Syllabus

CPUE – FL

Certified Professional for Usability and User Experience Engineering Foundation Level

Version 3.3 (EN)

IBUQ

in cooperation with

User Experience Quality Certification Center

UXQCC

Revision history

Version	Date	Remark
3.3	16.01.2019	Update
3.2	30.09.2018	Inclusion of UXQCC Board
3.1	10.05.2017	Corrections
3.0	25.02.2017	Focus on practical applicability increased. Update of perceptual psychology
2.02	17.02.2016	Update
2.0	31.12.2015	Update of UX sections and standards
1.9	24.11.2015	Update
1.8	28.07.2014	Comprehensive update
1.7	16.05.2012	Update
1.6	21.12.2011	Update
1.5	28.11.2011	Update
1.0	18.04.2011	New review
1.0 BETA	11.02.2011	BETA version

Scientific Advisory Board

The Scientific Advisory Boards of IBUQ and UXQCC consists of renowned scientists, representatives of relevant organizations as well as organizations involved in the fields of user experience as well as usability-relevant topics. The Board supports the didactic and content-related further development of the Syllabus. This ensures that the content is up-to-date, relevant and applicable from a scientific and from a practical point of view. For the current composition of the Board, please refer to the IBUQ website (https://www.ibuq.org) and to the UXQCC Website (https://www.uxqcc.org).

Introduction to this Syllabus

1) Purpose of this Document

This syllabus forms the basis (Foundation Level) of the International Board for Usability and User Experience Qualification (IBUQ) certification program for the *Certified Professional for Usability and User Experience Engineering*. The IBUQ 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 help candidates in their preparation for the certification examination.

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

	Objectives
Obtain new key qualifications	Software products or websites must fulfill their intended objectives and tasks. Therefore, implementation of usability and user experience is a key competence which ensures that software applications can be created that are in accordance with the needs of the target group(s) and that will be pleasurable to use.
	Benefit
Increase your customers' satisfaction	Increased customer satisfaction is achieved when they experience the performance that meets their expectations. Improved user experience and usability of software, Internet and mobile applications reduces any discrepancy between expected and the perceived performance, which will strengthen customer loyalty.
Minimize follow-up costs	Usability measures should be taken long before the launch or relaunch of a website or the market launch

	of a software product. This will avoid damage to the image or loss of customers or visitors and reduce costs for future improvements or corrective actions.
Competitive advantage	User-friendliness not only helps to win over desirable target groups, but also makes the provider's products and services stand out from those of the competition. Successful applications today are often not those that have been first to the market, but those that are perceived by customers as being user-friendly.
Build confidence	The users' needs are taken seriously making them feel more comfortable with the software solutions. This will strengthen their positive attitude towards the provider and the brand as well as improve customer loyalty.
	Focus
Human-machine-interfaces	Understanding the processes of perception, ergonomics as well as explanation of the differences online and offline. Characteristics of humans and implications on UX design
User-centered design	Design principles for software products, GUI design, storyboard, paper mockups, prototyping, Wireframes, card sorting or personas
Standards, norms and legal regulations	Overview of the most important standards, norms (ISO) and the W3C guidelines for web content accessibility
Usability und User Experience Engineering Lifecycle	Process-oriented procedure to safeguard future 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 and User Experience Engineering* addresses all persons and professional areas involved in the development of software, mobile or Internet applications. This includes software developers, GUI programmers, SCRUM masters, project managers and personnel, organizers, supervisors, technical staff, IT auditors and quality assurance representatives as well as management personnel in charge of software quality.

The program assumes basic experience gathered in development projects, in particular in software development. The Foundation Level certificate is pre-condition for taking the higher-level certification examination for the Usability and User Experience Professional Advanced Level.

Usability projects can only be successful when all persons involved can rely on a *common terminology* and a *common understanding of the key concepts*. Associating the same terms with different concepts might otherwise lead to misunderstandings.

The Foundation Level knowledge ensures that definitions and basic skills are obtained both about the human being (for example, regarding perception, mental models, faulty behavior/errors) and about the techniques for developing interactive systems (for example, interaction styles, modeling techniques, dialog principles). Generally accepted standards are an essential part of the Foundation Level syllabus.

Focus is also put on the development process, and in particular on the common methods and processes for developing software. The term *Usability and User Experience Engineering* implies that ergonomic design does not emerge at a certain point or will be demonstrated only in the end, e.g. with the aid of a user survey, but that a complete engineering process must be followed from requirements analysis through prototyping and UX specifications to implementation, evaluation and the obligatory usability testing.

In addition to the theory taught, the acquired knowledge is applied in practical exercises. Certified professionals are capable of practically applying the key techniques in the field of Usability und User Experience Engineering. A detailed description of these exercises as well as further important information can be found in the „Handbuch zur Version 3.0“, available on www.IBUQ.org.

3) Learning Objectives / Cognitive Levels of Knowledge

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

K1 Proficiency / Knowledge: Knowledge of precise details such as terms, definitions, facts, data, rules, principles, theories, characteristics, criteria, procedures; candidates are able to recall and express knowledge.

K2 Understanding: Candidates are able to explain or summarize facts in their own words, give examples, understand contexts, interpret tasks. This includes being able to transfer the contents from one notation into another (for example, words into a diagram), to explain and summarize the contents, and finally to derive future developments from the contents.

Selected sections of the Foundation Level:

K3 Apply: Knowledge transfer for problem solution; Candidates can apply their knowledge in new situations and use abstractions or form their own abstractions. Ability to use the acquired knowledge in new specific situations, for example, by applying certain rules, laws or theories. For example, an IT student should be able to program different sorting algorithms in any assembler language or a math student must be able to reason mathematically according to the valid rules.

Not part of the Foundation Level:

K4 Analysis: Candidates are able to partition a problem to understand how it is structured; they are able to discover inconsistencies, recognize correlations and derive conclusions, and distinguish between facts and interpretations. This includes, for example, identification of the individual elements, determination of the relationships between the elements and recognition of the design principles. The Analysis level requires a higher knowledge level than Understanding and Apply, because it assumes that both the contents and the structure of the learning matter are well understood. For example, the learning activity of art history students discovering the elements of a painting that determine the style and assigning them to a specific epoch belongs to this level.

K5 Composition: Candidates are able to build a new structure or create a new meaning on the basis of several elements; they are able to suggest new approaches, design new schemas or conceptualize substantiated assumptions.

K6 Judgment: Candidates are able to assess the value of ideas and materials and use them to weigh alternatives against each another, select them, make decisions and give reasons for them, and to deliberately transfer knowledge to others, for example, by providing flow charts.

4) The 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.

Exams may be taken as part of an accredited training course or taken independently (e.g. at an examination center). The training providers approved by IBUQ are listed on the IBUQ website (www.ibuq.org).

5) Accreditation

Training providers whose course material is organized in accordance with this syllabus must be recognized and accredited by the IBUQ.

6) Level of Detail

This syllabus is intended to allow internationally consistent training and examination. This syllabus comprises the following components to reach this goal:

- General learning objectives describing the intention of the Foundation Level
- A list of information to teach, including a description, and references to additional sources if required
- Learning objectives for each knowledge area describing the objective cognitive learning outcome of the course and the attitude that the participant is to achieve
- A list of terms that 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 content is not a description of the entire Usability and User Experience fields of knowledge. It reflects the scope and level of detail relevant for the learning objectives of the Foundation Level.

