynamic vision

Static vision:
- Focusing on an object
- Detailed vision
- Nuances in brightness and color are discernible

Dynamic vision:
- Mainly at the peripheral field of view
- Even the smallest movements are visible
- Details tend to be unimportant; "danger" must be recognized
- Draws attention

References
Schubert & Eibl [4]
Aage & Møller [26]

LO-2.2.3	Demonstrate the anatomical-physiological limitations of human perception (K1)	15 minutes

Terms
optical illusions, optical limitations, receptor cells

Limitations of human perception result in poor perception of reality. In many cases important elements or changes in a user interface are not perceived at all.

- Series of individual images can be perceived as moving images:
  - Cinema
  - Television

  Approx. 22 Hz are sufficient for the perception of movement instead of a series of images.
- interlaced-images are used to increase (double) the frequency and lower the perception of a flickering screen
- The bility to detect movements is much higher in the periphery of the field of vision.
- Rapid movements are perceived as flickering, if the refresh rate is low
- 50 Hz of the TV/monitor can be perceived as flickering.
- Flashing elements, e.g. on websites, immediately attract attention.
- Incorrect perception of absolute values of grey shades depending on the background.
- Receptor cells are linked by neurons in the retina. This leads, among other things, to movements being perceived more easily, or to the fact that the resolution of the eye decreases at low brightness
- Approx. 10 % of the information that can be seen in a user interface is perceived visually, and approx. 90 % of it is supplemented from memory. People often see what they remember and not what is on the screen. This leads to the effect that even the "obvious" is overlooked.
- In dark spaces (e.g. in vehicles at night), red and blue elements relatively close (e.g. at a distance of 70 cm) to the eye of the observer cannot be focused simultaneously and should therefore be avoided. This is mainly due to the different refraction in the lens of the eye of the different wavelengths of red.

Further example for limitation/illusion:
- "Lateral inhibition" (e.g. Hermann grid illusion)

References
Schubert & Eibl [4]
Aage & Møller [26]

LO-2.2.4	Estimate color associations and color effects (K1)	15 minutes

Terms
color associations, effects of color

Colors are not only relevant for design and highlighting. They evoke associations and create an emotional and psychological effect. Colors can reinforce messages or even confuse a recipient. Depending on their context, colors usually have a positive or negative connotation.

Red: love, fire, energy, passion, blood, stop, danger, heat, drive
Green: acid, nausea, nature, hope, life, pacification, OK, poison
Blue: dynamic, nobility, competence, coolness (calmness vs. distancing)
Purple: extravagance, clergy, power, rigidness, decadence, sin, vanity
Yellow: sun, vitality, warmth, versatility, envy, death
Pink: cute, sweet, tender, naïve, gentle
Orange: modern, funny, young, enjoyment, extroverted
Brown: warmth, decay, cozy, fascism, patina, lazy, aromatic, old-fashioned, withdrawn, comfortable
White: pure, bright, complete, sterile, neutral, bride, empty, innocence, illusionary, unreal
Black: death, night, elegance, mourning, neutral, difficult, threat, nothingness, misfortune, seriousness, pessimistic, hopeless, compulsive
Gray: pale, fog, neutral, boring, theory, poor, covert, unfriendly
Cyan: passive, concentrated, conscientious
Turquoise: expectant, defending
Magenta: idealistic, transcendent, theoretical

However, intercultural differences in the effect of colors have to be taken into account. For example, in China the color white is considered the color of mourning or death.

<u>Psychological effects of color</u>
Colors can also be interpreted emotionally. These effects are partly due to the use of colors as a system of order and security.
Today it is considered proven that certain colors can have an effect on physical reactions.

References
Schubert & Eibl [4]
McLeod [23]

LO-2.2.5	Describe color vision impairments and understand their influence on usability (K2)	15 minutes

Terms

color vision impairments, deuteranopia, dichromats, monochromats, protanopia, trichromats, tritanopia

In comparison to normal-sighted trichromats, a distinction is made between the following congenital color vision impairments:

a) Abnormal trichromats:
See three fundamental colors, but cannot distinguish some colors as well as normal-sighted people.

b) Dichromats:
Dichromats can only distinguish two fundamental colors.

c) Monochromats:
Monochromats can only distinguish between light and dark.

Terms
Protanomaly = reduced sensitivity to red light
Deuteranomaly = reduced sensitivity to green light (the most common form of colour blindness)
Tritanomaly = reduced sensitivity to blue light (extremely rare)

Color vision deficiencies are found in about 8% to 9% of all men (red-green) and 0.5 to 0.8% of all women.

To make sure that a design is correctly perceived by people with colour vision defects, it is recommended to use tools. Such tools can simulate the color perception of people with color vision deficiency so that countermeasures can be taken early on in the design process.

Furthermore, color schemes can be used which are also correctly perceived for example by red-green-color vision impairment.

References
Aage & Møller [26]

LO-2.2.6	Describe which environmental factors influence the usability (K1)	30 minutes

Terms
environmental influences

Environmental influences refer to various factors that influence the performance of human activities. Environmental influences can be classified into different types. Environmental influences can in some cases considerably reduce the performance efficiency of humans. It is therefore important to know under which conditions an interface will be used. In the following a few examples are listed:

- **Cold:** limited motor skills, big hands (gloves)
- **Dark:** loss of color vision, blindness
- **Sunlight, brightness:** Screens are difficult to read, weak contrasts are not visible in glare
- **Stress:** limited ability to think, reduced creativity
- **Loud environment:** quiet sounds are no longer perceived.
- **Tiredness, exhaustion:** reduced ability to think, poor concentration, limited motor skills

References
Struve [6]
Little [27]

LO-2.2.7	Give an overview of the Gestalt principles and some examples of their effect on usability (K2)	30 minutes

Terms
Gestalt principles

Gestalt psychology, developed in the 1920s, explores human perception. The Gestalt principles reveal certain principles in the formation of holistic entities. "Gestalt" in this case has nothing to do with " design".

For visual stimuli a network of features located in the brain is used. This network is used to examine and classify an object. There are nine types of characteristics that help to distinguish objects from one another:

- Shape, color, brightness
- Size, direction, texture
- Arrangement, depth, movement

The Gestalt principles can be classified in various categories:

- Classification into areas
- Distinction of figure and ground
- Connectivity and grouping
- Principle of good form and principle of conciseness

- Integration into frames of reference

Gestalt psychology studies how humans experience and perceive holistic entities.

For the perception of elements on a screen it is particularly important that functionally/logically related elements are also perceived as belonging together.

In order to create this perception of objects belonging together, the following Gestalt principles apply:

- **Principle of good form** (principle of conciseness): Complex shapes are decomposed into the simplest possible individual shapes (= good form).
- **Principle of similarity**: Objects that look similar are perceived a belonging together.
- **Principle of continuation**: Points lying next to each other are grouped together and perceived as a continuing line.
- **Principle of proximity**: Objects which lie close to each other are perceived a belonging together.
- **Principle of common region**: Objects which lie within a circumvented area are perceived a belonging together.
- **Principle of connectivity**: Connected objects are perceived a belonging together.
- **Principle of common fate**: Objects that move in the same direction or show the same dynamic visual appearance are perceived a belonging together.
- **Time synchronicity**: Objects that appear at the same time or that change at the same time are perceived as belonging together.
- **Learned meanings:** Depending on the context, we attribute different meanings to objects and tend to create a sense of belonging together based on meaning / past experience.

References

Anderson [5]
Butz, Schmid [7]
Zimbardo [8]
Metzger, Spillmann [28]

LO-2.2.8	Explain mental models, reading and information processing (K2)	20 minutes

Terms

mental models

Mental models are assumptions by user about how a user interface will function. These assumptions are mostly based on experiences users have made with similar systems. For this reason, it is often advantageous to adopt such familiar concepts in newly developed software. If known concepts are no longer used, but completely redesigned, many users react with rejection.

Examples:

- "Missing" Windows button in Windows 7 led to rejection.
- Visio was not developed by Microsoft, but was outsourced, the user interface was practically identical to the other MS products.
- People who use a smartphone for the first time have problems with "swiping ", as this does not exist on PC systems.

So-called "mental model diagrams" are a representation of the motivations, thought processes and deeper lying behavioral motives of users. The main purpose of these diagrams is to show the goals and the procedure used by people to achieve these goals, and depict these in relation to the user interface.

Mental models also play an important role in the understanding of words. Different groups of people often suspect different information behind certain terms. Therefore, it is important to adjust the terms that are used accurately with the user group.

In general, it is more difficult for people to recall something from memory than to recognize something.

The interpretation of a screen content is unconsciously done by using mental models.

In principle, only about 10% of the supposedly perceived information is captured via the sensory organs, the remaining 90% is retrieved from memory

Humans can only remember few read messages by the time they call the next page of an interface.

Mostly people read only a few letters and supplement the rest with the help of their mental models. They then try to see if it "works". If the interface does not behave according to their expectations, this will result in a negative attitude.

References

Young [29]
Weinschenk [17]

2.3 Standards, norms and style guides (K2) 85 minutes

LO-2.3.1	The significance and benefits of standards (K1)	5 minutes

Terms
ISO , international norms

National standards institutes develop norms and standards on the basis of country-specific agreements and are represented in the corresponding international institutions.

The purpose of standards is the national and international alignment and harmonization of products with each other and the promotion of rationalization, quality assurance and occupational health and safety. Norms standardize inspection methods and facilitate communication in business and technology. Through standardization and the resulting compatibility, competition and the associated market pressure for innovation and pricing can result. Standards are the basis for legal compliance and play a role in warranty, liability and compensation claims. However, they also restrict markets by excluding any products that do not comply with the standards.

Standards can be classified into the following areas:
- Safety standards
- Usability standards
- Quality standards
- Measurement standards
- Testing standards

ISO-Norms are developed by the International Standardization Organization (ISO) and are often adopted at European or national levels.

References
ISO 9241 [9]
Schneider [10]

LO-2.3.2	Provide an overview of the usability-relevant norms ISO 9241, in particular EN ISO 9241-110 ("Principles of dialogue design") and of ISO/TR 16982 (K2)	35 minutes

Terms

ISO 9241, ISO 16982

conformity with user expectations, controllability, design principles, error tolerance, self-descriptiveness, suitability for individualization, suitability for learning, suitability for the task

The central element of the normative framework of user interfaces of interactive systems is the ergonomics of human-system interaction according to EN ISO 9241 (The corresponding national designations are DIN EN ISO 9241 in Germany and ÖNORM EN ISO 9241 in Austria. For other European countries, it must be ascertained whether the EN ISO 9241 has been adopted in their corresponding national standards.)

References

ISO 9241 [9]
Schneider [10]
ISO/TR 16982:2002 [24]

LO-2.3.3	Describe the importance, application and benefits of style guides (K1)	10 minutes

Terms

Style guides

Style guides provide clear guidelines for the design of printed media, software user interfaces and web applications of a company. They range from concrete guidelines for manufacturer platforms or operating systems to individual guidelines for individual providers, which are specifically oriented to their corporate design.

In terms of content, the style guides can specify anything from the colors, icons, fonts, etc. to complete interaction patterns and information architectures of programs and websites.

The added value or benefit of such style guides is manifold, both for users and developers.

On the part of the user, the advantage lies especially in the consistency (internal and external), which leads to increased ease of use, less training effort and less susceptibility to errors. On the part of the developers, the advantage lies in higher quality standards, reduced design effort and frequently also in reusable source codes.

References

LO-2.3.4	Provide an overview of the purpose and significance of standards based on "IEC 62366-1:2015 Medical Devices Part 1 Application of Usability Engineering to medical devices" (K1)	10 minutes

(The International Electrotechnical Commission (IEC) is an international standardization committee for electrotechnical and electronics standards based in Geneva. Some standards are developed together with ISO.)

The importance and practical use of standards can be illustrated very well using IEC 62366-1:2015, which is aimed at the rapidly growing field of medical technology.

Medical technology comprises numerous devices, products and applications whose operation is directly related to the health and/or survival of people. The vast majority of these devices are operated by trained personnel (e.g. nurses, doctors), but a small part (e.g. defibrillator, blood pressure monitor) can/must also be operated by persons without any specific training. In either case, it is essential that the operation of the appropriate device for the respective user groups is simple, efficient and, above all, error-free, so that the medical problem is in the center of attention.

IEC 62336-1:2015 defines a process by which manufacturers can analyze, methodically develop and evaluate the usability of medical devices - in particular with regard to their safety. This process enables the manufacturer to evaluate and minimize the risk arising from normal and also erroneous operation of the device. It can also be used to identify "abnormal" operation, but cannot reduce the associated risks (e.g., intentional operation causing damage to the patient, sabotage, etc.).
Part 1 was updated in 2015 to incorporate modern concepts of usability engineering on the one hand and, on the other hand, to improve the linkage to ISO 14971:2007 and its methods of risk management that are applied to safety issues in medical technology.
Part 2 includes a tutorial for the application of Part 1 as well as supplementary methods and explanations of the usability engineering process with regard to aspects of medical technology that go beyond the safety-critical aspects.