7) How this Syllabus is Organized

There are three major chapters. The top-level heading for each chapter shows the learning objective category covered in the chapter and specifies the minimum amount of time that an accredited course must spend on the chapter.

For example:

2	Human-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. Sections that do not have a time associated with them are included in the time specified for the chapter.

Syllabus structure

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 LO, 90 minutes)

2 Human-Machine Interface (K3) — 390 minutes

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

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

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

Day 2 (480 minutes)

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

3.1 Principles of Usability Engineering (K2, 5 LO, 100 minutes)

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

3.3 Design phase (K2 and K3, 5 LO, 50 minutes)

3.4 Prototyping phase (K2 and K3, 5 LO, 150 minutes)

Day 3 (240 minutes)

3	Usability and User Experience Engineering – Part 2 (– K3)	240 minutes

3.5. Evaluation phase (K2 and K3, 2 LO, 240 minutes)

The Syllabus in Detail

1 Principles of Usability (K1) 90 minutes

1.1. Necessity and benefits of Usability (K2) – 4 LO (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 involved with insufficient Usability (K2)
LO-1.1.4	Define User Experience (UX) (K1)

1.1 Necessity of Usability (K2) — 90 minutes

1.1.1 Classify and define Usability (K1) — 40 minutes

Terms
Usability, learnability, efficiency, memorability, error, satisfaction, context of use, perspective taking, quality in use

Usability ensures that products and applications are usable. It should be easy to learn, understand and use any functions included.

Today Usability is a major factor in the development and design of software and Internet applications. Functionalities are often integrated in systems, however they cannot be used or used correctly by the user because they are complicated to use or because they cannot be found.

The International Organization for Standardization (ISO) describes Usability as “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, page 4]. The usability and the serviceability of a system in a user context are thus put in a specific user context.

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

- **Learnability**: It should be easy to learn the system. Unnecessary training and familiarization effort is reduced.
- **Efficiency**: The system should be time efficient to use and a high degree of productivity should be possible.
- **Memorability**: It should be easy to remember how to operate the system and use it without repeated training even after a longer break.
- **Errors**: The system's error rate should be low.

- **Satisfaction**: The system should give the user a feeling of satisfaction. Users should therefore be able to easily achieve their needs and wishes in relation to the system with their capabilities.

Despite all these requirements, the design should not be neglected. For example, the user decides within the first 50 milliseconds whether or not he/she likes a website. If users exit a website for this reason, all usability measures will serve no purpose. Besides, the aesthetics of a website contributes to its usability, because it makes the user feel more comfortable and he/she is thus more satisfied.

Eventually the creator of a website or a software application determines the purpose of the product. For example, websites used for marketing purposes show a preference for design over functionality. Usability always has to take the relevant context of impact into consideration in order to reach its objectives.

A high degree of usability in development is achieved with an iterative process, the Usability Lifecycle. Repeated and continually improved analysis and involvement of the target group in usability tests and their evaluation generate products with increased user-friendliness. New technologies continuously being added, such as mobile devices and services, account for perpetual review and extension of the methods employed in the development of usable products.

The usability of a system is largely dependent on the characteristics of its users. Imagine a software application for managing music. The expectations of a professional DJ regarding managing his music will be entirely different from those of a hairdresser requiring some background music for his/her salon. The needs of a private user wanting to manage his/her music on a PC, but wanting to be able to play it via his stereo system are again completely different. The “context of use”, i.e. the environment and the requirements that arise from the needs of the user, significantly influences the design of the software.

The term “perspective taking” originates from psychology and describes the ability to understand a given fact from another person’s perspective. This ability is already developed in childhood, and is developed to varying degrees in different persons. For good usability, it is particularly important that the need to consider perspectives is recognized, that other peoples’ perspectives are analyzed, and that the results are then actually applied.

Reference
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
Increase in productivity, competitive advantages, cost reduction

Today's applications must meet the customers' expectations; they must be simple and intuitive to use; and easy to understand.

In general, usability is an extremely effective tool for cost reduction. Usability helps the designers to create less complex products. Less complex products can be sold more easily and are easier for the customer to operate.

Basically, usability tests are an effective way to save time in the development and implementation of software websites and to reduce the stress on the design team. The test determines in advance the criteria that are important to the user and those that are less important. Furthermore, the test helps to find weak points and errors at an early stage that could cause major problems if found in a later development phase. The earlier an error is detected, the smaller the effort required to resolve it.

Usability Engineering, an iterative process for improving the usability of products, generates many monetary and non-monetary usability benefits. They can be quantified for three basic areas:

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

These are made possible through:

- Target group-oriented development from the beginning; saves future "touching up"
- Avoiding unnecessary design iterations
- Avoiding the development of unnecessary functions
- Allowing the design to be clarified and communicated with the customer at an early stage
- More customer satisfaction

- Later training costs of users are reduced.
- Usability test results can help to reach strategic decisions whether and how the development is to be continued.

- More efficient solutions
- The training effort is reduced as the solutions are easy to use.
- The support and call center effort for easily usable solutions is reduced.
- User errors are avoided and the effort to perform troubleshooting is reduced due to user-friendly solutions

- Optimal mapping of the required workflows within the software system in relation to the needs of the users will make users more satisfied.
- Focus on meeting the actual user requirements (and not only the buyers' expectations which may be vague).
- Integrating the relevant industrial standards

- Developing target-oriented, innovative solutions based on the knowledge of real user needs
- Using multi-disciplinary knowledge and methods
- Integrating experience and know-how from other domains
- Techniques for increasing the potential of innovations by involving the users or on the basis of expert knowledge

1.1.3	Use examples to describe the problems involved with insufficient Usability (K2)	15 minutes

Terms
Target group relevance

Unfortunately, usability is often prone to being deleted from the project budget. Similar to documentation or quality assurance, usability is regarded as a nice-to-have factor of the development process and is therefore given a lower priority by management.

However, usability may directly lead to the success or failure of a software application or website. Particularly in online trade it has a direct impact on the sales figures of the shops. Not being able to find central store functionalities, such as the shopping cart or the checkout path, or insufficiently described or hidden products within the product line may lead to loss of sales.

Usability problems can be more dangerous; for example, in medical devices incorrect setup may harm the patients' health. Switches and buttons in airplane cockpits must be easily accessible and operable even in stressful situations; status indicators must be quickly and directly comprehendible.

1.1.4	Define User Experience (UX) (K1)	15 minutes

Terms
User Experience (UX), Joy of Use

User Experience, in addition to Usability, not only represents the user's experience with the product itself, but a holistic approach including all experiences related to this product in any context.

All experiences and the feelings involved are included in the evaluation, from the desire to own this product to its last use. In addition to the actual usability of a product, factors such as reliability, emotion or aesthetics are considered. Using the product should trigger a "Joy of Use" feeling. The meaning of User Experience therefore includes the emotional appeal of the software.

User Experience therefore relates to the quality experienced in the user‘s interaction with the contact point of the technical device.
A number of different factors are responsible for this. The most important of these are psychological factors. Human beings judge machines in a way that is similar to the way they judge other human beings. Therefore, software is rejected as a matter of principle as soon as it triggers emotion like “I’m too stupid to understand this”.