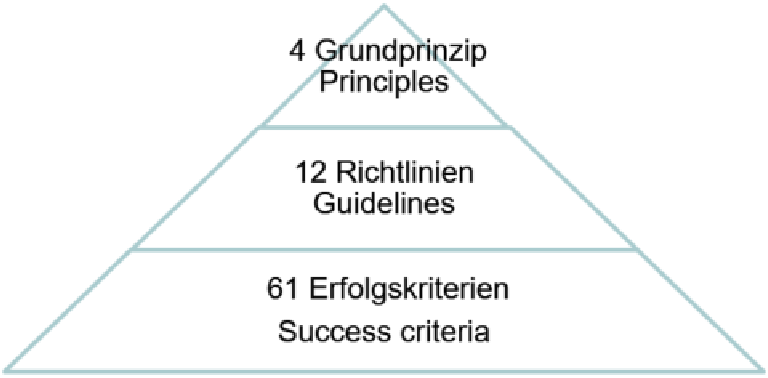
References
IEC 62366-1:2015 [12]

LO-2.3.5	Provide an overview of the Web Content Accessibility Guidelines (WCAG) 2.0 (now also available as ISO/IEC 40500!) (K1)	30 minutes

The W3C (World Wide Web Consortium) was founded in October 1994 to support the optimal develop the World Wide Web.

The social value of the Web is that it provides interpersonal communication, business environments and possibilities for knowledge exchange. One of the main goals of W3C is to make these benefits available to all people, regardless of their hardware, software, network infrastructure, native language, culture, geographical location and physical or mental abilities.

In order to make the Web, its contents and services "accessible", the W3C working group has developed appropriate guidelines. These Web Content Accessibility Guidelines (WCAG), currently available as Version 2.0, cover a wide range of recommendations for making web content more accessible. By following these guidelines, content will be accessible to a larger group of people with disabilities. These include blindness and visual impairment, deafness and deteriorating hearing, learning disabilities, cognitive impairment, limited mobility, speech impairment, photosensitivity as well as combinations of these disabilities. In addition, adhering to these guidelines will in many cases make web content more usable for other users.
The WCAG 2.0 success criteria were formulated as testable statements which are not technology-specific. Both a guide to fulfilling the success criteria for specific techniques and general information on interpreting the success criteria can be found in separate documents.



4 principles:

- Perceivable
- Understandable
- Robust
- Operable

12 guidelines

- These are not testable, but they provide a framework and overarching objectives for better understanding.
- There are 4 or respectively 3 measurable success criteria for each principle

Expample: Guidelines regarding „Operable":

2 Operable
- 2.1 Make all functionality available from a keyboard.
- 2.2 Provide users enough time to read and use content.
- 2.3 Do not design content in a way that is known to cause seizures.
- 2.4 Provide ways to help users navigate, find content, and determine where they are.

61 success criteria (directly implementable and measurable, not technically specific

- 25 with high priority (A)
- 13 with normal priority (AA)
- 23 with low priority (AAA)

Example: Success criteria regarding „Operable", 2.2.:

Guideline 2.2 Enough Time: Provide users enough time to read and use content. Understanding Guideline 2.2

2.2.1 Timing Adjustable: For each time limit that is set by the content, at least one of the following is true: (Level A)

How to Meet 2.2.1
Understanding 2.2.1

- **Turn off:** The user is allowed to turn off the time limit before encountering it; or
- **Adjust:** The user is allowed to adjust the time limit before encountering it over a wide range that is at least ten times the length of the default setting; or
- **Extend:** The user is warned before time expires and given at least 20 seconds to extend the time limit with a simple action (for example, "press the space bar"), and the user is allowed to extend the time limit at least ten times; or
- **Real-time Exception:** The time limit is a required part of a real-time event (for example, an auction), and no alternative to the time limit is possible; or
- **Essential Exception:** The time limit is essential and extending it would invalidate the activity; or
- **20 Hour Exception:** The time limit is longer than 20 hours.

There are 5 conformity levels (A, AA, AAA) for assessing the conformity of a website.

The degree of compliance is to be classified with regard to several aspects:

- Complete site or just parts of it?
- Complete process (e.g., order process)?
- Are barrier-free techniques used?
- Are techniques used that explicitly exclude certain individuals?

The WCAGs are now also anchored in ISO: ISO/IEC 40500!

References
Web Content Accessibility Guidelines 2.0 [11]

3 Usability Engineering und User Experience Design (K2) — 480 minutes

3.1. Usability engineering fundamentals (K2) – 5 LOs (100 minutes)

LO-3.1.1	Know the concepts of UCD (User-Centered Design) (K2)
LO-3.1.2	Describe the definitions and application of usability and user experience design (K2)
LO-3.1.3	Know and be able to assess the quality criteria of data collected in the context of usability and user experience engineering methods (K1)
LO-3.1.4	Describe the traditional usability engineering lifecycle (K2)
LO-3.1.5	Describe the requirements and challenges of user experience design (in comparison to usability engineering) (K1)

3.2. Analysis and concept phase (K2) – 3 LOs (180 minutes)

LO-3.2.1	Describe the difference between qualitative and quantitative usability goals and the basic principles of requirements analysis (K2)
LO-3.2.2.	Know the 4 pillars of requirements analysis in terms of usability and user experience design (K2)
LO-3.2.3	Know the principles for building user scenarios and the difference between these and use cases (K2)

3.3. Design phase (K2) – 2 LOs (50 minutes)

LO-3.3.1	NExplain and describe different design processes (K2)
LO-3.3.2	Know the fields of application and the components of wireframes (K2)

3.4. Prototyping phase (K2) – 1 LO (150 minutes)

LO-3.4.1	Enumerate different prototypes and know their fields of application (K2)

3.5. Evaluation-phase (K2) – 3 LOs (240 minutes) – (3rd day)

LO-3.5.1	Understand the purpose of evaluation (K2)
LO-3.5.2.	Know different test methods and give examples of their preferred application (K3)
LO-3.5.3	Know the basic contents of an evaluation report (K2)

3.1	Usability Engineering (K2)	100 minutes

LO-3.1.1	Know the concepts of UCD (User-Centered Design) (K2)	10 minutes

Terms
product lifecycle, user-centered design

Fundamental principles of user-centered design are:

1. The design is based on an explicit understanding of users, tasks and context of use.
2. Users are involved throughout the design and development process.
3. The design is driven and refined by user-centered evaluation.
4. The process is iterative.
5. The design addresses the whole user experience.
6. The design team includes multidisciplinary skills and perspectives.

Guidelines for user-oriented design activities within the entire product life cycle of computer-based interactive systems were formulated in the ISO 9241-210 standard.

The user-oriented design of interactive systems offers numerous advantages. The total costs of a product life cycle, including its conception, design, implementation, maintenance, use and servicing, can be significantly reduced.

The user-oriented, usable design of systems contributes to the following:

- Systems are easier to understand and to use, which reduces extra training and incidental product costs.
- The satisfaction of users is improved, thus reducing discomfort and stress.
- The productivity of users and thus the efficiency of the organization are improved.
- The product quality is improved. This increases the users' acceptance, which can lead to a competitive advantage.

References
ISO 9241 [9]
Schneider [10],

LO-3.1.2	Describe the definitions and application of usability and user experience design (K2)	10 minutes

Terms
usability engineering process, User Experience engineering process

The process of usability engineering runs in parallel with the software development process and ensures the future usability of a website or software application. Goals are defined in iterative steps in line with the needs of the target groups and are tested using prototypes. In the case of any deviations from the target state, project steps are repeated, reworked and improved.

In user experience design, which supplements the usability engineering process and covers includes all experiences that are in any way related to the product to be developed, these additional aspects are methodically addressed and optimized. New possibilities of the inventory of methods of empirical social research are introduced in this context and require the integration of appropriately trained persons into the usually mainly technical development teams to form multidisciplinary teams.

Usability and user experience engineering does, however, not end with the delivery of a product to the market or with the product going online. Rather, it is an ongoing process that also deals with ongoing optimization and the identification of the right time for a relaunch. The support of the users and the communication with them in the daily application and use of a system is a significant factor of the user experience.

LO-3.1.3	Know and be able to assess the quality criteria of data collected in the context of usability and user experience engineering methods (K2)	20 minutes

Terms
data quality, objectivity, reliability, validity

In the course of the usability engineering process, data is collected using a variety of methods. It is essential to assess the quality of the data, as incorrectly collected or interpreted data can have a sustained negative impact on the development of interactive systems or drive the development in the wrong direction. This also includes a differentiation from the questions and methods of market research.

The most important factors influencing the respective data must be recognized and understood. These are:

- Selection and number of interview partners, test persons
- Test management and interview effects
- Cognitive and social factors influencing the response behavior of test persons
- Basic understanding of questionnaire development
- Task validity

References
Tullis [19]

LO-3.1.4	Describe the traditional usability engineering lifecycle (K2)	20 minutes

Terms
evaluation, UCD analysis, usability engineering lifecycle

Usability engineering is not a multitude of unrelated separate methods, but is typically applied in a higher-level "lifecycle". The activities of this lifecycle already start before the actual development of the man-machine interface.

This results in the following phases of a so-called usability engineering lifecycle, which should be iteratively executed until the product meets the user requirements:

1. Analysis and concept phase
2. Design phase
3. Prototyping phase
4. Evaluation phase

There are now numerous variants of such lifecycle models, which differ mainly in their interrelation with existing development processes.
Further models for the usability engineering lifecycle are, for example, the delta method, contextual design, scenario-based development, usage-centered design or a version of the waterfall model extended by aspects of usability.

LO-3.1.5	Describe the requirements and challenges of user experience design (in comparison to usability engineering) (K1)	20 minutes

Terms
Experience, usability, User Experience

The traditional usability engineering process involves activities, methods and procedures that are designed to achieve purpose-built, function-oriented systems for clearly defined requirements in terms of their usage quality.

The much broader user experience (see point 3.1.2.) presents new requirements for the corresponding development processes. The focus is no longer only on the implementation of well-defined requirements, but also on how the respective system or specific functions can actively shape or influence the user experience. For example, the decision that a photo cannot be reproduced as often as desired can significantly influence the social value of this photo and thus give the corresponding application a completely different experience value (a different user experience).

The requirements and possibilities of modern software development are manifold and have to take these social and emotional aspects into account. There is great potential for innovation in these requirements, but also a potential risk if they are not taken into account.

References

Preece [20]

Flückiger [15]

3.2 Analysis and concept phase (K2) — 180 minutes

LO-3.2.1	Describe the difference between qualitative and quantitative usability goals and the basic principles of requirements analysis (K1)	40 minutes

Terms
qualitative usability goals, quantitative usability goals

Why usability goals?

Qualitative and quantitative usability goals serve as guidelines for the design of interactive user interfaces and form acceptance criteria for the evaluation of the design process. They facilitate the decision to either undergo a further design cycle or to move forward to interface development.
The first step is to create a common and accurate picture of the user groups (derived from the user profiles) and a corresponding and appropriate model of the work and working environment (based on the task analysis) so as to better focus the design process.

Qualitative usability goals
Qualitative goals are helpful to guide the interface design, especially in the initial phase. They result from the requirements derived from the user profiles and from the context-related task analysis.

Examples:
- The system shall not require knowledge of the underlying technology.
- During the transition to new releases, changes that are irrelevant to the tasks of the users should not be visible.
- The system shall support collaborative group work.

Quantitative usability goals
The achievement of qualitative objectives is often difficult to precisely define. In contrast, additionally defined quantitative goals are more objective and can be measured more accurately.

Examples:
- Definition of a specific or maximum allowed execution time
- Execution times are specified for a certain level of user experience:
  For experts: ease of use of the application
  For new users: ease of learning of the application

- Absolute targets use absolute quantitative parameters such as processing time (in minutes, seconds), number of errors, etc.
- Relative targets refer to the user experience with a certain product/interface relative to the experience with another products/interfaces
- Clear preference between alternatives
- Level of satisfaction with a particular interface (5-level scale: dissatisfied to fully satisfied)
- Performance goals quantify the current performance of a user in the execution of a particular task. Typical: Time to execute the task or learn how to execute it, number and type of errors, and the time required to complete the task.

  At this point ca. 20 minutes are planned for exercises, reflection or discussion of case studies.

References
Urban [13]
Tullis [19]

LO-3.2.2	Know the 4 pillars of requirements analysis in terms of usability and user experience design (K2)	90 minutes

Terms
user analysis, task analysis, context analysis comparative/competitor analysis, , ,

In order to optimally design a system for the real future users, it is necessary to have all the information available for the implementation or design of the system that may be relevant for the use of the system. In the corresponding analysis or data collection procedure, data is collected from which the relevant information can be derived. It is important that the derivation of the information must not be a subjective interpretation by individual designers or developers!