Reference
Cooper [18]

2 Human-Machine Interface (K2) 390 minutes

2.1 Software ergonomics and design philosophies (K2) – 3 LO (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	Describe the influence of social rules on the User Experience (K2)

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

LO-2.2.1	Describe the biological principles of visual perception (K1)
LO-2.2.2	Distinguish dynamic and static vision (K1)
LO-2.2.3	Explain the anatomic-physiological limitations of human perception (K1)
LO-2.2.4	Estimate color associations and color effects (K1)
LO-2.2.5	Describe color vision defects and understand how they influence Usability (K2)
LO-2.2.6	Describe the environmental impact on Usability (K1)
LO-2.2.7	Provide an overview of the Gestalt laws and give some examples of their impact on Usability (K2)
LO-2.2.8	Mental models, reading and information processing (K2)
LO-2.2.9	Practical exercises and reflections of Chapter 2.2 based on real examples (K3)

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

LO-2.3.1	Rank the significance of standards (K1)

LO-2.3.2	Provide an overview of the Usability-relevant standards ISO 9241, in particular of EN ISO 9241-110 ("Dialog principles") and ISO/TR 16982 (K2)
LO-2.3.3	Provide an overview of the significance, use and advantages of style guides (K1)
LO-2.3.4	Provide an overview of the usefulness and importance 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 ISO/IEC 40500!) (K1)

2.1	Software ergonomics (K2)	45 minutes
2.1.1.	Describe the procedure and areas of application of software ergonomics (K2)	20 minutes

Terms

HCI, HMI, software ergonomics, hardware ergonomics, user interface

With regard to software ergonomics, human-machine interaction (HMI) can be narrowed down to human-computer interaction (HCI). In English-speaking countries, the latter is also referred to as software ergonomics. In the end, HCI includes both software and hardware ergonomics.

Hardware ergonomics adapts the tools (input and output devices) for human-computer interaction to the physiological characteristics of humans, while software ergonomics has the goal of adapting to the cognitive capabilities of humans or their ability to process information. It describes and evaluates user interfaces for human-machine interaction.

Both focus on the user interface, which according to Herczeg includes the following components and characteristics:

- User interface including the input options for the users and output options of the computer system
- Rules for input and output processes at the user interface
- Systems to support human-computer communication

With regard to software ergonomics, input and output processes are not related to using technical devices such as a mouse or keyboard, but to dialog operations within the software such as menus, command dialogs or input forms. This enables interaction or a mutual influence between humans and the computer. Software ergonomics provide 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 principles such as visual color and sensory perception, auditive perception of sounds or haptic perception, which is the active sensing of an object by integrating all tactile senses of the skin as well as bathyesthesia
- **Psychology**
  Applying the theories of cognitive processes, design psychology and empirical analysis of user behavior
- **Sociology and anthropology**
  Interaction between technology, work and organization
- **Computer sciences**
  Application design and development of human-machine interfaces
- **Design**
  Design of the appearance of interactive applications

Formal guidelines for software ergonomics are defined in the Regulation for Computer Workplaces (applicable law in Germany since 1996) as well as in standard EN ISO 9241.

Reference

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) aims to design products and services in a way that they can be used by all people regardless of their age, capabilities and usage scenario.

Principles of 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 parts considerable. Universal Design originates from the USA. In Europe, the term “Design for All” is frequently used. “Design for All” as a European strategy therefore means to integrate diverse groups of human beings without forcing uniformity.

As far as needed, "Universal Design" includes support for certain groups of people with disabilities.

Reference

Center for Universal Design (CUD) [25]

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

Terms

Human-machine interaction, social rules

Humans are social beings. For each human-machine interaction, this means that the human expects a certain social behavior of the machine. This can best be described with the following sentence: “Software is to behave like a good friend or girl-friend”.

Good friends …

- … try to make suggestions on how to proceed, when one doesn’t know what to do,
- … never try to make you feel incompetent or like a fool,
- … know the needs of their friend or girl-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.

This list can of course be extended at will.

Reference

Weinschenk [17]

Cooper [18]

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

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

Terms

Primary colors, rods, cones

Visual perception is not only determined by the physical condition of the eyes. The strongest impact is caused by processing through the executive system of the brain. Habits as well as psychological facts play a major role in this.

<u>Anatomy</u>

Main field of vision approx. 30° around the optical axis

Remaining area (up to approx. 110°) is peripheral

Foveal vision, approx. 1-2° around the optical axis, is seen 100 % in focus

More peripheral objects are supplemented or substituted from memory. On average only approx.10 % of what is "seen" is actually seen; approx. 90 % of what we believe to be seeing is substituted from memory.

The anatomy of the eye has far-reaching consequences for the reading of texts. Text can only be read if it is looked at directly.

During reading, the eye is briefly fixated before it moves in a fast jump (saccade) to the next position and is fixated again. Reading takes place during the brief periods of visual fixation.

This has particular impact for example on the comparison of values on a screen. These can only be compared well if they can be seen within one visual fixation, i.e. if they are very close together.

Primary colors

The eyesight is formed by:

- Rods, which can only distinguish between brightness levels
- Cones, which are responsible for color perception

To function correctly, cones need a higher light intensity than rods.

- 3 cone types
- 3 primary (basic) colors
- (Almost) any choice of primary colors; mixed all visible colors from the signals of the 3 cone types

Reference

Schubert & Eibl [4]

Hunzinker [22]

Aage & Møller [26]

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

Terms

Static vision, dynamic vision

It is distinguished between:

- Static vision
- Dynamic vision

Static vision:

- Focusing on one object
- Clear vision
- Nuances of brightness and color are seen clearly

Dynamic vision:

- Mostly peripheral field of vision
- Even the smallest movements are visible
- Details not so important: the "danger" must be perceived
- Tightly linked to attentiveness

Reference

Schubert & Eibl [4]

Aage & Møller [26]

LO-2.2.3	Explain the anatomic-physiological limitations of human perception (K1)	15 minutes

Terms

Optical limitations, optical illusions, receptors

Limitations in perception cause humans not to apprehend their environment as it is. In many cases, important elements or changes in an interface are not perceived at all.

- Perception of individual images as a continual process
    - Cartoons
    - Flip book
    - TV

  Approx. 22 Hz are enough for the perception of movement.

  But: the eye "gets used" to the current image

- Integrating the use of half images to perceive more changes
- Sensitivity to movements is much higher in the peripheral area (at the edge) of the field of vision.
- Rapid movements are perceived as flickering
- 50 Hz of the TV/monitor can be perceived as flickering
- Flashing elements, for example, on websites immediately grab attention.
- Wrong perception of contrast with different comparison values
- Linking of receptor cells causes mutual influence. Movements are therefore perceived more easily. However, this also results in the resolution of the human eye decreasing at low brightness levels.
- Some 10 % of the information visible in a user interface is actually visually perceived. Approx. 90% are supplemented from memory. Human beings often see what they remember, and not what is displayed on the screen. This also leads to the obvious being overlooked.
- In darkened spaces (e.g. in cars at night) red and blue displays that are positioned next to each other (e.g. at 70 cm distance) cannot be simultaneously fixated by the human eye and should therefore be avoided. This is primarily caused by the different breaking of the extremely different wavelengths of red and blue in the lens of the human eye.

Additional examples for limitations/illusions:

- "Lateral inhibition" (e.g. Hermann grid illusion)

Reference

Schubert & Eibl [4]

Aage & Møller [26]

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

Terms

Color associations, color effects

Colors are not only relevant for design and highlighting; they evoke associations and create emotional and psychological effects. Colors can make messages look more important, but can also confuse the recipient. Depending on the context, colors can have a positive or negative effect.

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. alienation)
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, rotten, aromatic, old-fashioned, withdrawn
White: pure, bright, complete, sterile, neutral, bride, empty, innocence, illusionary, escapist
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 must be considered. For example, in China the color white represents mourning or death.

<u>Psychological color effects</u>

Colors can be interpreted emotionally, too. These effects are partly based on the use of colors as a classification or safety system.

Today it is regarded as proven that certain colors can have an impact on physical reactions.

Reference

Schubert & Eibl [4]

McLeod [23]

LO-2.2.5	Describe color vision defects (K2)	15 minutes

Terms

Color vision defects, trichromats, dichromats, monochromats, protanopes, deuteranopes, tritanopes

Compared to normal trichromats, we distinguish the following congenital color vision defects:

a) Abnormal trichromats:

They see three primary colors, but cannot distinguish some colors as well as persons with normal color vision.

b) Dichromats:

Dichromats can distinguish only two colors.

c) Monochromats:

Monochromats can only distinguish between bright and dark.

Terms

Protanomaly = Red weakness (distinguishing between red and green impaired)

Deuteranomaly = Green weakness (distinguishing between red and green impaired)

Tritanomaly = Blue weakness

A color vision defect occurs in about 8 to 9 % of all men (mostly blue weakness) and 0.5 to 0.8 % of all women.

In order to ensure that a design is correctly perceived by persons with a color weakness, it is recommended to use tools for verification purposes. With these tools, the color perception of persons with a color weakness can be simulated. Corresponding countermeasures can thus be taken early in the design process.

Furthermore, color schemes can be used which can also be correctly recognized, e.g. by persons with red-green color blindness.

Reference

Aage & Møller [26]

LO-2.2.6	Describe the environmental impact on Usability (K1)	30 minutes

Terms

Physical environmental influences, organizational environmental influences, social environmental influences

Environmental influences comprise various factors which influence human activities.
Environmental influences can be classified in three different types:

- Physical environmental influences
- Organizational environmental influences

- Social environmental influences

Environmental influences can diminish human efficiency, sometimes significantly. It is therefore important to know the conditions under which an interface is used, see the following examples:

- **Cold**: limited movement abilities, big hands (gloves)
- **Dark**: loss of color vision, blindness
- **Sunlight, brightness**: screens are hardly readable, low contrasts are invisible in glare
- **Stress**: limited intellectual power, reduced creativity
- **Loud environment**: quiet sounds are no longer perceived.
- **Fatigue, exhaustion**: limited intellectual power, poor ability to concentrate, impaired motor skills

Reference
Struve [6]
Little [27]

LO-2.2.7	Provide an overview of the Gestalt laws and give some examples (K1)	30 minutes

Terms
Gestalt laws

The Gestalt Psychology or Gestaltism was founded in the 1920s and investigates human perception. The Gestalt laws reveal the principles in the creation of entities.

For visual stimuli, a network of features is used in the brain. Examination and classification of an object are performed by this network. Nine types of features contribute to the differentiation between various objects:

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

The Gestalt laws can be classified in various categories:

- Classification into properties
- Distinction between figure and background
- Closure and grouping
- Principle of “good design” and principles of grouping
- Integration in reference frames

The so-called Gestalt Psychology or Gestaltism investigates how human beings experience and perceive entities.

For the perception of elements on a screen, it is particularly important that elements that belong together (functionally/logically) are also perceived as belonging together (i.e. as a whole).

In order to achieve this grouping, the following Gestalt laws or principles are applied:

- **Principle of Good Gestalt** (principle of grouping) – Complex shapes are broken down into simple individual elements (= good Gestalt).
- **Similarity** – Similar objects are perceived as belonging together and grouped together
- **Principle of continuity** – Points/objects tend to be grouped together and perceived as a whole line
- **Proximity** – Objects that are close to each other are perceived as forming a group
- **Common region** – Objects that are inside a closed area are perceived as a whole

- **Closure** – Connected elements (e.g. lines) are joined and perceived as belonging together
- **Common fate** – Objects that change and move together are perceived as groups belonging together
- **Time synchronicity** – Objects that appear at the same time or that change at the same time are perceived as groups belonging together
- **Past experience/learned meaning** – Depending on the context, we give different significance to elements and tend to group these together based on significance/past experience

References

Anderson [5]

Butz, Schmid [7]

Zimbardo [8]

Metzger, Spillmann [28]

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

Terms

Mental models

Mental models are assumptions made by users of how the user interface functions. These assumptions are usually based on experiences made by the users with similar systems. For this reason, it is usually an advantage to apply well-known concepts in newly developed software. If known concepts are not applied in favor of a completely new design, many users react with rejection.

Examples

- The “missing” Windows button in Windows 7 led to rejection.

- Visio was not developed by Microsoft, but was acquired; the user interface was practically identical with that of other MS products.
- People that use a smartphone for the first time usually have problems with “swiping” since this function does not exist on PC systems.

Mental model diagrams are a representation of the motivations, thought processes and underlying behavioral motives of users. The main purpose is to present the objectives and the processes with which people try to accomplish these objectives with regard to the user interface.

Mental models also play an important role in the understanding of words. Different groups of persons frequently assume different information associated with certain terms. It is therefore important to adapt the terms used to the specific user group.

In principle, people find it harder to recall something from memory than to recognize something.

The interpretation of screen content takes place unconsciously via mental models.

Humans can only retain a few instructions in memory which they have read.

Humans mostly only read a few letters and supplement the remaining letters based on their mental models. They then check whether it „functions“. If the interface does not behave in accordance with their expectations, it gives rise to a negative attitude.

References

Young [29]

Weinschenk [17]

LO-2.2.9	Practical exercises and reflections of Chapter 2.2 based on real examples (K3)	100 minutes

In-depth explanations and/or exercises for Chapter 2.2. For further details, see handbook relating to this Syllabus.

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

LO-2.3.1	Rank the significance of standards (K2)	5 minutes

Terms

International standards, ISO

National organizations for standardization develop standards and norms on the basis of their country-specific agreements. They are represented in the relevant European and international institutions.

The whole purpose of standards is the national and international alignment of products, promotion of rationalization, quality assurance and safety at work. Standards normalize test methods and facilitate communication in business and technology. Standardization and the resulting compatibility can cause competition and a corresponding pressure for innovation and on the price. Standards form the basis for legal certainty and play a major role in actions for breach of warranty, liability suits and actions for damages. However, they also restrict markets by excluding products which do not meet the standards.

Standards can be classified into the following areas:

- Safety standards
- Usability standards
- Quality standards
- Measurement standards
- Testing standards

ISO standards 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 standards ISO 9241, in particular of EN ISO 9241-110 ("Dialog principles") and ISO/TR 16982 (K2)	35 minutes

Terms

ISO 9241, ISO 16982

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

The central element of the framework of standards for user interfaces in 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 corresponding national standards).