The 4 relevant components (pillars) of such analyses are:

- User analysis
  All characteristics of the users that can or might have an influence on the usage (eyesight, body height, expertise, affinity for technology, etc.) are collected.

- Task analysis

In most cases, users have concrete tasks in mind when they use a system (looking for concrete content, buying something, communicating, etc.). Task analysis is aimed at identifying these concrete tasks so that they can then be optimally represented in the system. Every task analysis method is based on breaking down the respective task into its individual components (subtasks).

There are 2 types of tasks:

Action-driven, i.e. focused on the required actions that the user must perform (e.g. manual activities, movement or manipulation of objects).

Cognition-driven, i.e. focused on the mental processes that the user undergoes while working on a task. These include important cognitive aspects of decision making, problem solving, attentiveness and memory.

- Context analysis

The usability of a system or its user experience is largely dependent on the context in which it is used. Only if the different contexts of use are known can the system be optimized in this respect. Context factors include the external, physical context (light, temperature, etc.), the psychological context (stress, privacy, motivation, etc.), as well as the personal physical context (sitting position, movement, freedom of hands, etc.).

- Comparative/competition analysis

Users today use numerous systems, from the use of which they gain experience which they then apply to the handling of another system. This can be advantageous or disadvantageous. It is therefore crucial to know about systems that could potentially have an influence, in order to make sure that their effect is positive. Correspondingly influencing systems can be systems from a similar subject area (e.g. accounting programs), systems that use similar concepts (e.g. product search in online shops), or directly embedded modules (e.g. interactive city maps).

At this point ca. 40 minutes are planned for exercises, reflection or discussion of case studies.

LO-3.2.3	Know the principles for building user scenarios and the difference between these and use cases (K2)	50 minutes

Terms
persona, use case, user scenario

User scenarios
User scenarios show how users perform tasks in a specific context. They give examples of the different usage of devices and applications and form a basis for subsequent usability tests. For these scenarios, the tasks, goals and motivations of a user must be determined.

User scenarios can have different levels of detail. Goal-driven or task-driven user scenarios only define what a user wants to achieve. Comprehensive scenarios consider the background of the user and the task. They provide a deeper understanding of the user's motivation and behavior for solving the task.

In principle, user scenarios should cover a wide variety of situations. Care must be taken to ensure that not only obvious cases are taken into account or those that are of interest to the design and development team. Situations that challenge the concept of the system as such must also be considered.

Use cases

Use cases, on the other hand, describe the use from the perspective of the application. They facilitate the addressing of concrete processes. These describe the steps that a user performs for the specific task of an application and the way in which the application reacts to the user's actions. Use cases are used to describe the interaction processes and evaluate them with regard to their priority. As is the case with user scenarios, it is also important for use cases to have the most exact data about the user available.

In contrast to conventional software applications, the context of use of web applications is characterized by special features. For example, conventional software applications are usually based on defined user groups, task and organizational contexts, whereas public websites often address a broader user group with sometimes very different interests and information needs. It is therefore all the more important to know the basic design decisions and strategies when developing WWW user interfaces and to take them into account in the development process.

Persona

For setting up test series, some fictitious persons (personas) are deveoped, who are to represent the majority of the future actual users. The design and development team will later address the needs of these fictitious persons and run through the corresponding different user scenarios. A list of such profiles is more than just a tabular list of characteristics. Photos and names as well as personal data such as age, gender, educational background, preferences, hobbies, character traits and social background make the personas come alive. Personas will not only help to fulfill the pure software-ergonomic requirements in the design process, but will also help to consider the desired user experience for the target group.

Defining such types of persons prevents that a non-existent standard/average user is assumed, but rather that specific user requirements must also be fulfilled.

> *At this point ca. 40 minutes are planned for exercises, reflection or discussion of case studies.*

References
Flückiger [15]

3.3 Design phase (K2) 50 minutes

LO-3.3.1	Ability to name different design processes (K2)	40 minutes

Terms
iterative design, Lean UX, parallel design, participatory design

In practice, very different processes to user interface / UX design have become established. None of them is necessarily right or wrong. Depending on the environment, system, resources, qualifications, etc., one process may be better suited than another. The following types can be roughly distinguished, although in most cases a hybrid of these is used in practice.
At the beginning of each design it must always be decided (and documented in writing) which standards/norms are to be applied, to what extent the system will be subject to the accessibility guidelines WCAG of the W3C, and whether special manufacturer guidelines must be followed.

Parallel design

- Start design as a parallel design involving several developers, develop different design alternatives and test the different usability goals that are intended
- Draft design solutions
- Make the design solutions more concrete with the help of simulations, models, full-scale models, etc.

Participatory design

- Directly involve users in the design process
- Development of design proposals with a multidisciplinary approach using the existing knowledge
- Present design solutions to users and let them perform (real or simulated) tasks on a trial basis
- Multidisciplinary design

Problems occurring in the evaluation phase are solved and improved in iterative steps in design and development.

Iterative design

Define the basic principles of the design
Permanent evaluation of new designs
Change of the design solutions in line with the user feedback

Lean UX

Lean UX refers to a very lean, design and product-oriented approach to design and development. The LEAN-UX understanding is based on the continuous co-operation of all teams involved, including product management, design, programming, marketing etc.
Regular communication right from the start is intended to ensure that all team members have the same level of knowledge of the project. Lean prototypes are already validated with end users in the first phase of the project to minimize the time spent on pursuing false hypotheses.

The basis for the various lean variants is the idea of the **Lean UX Manifest**, in which the author, Anthony Viviano, has defined his basic requirements for lean development.

Quote of the points from the original:

- Early customer validation over releasing products with unknown end-user value
- Collaborative design over designing on an island
- Solving user problems over designing the next “cool” feature
- Measuring KPIs over undefined success metrics
- Applying appropriate tools over following a rigid plan
- Nimble design over heavy wireframes, comps or specs

At this point ca. 20 minutes are planned for exercises, reflection or discussion of case studies. You will find a corresponding suggestion in the enclosed manual for exercises.

References
Stary et al. [20]
Gothelf [22]
Preece [20]
Cooper [18]

LO-3.3.2	Know the fields of application and the components of wireframes (K2)	10 minutes

Terms
wireframe

A wireframe is the schematic representation of a website. The wireframe (or wireframe model) serves to illustrate and plan elements that are to be present on a website. The basic elements of a page are shown, which initially has nothing to do with the design of the website.

Wireframes are intended to focus on the essential elements of the concept.