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

LO-2.3.3	Provide an overview of the significance, use and advantages of style guides (K1)	10 minutes

Terms

Style guides

Style guides specify clear guidelines for designing the printed material, software user interfaces and web designs of an organization. They range from concrete guidelines for manufacturer platforms or operating systems to custom guidelines of individual vendors which are in particular aligned to their specific Corporate Design.

The specifications can include anything from the definition of colors, icons, fonts etc. to complete interaction patterns and information architectures of software programs and websites.

The added value or benefit of such style guides is diverse, both for users and for the developers.
On the part of the users, the benefit is mainly in the (internal and external) consistency, which results in easier operation, reduced training effort and makes them less error-prone.
On the part of the developers, the benefit lies in the enhanced quality standards, reduced design effort and often also in reusable source code.

LO-2.3.4	Provide an overview of the “IEC 62366-1:2015 Medical Devices Part 1 Application of Usability Engineering to medical devices” (K2)	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 significance and the practical benefits of the standard can be very well shown by looking at IEC 62366 -1:2015, which relates to the rapidly growing area of medical technology.

Medical technology includes numerous devices, products and applications, where the operation is directly related to the health and/or survival of human beings. The vast majority of these devices is operated by trained personnel (e.g. nurses, doctors); a small part, however, can/must be operable by normal persons without any specific training (e.g. defibrillators, blood pressure monitors). In either case, it must be absolutely ensured that the device can be operated in a simple, efficient and error-free manner by the respective user groups so that the medical problem can remain in the foreground.

IEC 62336-1:2015 defines a process that can be used by manufacturers to analyze, methodically develop and evaluate medical devices, in particular in relation to their safety. This process enables manufacturers to evaluate and minimize the risk that arises from normal and also from incorrect operation of the device. The process can also be applied to identify “abnormal” operation; however, it cannot reduce these risks (e.g. intentional operation causing damage to the patient, sabotage etc.).
Part 1 was updated in 2015 in order to include the modern concepts of usability engineering, but also to improve links to ISO 14971:2007 and its methods of risk management that are applied in connection with safety issues in medicinal technology.
Part 2 includes a tutorial on the use of Part 1 and supplementary methods and explanations of the usability engineering process regarding aspects of medicinal technology that goes beyond the safety-critical areas.

References

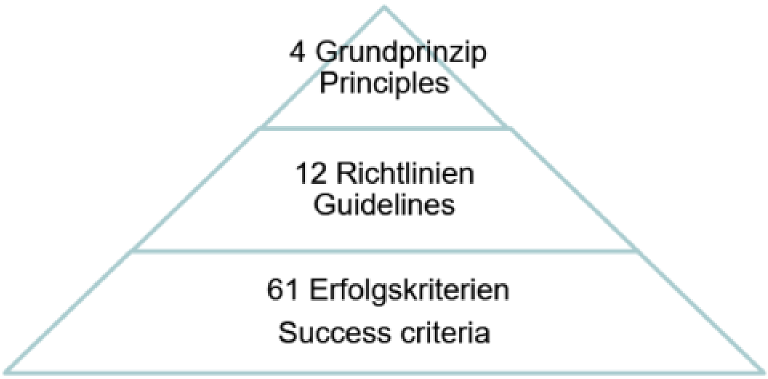
IEC 62366-1:2015 [12]

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

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

The social value of the Web is that it enables interpersonal communication, business environments and opportunities for the exchange of knowledge. One of the main goals of W3C is to make these advantages available for all people, independent of their hardware, software, network infrastructure, native language, culture, geographic position, and their physical or mental abilities.

To make the Web, its contents and services accessible, corresponding guidelines were developed by the W3C working group.
These Web Content Accessibility Guidelines (WCAG) 2.0 cover a wide range of recommendations aimed at making web content more accessible. If these guidelines are adhered to, web contents will become more accessible for a larger group of people with disabilities. These include blindness and visual impairment, heading loss, learning disabilities, cognitive impairment, limited mobility, speech impairments, photo sensitivity, or any combination of these disabilities. Apart from this, adhering to the guidelines will in many cases make web contents more useable for many users.
The WCAG 2.0 success criteria were formulated as testable statements which are not technology-specific. Separate documents provide both an instruction on how to meet the success criteria for certain technologies and general information on the interpretation of the success criteria.



4 Principles

- Perceivable
- Understandable
- Robust
- Operable

12 Guidelines

- These are not testable, but provide a framework and overarching objectives to facilitate better understanding.
- 4 or 3 measurable success criteria for each of the principles

e.g. relating to "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)

e.g. relating to "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)
- **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.

How to Meet 2.2.1
Understanding 2.2.1

There are 5 conformance levels (A, AA, AAA) to assess the conformance of a website.

In this context, the degree of fulfillment must be considered with regard to several aspects:

- Complete page or only sections?
- Complete process (e.g. order process)?
- Are accessibility techniques used?
- Are techniques used that explicitly exclude certain persons?

The WCAG are now also incorporated in ISO (ISO/IEC 40500)!

Reference

Web Content Accessibility Guidelines 2.0 [11]

3 Usability and User Experience Engineering (K2) 480 minutes

3.1. Principles of Usability Engineering (K2) – 5 LO (100 minutes)

LO-3.1.1	Know the concepts of User-Centered Design (UCD) (K2)
LO-3.1.2	Provide the definition and explain the use of Usability and User Experience Engineering (K2)
LO-3.1.3	Know and be able to judge the quality criteria for collected data within the scope of Usability and User Experience engineering methods (K1)
LO-3.1.4	Describe the Usability Engineering lifecycle (K2)
LO-3.1.5	Describe the requirements and challenges of User Experience engineering (compared to Usability engineering) (K1)

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

LO-3.2.1	Describe the difference between the quality and quantity targets of Usability (K2)
LO-3.2.2.	Know the 4 pillars of requirements analysis in terms of Usability and User Experience Engineering (K2)
LO-3.2.3	Know the principles for building user scenarios and the different views of use cases (K2)

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

LO-3.3.1	Enumerate various design processes (K2)
LO-3.3.2	Know the areas of application and the components of wireframes (K2)

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

LO-3.4.1	Enumerate various prototypes and their areas of application (K2)

3.5. Evaluation phase (K3) – 3 LO (240 minutes) – (3rd Day)

LO-3.5.1	Understand the spirit and purpose of evaluation (K2)

LO-3.5.2.	Know different test methods and give examples for their preferred use (K3)
LO-3.5.3	Know the essential content of an evaluation report (K2)

3.1 Usability Engineering (K2) 100 minutes

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

Terms
User-centered design, product lifecycle

Fundamental principles of UCD are:

1. The design is based on a thorough understanding of the users, their tasks and the context of application.
2. Users are involved during the design and development process.
3. The design is guided and improved through user-centered evaluations.
4. The process is iterative.
5. The design is oriented at the whole user experience.
6. The design team brings together multi-disciplinary skills and perspectives.

Guidelines for user-oriented design activities within the entire product lifecycle of computer-aided interactive systems were formulated in standard EN ISO 9241 - 210.

A user-oriented design of interactive systems provides numerous advantages. This way the total cost of a product lifecycle including its concept, design, implementation, upkeep, use and maintenance can be reduced considerably.

A user-oriented, fit-to-use design of systems contributes to the following aspects:

- Systems are easier to understand and to use, which reduces extra training and incidental product costs.
- Users are more satisfied, which reduces discomfort and stress.
- User productivity and thus the organization's efficiency are increased.