3.4	Prototyping phase (K2)	150 minutes
LO-3.4.1	Enumerate different prototypes and know their fields of application (K2)	150 minutes

Terms
high-fidelity prototype, horizontal prototype, low fidelity prototype, paper prototype, scenario prototype, vertical prototype

Prototypes help to make the design and processes understandable and serve to illustrate a preliminary stage of the later application. They are used at a very early stage of the development process. In this way, potential dangers or problems can be identified and eliminated in advance. Prototypes support discussions and avoid misunderstandings in the development process.

Often prototypes only represent the part of the functional scope that shall be tested and thus allow different concepts to be explored. If a prototype serves the exploration of not yet understood usage requirements, this process is called explorative prototyping or usability prototyping.

Different types of simulations by means of prototypes can be distinguished:

- Vertical prototypes: Reduction to a few individual but detailed functions
- Horizontal prototypes: if possible, all functions integrated, but not functional (mostly used for testing user interfaces)
- Scenario prototypes: All functions for a specific task are simulated using a combination of vertical and horizontal prototypes

Depending on the intended use of the prototype, itsproductionis used in different forms and variants. A basic distinction is made between low-fidelity prototypes (low similarity to the final product, testing of the usefulness of the idea) and high-fidelity prototypes (high similarity, testing of details and exact functions). Hybrid forms - such as interactive simulations using HTML or PowerPoint - are also referred to as medium (lo-hi) fidelity prototypes.

<u>Low-fidelity-prototypes</u>

- **Verbal prototype**
  A person describes how he/she wants to interact with the system, while another person describes the reaction and condition of the system.

- **GUI prototypes**

Large index cards are used to present screen masks or task steps, which are "played through" in card stacks by one person with the support of a moderator.

- **Storyboards**
  Storyboards are illustrations that, when lined up together, visually depict the processes of interaction with a system. This form of prototyping originally comes from film production and is mostly used in connection with user scenarios.

- **Paper prototypes**
  The paper representation imitates the basic form of user interfaces.

High-fidelity-prototypes

- **Wizard-of-Oz prototype**
  With this type of prototyping, the user believes that he or she is interacting with the computer. However, a developer or experiment supervisor reacts and simulates the system behavior in the background.

- **Programmed prototypes**
  These digital and interactive prototypes are already very similar in form and function to the final product. It is important to note, however, that they must not give the impression that the program is already finished.

  At this point ca. 100 minutes are planned for exercises, reflection or discussion. You will find a corresponding case study in the enclosed manual for exercises.

3.5 Evaluation phase — 240 minutes

LO-3.5.1	Understand the purpose of evaluation (K2)	15 minutes

Terms
formative evaluation, summative evaluation

There are 2 different basic approaches/purposes of evaluations.

- **Formative evaluation**
  - Evaluation accompanying the process to improve the product quality, to form the product
- **Summative evaluation**
  - Final evaluation against specified benchmarks

Formative evaluation

Usability engineering is a itrerative process of prototyping. With the participation of future users, the prototypes are evaluated and improved in an iterative process. User participation during the evaluation phase ensures a reality-based examination of the development steps. This reduces the risk of developing without taking the users' needs and behavior into account.

- Target group is the project team itself
- Purpose: to obtain directly implementable directions forimprovements and corrections

Summative evaluation

In order to check the goals/benchmarks that were set at the beginning for the design of a user-friendly user interface, appropriate tests/measurements can be performed on the finished end product.
These can take place in different ways.

- Only works when the system is in a relatively finished state
- Assessment / evaluation against quantitative criteria or comparable systems
- Concrete measurable performance and satisfaction targets
- Benchmark for other systems
- Methods are for example:
  - Usability tests, special questionnaires, e.g. ISOMetrics (details follow)

LO-3.5.2.	Know different test methods and give examples of their preferred application (K2)	215 minutes

Terms
cognitive walkthrough, constructive interaction, CUSQ, eye tracking, focus group, heuristic evaluation, IsoMetrics, QUIS, SUMI, SUS, teach-back, Thinking Aloud, video

There is a whole range of different methods for carrying out different evaluations, both with user participation and UX expert-based. The participants should gain a basic understanding of the following methods. In addition to the usability test, a case study is also to be conducted.

Cognitive walkthrough

Based on an existing task analysis or on the tasks deconstructed into their subtasks, the project team (designers, developers ...) "walks" through the system - step by step according to the deconstructed tasks from the task analysis - and in the process checks the following questions repeatedly:

- Original by C. Wharton, 4 questions
- Streamlined version by P. Spencer, 2 questions

Questions according to Wharton

- Will the user try to achieve the right effect?
- Will the user notice that the correct action/function is available?
- Will the user associate the correct action with the effect to be achieved?
- If the correct action is performed, will the user see that progress is being made toward solution of the task?

Questions according to Spencer

- Will the user know what to do in this situation/condition?
- Having set the action, will the user know if this was successful or whether he or she has set the desired action with the corresponding result?

Disadvantages / problems

- The evaluators themselves do not necessarily know how a task should be performed (e.g. subject-specific features). It is therefore possible that they may make incorrect assumptions.
- The method is very dependent on a very thorough task analysis.
- No real users walk through the system - sometimes experts identify problems that users do not even perceive as such.

Constructive interaction

With this method 2 persons solve tasks together with the system/prototype. The interaction or discussion between the persons is in the focus of the observation. This is often very helpful to understand motivations or reasons for actions. With this method it is especially important to make sure that both persons act and not only one.
Frequently used for children and seniors.

Teach-back

This is a modification of the constructive interaction.
Once again 2 test subjects/users are tested simultaneously.
The system is explained to one person, who is then asked to explain the operation and functionality of the system to the other person, who is not familiar with the system. If necessary, the person may also help to solve given tasks with the system.
By observing these processes, insights into the mental models of the users can be gained.

Focus groups

A focus group is a strictly moderated discussion following a given agenda in order to address predefined questions.
The ideal number of participants is between 5 and 8 persons. Although the group should be homogeneous, a certain amount of variation is necessary, as otherwise no discussion will occur.
If there are several user groups of the planned system, several focus groups will be necessary.

Advantages

Transparency of the users' world of thoughts and experiences
- Development of hypotheses about participants' motives
- Inspiration for further, more detailed, in-depth statements
- Inclusion of quieter participants
- Even "unfinished" products and templates, e.g. drawings, can be tested

Disadvantages

- Possible dominance of individual participants
- Complexity due to too many participants, difficulty of coordinated moderation

- Evaluation of the materials can be very time-consuming.