- Product quality is improved. Users are more interested, which may result in a competitive advantage.

References

ISO 9241 [9]
Schneider [10],

LO-3.1.2	Provide the definition and explain the use of Usability and User Experience Engineering (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 webpage or software application. Goals are defined in iterative steps in line with the target groups' needs and are tested using prototypes. In the case of any deviations from the intended state, project steps are repeated and improved.

In the process of User Experience engineering, which encompasses (supplementary to the Usability engineering) all experiences that relate in any way to the product being developed, these additional aspects are methodically addressed and optimized.
New possibilities using methods of empirical social research are introduced in this process, and this requires from the predominantly technical development teams that suitably trained persons are integrated into multi-disciplinary teams.

Delivery of a product or putting it online for the market, however, does not terminate the process of Usability and User Experience Engineering. It is a continuous process which also deals with continual optimization, and even with identification of the right time for a relaunch. Support of the users and communication with users in the day-to-day use of the system is an essential factor of the User Experience.

LO-3.1.3	Know and be able to judge the quality criteria of data collected within the framework of Usability and User Experience engineering methods (K2)	20 minutes

Terms
Data quality, validity, reliability, objectivity

In the course of the Usability Engineering process, data is collected using different methods. In this context, it is absolutely essential to be able to judge the quality of the data, especially since data that were incorrectly collected or interpreted can have a sustained negative impact on the development of interactive systems, or cause the development to go in entirely the wrong direction. This also includes a differentiation with regard to the questions and methods of market research.

An awareness and understanding is to be raised for the most significant factors that influence such data:

- Selection and number of interviewees, test persons
- Investigator and interviewer distortions
- Cognitive and social factors influencing the response behavior of probands
- Basic understanding of questionnaire development
- Task validity

Reference
Tullis [19]

LO-3.1.4	Describe the Usability Engineering Lifecycle (K1)	20 minutes

Terms

Usability Engineering lifecycle, UCD analysis, evaluation

Usability Engineering is not a variety of incoherent individual methods, but is integrated in a higher-level "lifecycle". The activities in this lifecycle commence prior to the development of the human-machine interface.

For a so-called Usability Engineering Lifecycle, this results in the following phases, which are to be repeated as often as required until the product meets the user requirements:

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

In the meantime, there are numerous variations of such lifecycle models, which mainly differ with regard to their integration in existing development processes.
Additional models of Usability Engineering Lifecycles are, for example, the Delta Method, the Contextual Design, the scenario-based development, the usage-centered design or the waterfall model that has had the aspect of usability added to it.

LO-3.1.5	Describe the requirements and challenges of User Experience engineering (compared to Usability engineering) (K2)	20 minutes

Terms

User Experience, Usability, experience

The traditional Usability engineering process provides for activities, methods and procedures, which aim to provide goal-oriented and function-oriented systems that meet clearly defined requirements with regard to their quality of use.

The much wider concept of User Experience (see point 3.1.2. above) places new demands on 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 have an influence on users' experiences. For example, the decision that a photograph cannot be reproduced as often as desired, can significantly influence the social value of this photo and thus give the respective application a completely different experience quality (a different user experience).

The requirements and possibilities of modern software development are correspondingly diverse and must fulfil these social and emotional aspects. These requirements hold great potential for innovation, but at the same time also a risk potential if they are not taken into consideration.

References

Preece [20]

Flückiger [15]

3.2 Analysis and concept phase (K2) 180 minutes

LO-3.2.1	Describe the difference between the quality and quantity targets of Usability and the fundamentals of requirements analysis (K1)	40 minutes

Terms

Quality targets for Usability, quantity targets for Usability

Why Usability targets?

Quality and quantity targets for Usability provide the guideline for the design of interactive user interfaces and create acceptance criteria for the evaluation of the design process. They facilitate the decision whether or not to repeat a design cycle or to transition to the development of the user interface.
For this purpose, a mutual and valid view of the user groups (derived from the user profiles) and a corresponding and valid model of the work and work environment (from task analysis) must first be created to focus the design process more precisely.

Quality targets for Usability

Quality targets help to control the interface design particularly in the starting phase. They are derived from the requirements in the user profiles as well as from the context-related task analysis.

Examples:

- The system shall not require any knowledge about the basic technologies.
- During transition to new releases, changes irrelevant to the users' tasks shall not be visible.
- The system is to support teamwork.

Quantity targets for Usability

It is often difficult to define how quality targets are to be achieved. In contrast, additionally specified quantity targets are more objective and can be measured more accurately.

Examples:

- Definition of specific or permissible maximum execution time
- Execution times are specified for a certain level of user experience:
  Expert: ease of use
  New user: ease of learning
- Absolute targets use absolute, quantitative units such as processing time (in minutes, seconds), number of errors, etc.
- Relative targets refer to the experience of the users with a certain product/interface relative to the experiences with another product/interface
- Clear preference of one of various alternatives
- Level of satisfaction with a certain interface (5-level scale: unsatisfied to completely satisfied)
- Performance targets quantify the current performance of a user when executing a certain task. Common: time to execute the task or to learn how to execute it; number and type of errors

At this point in time, 20 minutes are allocated for exercises, reflection or discussion. In the handbook provided you will find a corresponding case study.

Reference

Urban [13]

Tullis [19]

LO-3.2.2	Know the 4 pillars of requirements analysis in terms of Usability and User Experience Engineering (K2)	90 minutes

Terms

User analysis, task analysis, context analysis, competitor analysis/ comparison

In order to design a system optimally for the actual future users, it is necessary when implementing or designing the system to have all information available that could be relevant for its use. In corresponding analyses and elicitation processes, data are collected from which the relevant information can then be derived. “Derivation” of the information is important, since this must not be a subjective interpretation by any individual designers or developers!

The 4 relevant parts (pillars) of these analyses are:

- User analysis

  Elicitation of all user characteristics that can/could influence the use of the system (eyesight, body height, special knowledge, affinity towards technology and many more.

- Task analysis

  When using a system, users normally have specific tasks in mind that they wish to perform (looking for concrete contents, purchase something, communicate, etc.). In the task analysis, these specific tasks are identified so that they can be optimally mapped in the system. All task analysis methods are based on breaking down the tasks into their components (sub-tasks).

Two types of task are distinguished:

Action-driven: focused on the actions required to be performed by the user (e.g. manual activities, movements or object manipulations).

Cognitively driven: focused on the mental processes that the user goes through when executing a task. These include important cognitive aspects of decision-making, problem solving, attentiveness and memory.

- Context analysis

Usability of a system (or the User Experience) is largely dependent on the context in which the system is used. Only if the different contexts of use are known, can the system be optimized in this respect. Context factors include both external, physical contexts (light, temperature, etc.), the psychological context (stress, privacy, motivation, etc.), and the personal physical context (sitting position, movement, room for moving hand, etc.).

- Competitor analysis/ comparison

Today users use a variety of different systems. From the use of different systems, they bring with them experiences in the handling of other systems. This can be beneficial or detrimental. It is therefore decisive to know the systems that could potentially have an influence in order to turn their effect into a positive one. Corresponding systems that can have an influence could be systems of a similar department (e.g. accounting programs), as well as systems using comparable concepts (e.g. product search in an online shop), or directly embedded modules (e.g. interactive city maps).

At this point in time, 40 minutes are allocated for exercises, reflection or discussion. In the handbook provided you will find a corresponding case study.

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

Terms

User scenario, use case, persona

User scenario

User scenarios show how users manage tasks in a specific context. They provide examples for the differing use of devices and applications, and form a basis for subsequent usability tests. For these scenarios, tasks, targets and motivations of a user must be determined.

User scenarios can have different levels of detail. Target or task-controlled user scenarios only define what a user wants to achieve. Extensive scenarios observe the user's background and task. They provide an in-depth understanding of the user's motivation and behavior for the completion of the task.

Basically, user scenarios should cover a wide variety of situations. The design and development team must be certain that they consider not only the obvious cases or the cases they are interested in. They should also consider the situations which challenge the concept of the system as such.

Use case

By contrast, the usage is described in use cases from the point of view of the application. These make it possible to address actual procedures, which describe the steps a user performs for a specific task of an application as well as how the application reacts to the user's actions. Use cases serve to describe the interaction procedures and evaluate them in the order of their priority. As with user scenarios, it is important for use cases that user data are available and as precise as possible.

In contrast to conventional software applications, the usage context of web applications is characterized by special properties. Conventional software applications are mostly based on defined user groups, task and organization contexts, while public web pages often address a wide user spectrum with sometimes quite different interests and information requirements. In the design of world-wide-web user interfaces it is consequently even more important to know the basic design decisions and strategies and to consider them in the course of the development process.

Persona

For setting up test series some virtual persons ("personas") are conceived, who are to represent the majority of the future real users. The team of designers and developers later refers to the needs of these virtual persons and runs through the corresponding different user scenarios. Setup of such profiles is more than just a tabular list of characteristics. Photos and names as well as data such as age, gender, education, preferences, hobbies and finally characteristics and backgrounds make the personas come alive. This way, personas not only help to meet the actual software-ergonomic requirements in the design process, but also to consider the desired user experience for the target group.

Using the setup of these types of persons avoids having designers act on the assumption of non-existent average users, but also makes them consider and fulfill specific user requirements.

At this point in time, 30 minutes are allocated for exercises, reflection or discussion. In the handbook provided you will find a corresponding case study.

Reference

Flückiger [15]

3.3 Design phase (K2) — 50 minutes

LO-3.3.1	Enumerate various design processes (K1)	40 minutes

Terms

Parallel design, participatory design (cooperative design), iterative design, Lean UX

In practice, various different approaches to the design of a User Interface (UX) have become established. None of them is necessarily right or wrong. Depending on surrounding context, system, resources, qualifications, etc., a particular approach may be better suited than another. Roughly, a distinction can be made between the following different types, whereby it is common in practice that a mixture is applied.
At the start of each design, it is essential to decide (and document in writing) which standards/norms will be applied, the extent to which the system is subject to the accessibility guidelines (WCAG of W3C), and whether specified manufacturer guidelines must be followed.

Parallel design

- Begin the design as a parallel design with several designers involved; develop different design alternatives and use them for testing the various intended usability goals
- Draft design solutions
- Put the design solutions into concrete forms using simulations, models, life size models, etc.

Participatory design (cooperative design)

- Directly involve the users in the design process
- Develop the design proposals with a multi-disciplinary approach using existing knowledge

- Present the design solutions to the users and have them execute test tasks (real or simulated tasks)
- Multi-disciplinary design

Problems that occurred in the evaluation phase are eliminated and improved in design and development in iterative steps.

Iterative design

- Determine the basic principles of design
- Continually evaluate new designs
- Change the design solutions according to user feedback

Lean UX

Lean UX denotes a lean, design and product oriented approach to design and development. Lean UX understanding is based on the continuous collaboration of all involved teams, including product management, design team, programmers, marketing team, etc.
As a result of regular communication from the very beginning, all persons involved in the project should be kept up to the same level of knowledge. Lean prototypes are already validated with end users in the first project phase in order to minimize time and effort spent on pursuing wrong hypotheses.

The various lean variants are based on the idea of the **Lean UX Manifesto** in which the author, Anthony Viviano, outlines the fundamental 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 in time, 20 minutes are allocated for exercises, reflection or discussion. In the handbook provided you will find a corresponding case study.

Reference

Stary et al. [20]

Gothelf [22]

Preece [20]

Cooper [18]

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

Terms

Wireframe

A wireframe is a schematic representation of a web page. The wireframe serves to illustrate and plan elements that are to be present on a web page. Although the basic elements of a page are represented, it has nothing to do with the design of a web page.

Wireframes are to direct the concept creators' attention to the major elements.

3.4 Prototyping phase (K2) — 150 minutes

LO-3.4.1	Enumerate various prototypes and their areas of application (K2)	150 minutes

Terms

Vertical prototype, horizontal prototype, scenario prototype, paper prototype, lo-fi prototype, hi-fi prototype

Prototypes help to make design and procedures comprehensible and serve to map an early stage of the future application. They are used at a very early stage of the development process. They help to identify and remove potential dangers or problems in advance. They support discussions and help to avoid misunderstandings in the development process.

Prototypes frequently only map the part of the scope of functions to be tested and thus allow testing of various concepts. When a prototype serves to explore not yet understood usage requirements, the process is called explorative prototyping or usability prototyping.

The following different types of simulations with prototypes are distinguished:

- Vertical prototypes: reduction to a few individual, but detailed functions
- Horizontal prototypes: as many functions integrated as possible, but not functional (mostly serve for user interface testing)
- Scenario prototypes: all functions are simulated for a specific task using a combination of vertical and horizontal prototypes

Depending on the purpose of use, the creation of prototypes in different forms and variations is used. Basically, we distinguish low fidelity (lo-fi) prototypes (low similarity with the end product; review the idea's benefit) and high fidelity (hi-fi) prototypes (high similarity; review of details and exact functions). Hybrid forms – for example, interactive simulations using HTML or PowerPoint – are referred to as the low-high fidelity (lo-hi-fi) prototypes.

Low fidelity prototypes

- **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**
  Screen masks or task steps are represented on large file cards. A person "plays" the card deck supported by a moderator.

- **Storyboards**
  Storyboards are illustrations that visually map the chained processes of an interaction with a system. This form of prototyping goes back to movie production and is mostly used in the context of user scenarios.

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

High fidelity (hi-fi) prototypes

- **Wizard-of-Oz prototype**
  In this form of prototyping, the user believes that he/she interacts with the computer. However, it is a designer or test director who reacts or simulates the system behavior in the background.

- **Programmed prototypes**
  These digital and interactive prototypes are quite similar to the form and function of the final end product. However, take care to avoid giving the impression that the program is finished.

At this point in time, 20 minutes are allocated for exercises, reflection or discussion. In the handbook provided you will find a corresponding case study.

3.5 Evaluation phase 240 minutes

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

Terms
Summative evaluation, formative evaluation

In principle, 2 different approaches/purposes of evaluation are distinguished.

- **Formative evaluation**
    - Evaluation which accompanies the process in order to improve product quality and to shape the product
- **Summative evaluation**
    - Final evaluation according to specified requirements

Formative Evaluation

Usability Engineering is a cyclical process of prototyping. The future users participate in an iterative process of evaluating and improving the prototypes. User participation during the evaluation phase guarantees a review of the development steps that is close to reality. This reduces the danger that the needs and behavior of users are ignored in the planning.