Heuristic evaluation

Heuristics (finding, discovering) describes the art of arriving at good solutions with limited knowledge ("incomplete information") and little time. It describes an analytical procedure that uses limited knowledge about a system to draw conclusions or make statements about the system with the help of assumptions.
In a heuristic procedure, the system is evaluated using predefined heuristics, whereby the underlying assumption is: If the heuristics are fulfilled, then the system as a whole is also well usable.

Procedure
- Several evaluators assess the system - each independently of the other.
- They go through all views/screens/windows one by one and evaluate them using all heuristics.
- Usually several iterations are necessary.
- Then the evaluators compare and discuss their results and define a prioritized list of problems.

Disadvantages:
- Task orientation is not represented.
- The method requires a lot of practice on the part of the evaluators to work efficiently and to reach valid results.

Heuristics by Jakob Nielsen – 10 heuristic principles

The best-known heuristics come from Jakob Nielsen, the inventor of heuristic evaluation. These are:

Visibility of system status
The system should always keep the user informed about what is going on - through appropriate feedback within a reasonable time.

Match between system and real world
The system must speak the language of the users, in terms of words, phrases, symbols and concepts. Conventions from the real world should be adopted and information presented in a logical, natural order.

User control and user freedom

Users often use a function/navigation unintentionally - the system must provide a clear "emergency exit". Undo and Re-do functions must always be offered.

Consistency and standards
Users should not have to wonder whether different terms, representations or elements mean the same or something different in different situations.

Error prevention
Error prevention through careful design is better than a good error message. You can either successfully eliminate error-prone situations, or have the user confirm critical or complex actions with an additional command (button).

Recognition rather than recall
The memorization effort of the user is minimized by the fact that activities, information etc. are displayed and the user does not have to know them by heart. In particular, this functionality should be supported when switching between different windows/views.

Flexibility and efficiency of use
Accelerating interaction elements (e.g. quick shortcuts) - invisible to the untrained user - often help to support different user groups.

Aesthetics and minimalist design
Dialogs should not contain any information or elements that are irrelevant or very rarely needed. Each irrelevant information competes with the relevant content for the users' attention and therefore reduces their perception.

Help users recognize, diagnose, and recover from errors
Error messages must be written in a simple language and allow the user to recognize the error and understand the possible solutions.

Help and documentation
Although it is better for a system to do without documentation, there are still systems that require it. A corresponding help or documentation must be easy to search, task-oriented and focused on the essential information.

Thinking Aloud

While performing a task, the user is encouraged to "think aloud", i.e. to comment on his actions and motives. This often makes it easier for the test lead to understand the actions or behavior of the test person.
Attention: It cannot be assumed, however, that users really say everything - Hint: self-presentation effect! Besides, "Thinking aloud" also distracts from the actual task to be performed and cognitive ressources are decreased.

SUMI (Software Usability Measurement Inventory) (1998)

SUMI is used to measure the quality of use of software from the user's perspective.
Purpose:

  - Evaluation of products during development
  - Product comparisons
  - Formulation of design goals for the further development of a product

- 50 items of the questionnaire, which are assigned to 5 subscales
  - The subscales are: efficiency, affect, helpfulness (and support), controllability, and learnability
- 10 three-step items each with the verbal anchors: "agree", "undecided" or "disagree".
- "Global" scale, includes 25 of the total of 50 items which together best represent the construct of usability.
- Fully standardized
- Available in many languages (including English, German, Italian, Spanish, French and Italian)
- Item Consensual Analysis (ICA)
- Item-level response patterns are compared with the response patterns from a "standardization database" that represents a "generic software standard" (showing which of the items of the software are rated better or worse than the generic standard).

System Usability Scale (SUS)

SUS is a "quick & dirty", but still reliable method to have the subjective usability of a system (hardware, software, websites, mobile devices) assessed by users. The SUS questionnaire consists of 10 items (statements) with 5 answer options each, scoring from "strongly agree" to "strongly disagree".

SUS does not help to determine which usability problems are present in the software; rather, the method allows an assessment of the usability or the tested system.

The evaluation results in a score between 0 and 100, although this is not a percentile. Experience and research show that a score above 68 is indicative of good usability.

Items from the original SUS questionnaire:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Computer System Usability Questionnaire (CUSQ)

The CUSQ surveys the subjective satisfaction of users with a system. Users answer a standard questionnaire online (http://hcibib.org/perlman/question.cgi) and can submit additional comments.
The result is sent directly to an e-mail address.
http://hcibib.org/perlman/question.html#abstract

ISOMetrics

This is a software evaluation procedure based on ISO 9241-110; there are two versions of the ISOMetrics procedure, both of which use the same items.

  - ISOMetrics S (short) enables the exclusively numerical evaluation.
  - ISOMetrics L (long) can be used for the numerical and the qualitative, design supporting evaluation of a software.

- Available in a German and an English-language version.
- ISOMetrics S can be completed in about 30 to 60 minutes.
- ISOMetrics L requires at least two hours (including the completion of test tasks) per person participating.
- 7 subscales in accordance with the design principles of ISO 9241-110 with a total of 75 items that are scored by means of a rating scale

- ISOMetrics L has an additional rating scale for each item to evaluate its importance as well as free space for the presentation of concrete examples that describe weaknesses of the system regarding the content of the item.
- Insights gained
  - The numerical evaluation in relation to the design principles of ISO 9241-110
  - Concrete indications of malfunctions and weaknesses of the software from a user perspective
  - Weighting of problem categories, which are empirically obtained from a user perspective

Questionnaire for User Interface Satisfaction (QUIS; currently 7.0)

Originating from Shneiderman (1987)

QUIS is a questionnaire that exclusively records the subjective satisfaction of users with the interface of a system

- Online version
- Available in English, German, Italian, Portuguese, Spanish
- Long and short version
- 20/40 main questions and 5 items for a general evaluation
- Each item consisting of two opposite adjectives
- e.g., "inconsistent" versus "consistent"

Package includes the following:

- Demographic questionnaire
- Evaluation of general user satisfaction on six scales
- - Four evaluation areas for separate components of systems in general, e.g., layout factors, system feedback and suitability for learning
- - Optional evaluation areas for separate components of the system being evaluated, such as manuals, online help, Internet access and system installation.

Use of videos

Users or the screen are recorded by video while a task is being performed. Afterwards the video is discussed with the user. He or she is asked to explain and justify what they have done and why they did that. This procedure is especially helpful with complex systems, if not everything can be questioned during the actual test.

Eye-tracking

Eye-tracking is the recording of a person's eye movements, which mainly consist of fixations (points that are looked at closely), saccades (rapid eye movements) and regressions (jumping backwards). In the course of usability studies these methods are used to come to conclusions about the behavior, understanding or problems of test persons.
The interpretation of eye-tracking data must be carried out with great care. Misinterpretations are common!
The observation that someone, for example, looks at the header on a screen page first, does not yet allow any qualitative conclusions as to why this is the case - this would require the additional questioning of the person or using the method of "Thinking aloud".

Usability testing

Usability testing usually consists of a "package" in which future users perform precisely defined tasks in a system or on prototypes. They are observed and their actions are analyzed and interpreted. In addition, questionnaires and/or interviews are usually carried out before or after the test. Other methods such as "Thinking aloud", use of video or eye tracking can be applied to support the execution and evaluation of these activities.

Such tests are suitable for obtaining a first-hand impression of the users and drawing conclusions from their behaviors.

For a usability test it is necessary to have the appropriate room(s) and ideally (but not necessarily) some technical equipment so that valid usability tests can be carried out, observed and evaluated. An external usability laboratory is advantageous, but not absolutely necessary.

A detailed test plan must be prepared before the test is performed. Test plans usually contain the following elements:

- Test objective
- Test duration
- Date, time and location of the test
- Required infrastructure
- Development status of the system at the time of execution
- Person responsible for the test
- Test persons
- Tasks to be performed
- Amount and composition of the test budget

- Test procedure

When conducting a test, it is important that the test lead is appropriately trained or at least aware of the most important test lead effects! These include, for example, the following:

- Developer effect, personal success / failure!
- Body language, clearing of throat, coughing
- Unequal, improper assistance
- The desire to help the user
- The user is "exhausting" in his own way, and one hopes that he or she will be finished soon.
- Balancing "justice" (*he had some bad luck with the link, so I'll help him a bit here ...*)

Representative procedure of a test session (excl. questionnaires, interview etc.):

- One test lead or supervisor conducts the test with the test person.
- The test person is presented with the task in written form.
- The test person reads the task; if there are any questions, he or she asks them immediately.
- Then the test person must solve the task alone.
- If the test person has problems during the completion of the task, he or she should actively address the test supervisor.
- The test supervisor then provides help in accordance with a predefined scheme:
  - i.e., step-by-step guidance towards the solution.

At this point ca. 120 minutes are planned for exercises, reflection or discussion. You will find a corresponding case study in the enclosed manual for exercises.

LO-3.5.3.	Know the basic contents of an evaluation report (K2)	10 minutes

Terms

formative evaluation, summative evaluation

Evaluation can be performed as a summative or formative evaluation. The term "summative" refers to a final evaluation, while "formative" refers to an evaluation accompanying the development process, which is intended to contribute to improving the quality of the product. It is also possible to evaluate processes, such as the usability engineering process of a manufacturer.
Examples of common results from a formative usability evaluation:

- Usability problems in detail
  - Quantified parameters (how many people, etc.)
- Causes
- Rating (often traffic light system)
- Proposed solutions/remedies

Examples of common results from a summative usability evaluation:

- Achievements of precefined benchmarks
- Conformity with predefined criteria
- Deviations from precefined benchmarks and a respective rating
- Deviations from predefined criteria and a respective rating

References and literature

[1] Jakob Nielson, Designing Web Usability New Riders, 1999

[2] Michael Herczeg, Software-Ergonomie: Grundlagen der Mensch-Computer-Kommunikation, Addison-Wesley, 1994

[3] Weimarer Erklärung, http://www.udgermany.de/html/ud/g/Espacio_Vital_2010/charta_UD_ 14nov092.pdf

[4] S. Schubert & C. Eibl, Die 3 Gestaltgesetze, Fachtagung der Universität Siegen"Didaktik der Informatik und E-Learning", 2007

[5] J.Anderson, Cognitive Psychology and Its Implications, Worth, 2014

[6] Dr. Dirk Struve, Designdesaster und Usability: Einführung in die Gebrauchstauglichkeit, Walldorf, 2005

[7] Prof. Dr. Schmidt, Prof. Dr. Butz, Vorlesung „Mensch-Maschine-Interaktion", Universität Passau, 2003/2004

[8] Philip Zimbardo, Psychologie, Berlin, 1999

[9] DIN EN ISO 9241: Ergonomie der Mensch-System-Interaktion – Teil 110

[10] Wolfgang Schneider, Ergonomische Gestaltung von Benutzungsschnittstellen: Kommentar zur Grundsatznorm DIN EN ISO 9241-11, Beuth, 2008

[11] Web Content Accessibility Guidelines 2.0

[12] IEC 62366-1:2015

[13] Prof. Dr. Christian Stary, Hannes Gotthartsleitner, Ing. Mag. Peter Eberle, Zur Verschränkung von User Experience und Usability Engineering: Merkmale, Prinzipien und Vorgehensmodelle, Linz, 2009

[14] Steve Krug, Don't make me think! Web Usability: Das intuitive Web, 2. Auflage, Redline, Heidelberg, 2006

[15] Michael Richter, Markus Flückiger, Usability Engineering kompakt, Spektrum Verlag,Heidelberg 2. Auflage 2010

[16] Hans-Werner Hunziker, Im Auge des Lesers: vom Buchstabieren zur Lesefreude; foveale und periphere Wahrnehmung, transmedia verlag, Zürich, 2006

[17] Susan Weinschenk, Ph.D. 100 Things Every Designer Needs to Know About People, New Riders, 2010

[18] Alan Cooper, The Inmates Are Running the Asylum: Why High-tech Products Drive Us Crazy and How to Restore the Sanity, publisher: SAMS 2004

[19] Tom Tullis, Morgan Kaufmann, Measuring the User Experience, Morgan Kaufmann, 2013

[20] Jenny Preece et al., Interaction Design, Wiley, 2012

[21] Steve Krug, Rocket Surgery made easy, New Riders, 2010

[22] Jeff Gothelf, Lean UX, O'Reilly, 2013

[23] June McLeod, Colour Psychology Today, John Hunt Publishing Ltd, 2016

[24] ISO/TR 16982:2002 International Organization for Standardization

[25] Center for Universal Design (CUD) https://www.ncsu.edu/ncsu/design/cud/ (last access April 2017)

[26] Aage R. Møller Ph.D, SENSORY SYSTEMS: Anatomy and Physiology, Second Edition, Aage R. Møller Publishing, 2012

[27] Linda Little Social and Environmental influences on the use of technology in public spaces, Doctoral thesis, Northumbria University, 2012

[28] Metzger, Spillmann, Laws of Seeing, MIT Press, 2009

[29] Indi Young, Mental Models: Aligning Design Strategy with Human Behavior, Rosenfeld Media, 2008