- The target group is the project team itself
- Purpose: Achieving directly implementable improvement requirements and possibilities or corrections for requirements analysis.

Summative Evaluation

Evaluations must be performed to ensure that the intended goals for designing a user-friendly interface that were set out in the beginning have been achieved. These inspections/measurements are performed on the finished product.

These can be performed in different ways:

- It only functions if the system is in a relatively finished state
- Assessment / evaluation against quantitative criteria or comparable systems
- Concrete measurable performance or satisfaction targets
- Benchmark for other systems
- Methods include:
    - Usability tests, special questionnaires, e.g. ISOMetrics (details see below)

LO-3.5.2.	Know different testing techniques and provide examples for their preferred use (K2)	215 minutes

Terms

Cognitive walkthrough, constructive interaction, eye tracking, focus group, heuristic evaluation, IsoMetrics, Thinking Aloud, SUMI, QUIS, CSUQ, SUS, Teach-back, video

A variety of different methods exist for performing evaluations, both with participation of users or UX experts. Participants shall acquire a basic understanding of the following methods. In addition to the usability test, a case study is to be conducted.

Cognitive walkthrough

Based on a previously performed task analysis or on tasks broken down into subtasks. The project team (designers, developers …) "walks" through the system – step-by-step according to the broken-down tasks of the analysis – asking themselves time and again the following set of questions for each subtask:

- Original from C. Wharton, 4 questions
- Short version from Spencer, 2 questions

Questions by Wharton

- Will the user try to achieve the effect the subtask has?
- Will the user notice that the correct action is available?
- Will the user associate the correct action with the effect that the user is trying to achieve?
- If the correct action is performed, will the user see that progress is being made toward the solution of the task?

Questions by Spencer

- Will the user know what to do at this step/in this situation?
- If the user does the right thing, will the user know that he/she did the right thing, and is making progress towards the goal?

Drawbacks/problem

- The evaluators do not necessarily know themselves how a specific task should be performed (e.g. subject-specific/technical specialties). It can therefore happen that they make the wrong assumptions.
- The method is very dependent on a very careful task analysis.
- No real users “walk” through the system. Experts sometimes identify problems that users do not perceive as problems.

Constructive interaction

With this method, 2 persons solve tasks with the system/prototype together. The interaction or discussion between the persons is at the center of the observation. This can often be very helpful in understanding

motivations or reasonings for certain actions. With this method, it is essential to ensure that both persons are actively involved and not just one of them.
Frequently used with children and elderly persons.

Teach Back

This is a variant of Constructive Interaction.
Here again, 2 test persons/users are tested at the same time.
The system is explained to one person who then explains the operation and function of the system to the other person that is not familiar with the system, and if necessary assists in solving predetermined tasks with the system.
By observing the proceedings, an insight into the mental models of the users is obtained.

Focus groups

A focus group is a structured, strictly moderated discussion group which follows a clear guideline and clearly defined questions!
The ideal number of participants is between 5 to 8 persons. Whilst the group should be homogenous, a certain variation is necessary to stimulate discussion.
If there are several user groups of the planned system, there must also be several focus groups.

Advantages

- Transparency of thoughts and past experiences of users
- Development of hypotheses about the participants‘ motives
- Inspiration to make further, more detailed, in-depth statements
- Inclusion of quieter participants
- “Unfinished” products and drafts (e.g. drawings) can also be tested

Drawbacks

- Possible domination of individual participants
- Complexity if there are too many participants, difficulty of coordinated moderation
- Evaluation of the material can require extensive effort.

Heuristic evaluation

Heuristics (to find, discover) relates to the art of achieving good solutions with limited knowledge ("incomplete information") and little time. It denotes an analytical approach by which assumptions are made based on the limited knowledge of a system in order to come to conclusions or statements about the system.
In a heuristic procedure, the system is evaluated based on predefined heuristics. This is based on the following assumption: If the heuristics apply, then the usability of the system as a whole must be good.

Procedure

- Several evaluators evaluate the system separately and independently of each other.
- They go through all displays/screens/windows one by one and assess these on the basis of all heuristics.
- Usually several iterations are necessary.
- Finally, the evaluators discuss and compare their results and define a prioritized problem list.

Drawback:

- Task orientation is not represented.
- The method requires a lot of practice from evaluators to be able to work efficiently and achieve valid results.

Heuristics according to Jacob Nielsen – 10 points

The best-known heuristics were developed by Jacob Nielsen, the inventor of heuristic evaluation.

Visibility of system status

The system should always keep users informed about what is going on by providing appropriate feedback within reasonable time.

Match between system and real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom

Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state. “Undo” and “redo” functions must always be offered.

Consistency and standards

Users should not need to consider whether different terms, presentations, or elements mean the same thing in different situations or not.

Error prevention

Even better than providing good error messages is a careful design. Either error-prone situations are eliminated, or users are supported in these critical or complex actions with an additional confirmation option (button).

Recognition rather than recall

The user's memory load is minimized by making actions, information etc. visible so that the user does not need to remember them. This functionality shall be supported in particular when users have to switch between windows/displays.

Flexibility and efficiency of use

Accelerating elements to speed up interactions (e.g. shortcuts) – often help – invisible to the inexperienced user – to support different user groups.

Aesthetic and minimalistic design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information for the users‘ attention and diminishes their relative visibility.

Help users recognize, diagnose and recover from errors

Error messages should be expressed in plain language and offer the user a possibility to recognize the error and to understand the suggested solution possibilities.

Help and documentation

Even though it is better if the system can be used without documentation, there may be systems for which it is necessary to provide help and documentation. Any such information should be easy to search, designed for the user's task, and focused on the essential.

Thinking aloud

When solving tasks, the user is encouraged to think aloud, i.e. to comment his/her actions and motives. This often makes it easier for the test lead to understand the actions or behavior of the test participant. Please note: It must not be assumed that the user will really say everything when thinking aloud – Keyword: Self-presentation! In addition, thinking aloud may also distract from the task at hand.

SUMI (Software Usability Measurement Inventory) (1998)

SUMI is used to measure the quality of software from the end user's point of view.

Purpose

- Evaluation of products during development
- Product comparison
- Formulation of design objective for the further development of a product
- 50 items allocated to 5 subscales
  - Subscales: efficiency, affect, help and support, controllability, and learnability
- 10 three-stage items each with the verbal anchors: Agree, Don't Know, or Disagree.
- "Global" scale comprising 25 of the 50 items that together best represent the subject of usability.
- Completely standardized
- Available in multiple languages (including English, German, Italian, Spanish, French)
- Item Consensual Analysis (ICA)
- Response patterns at item level are compared to response patterns of a "standardization database" that represents a generic software standard (indicating the items where the software is rated better or worse than the standard).

System Usability Scale (SUS)

SUS is a “quick & dirty”, but nevertheless reliable method in which users are asked to assess the usability of a system (hardware, software, websites, mobile devices). The SUS questionnaire consists of 10 items (statements) that can be scored with one of five responses that range from Strongly Agree to Strongly Disagree.

SUS is not a tool to determine which usability problems are present in a system, but rather a method that facilitates an assessment of the usability or of the tested system.
The evaluation results in a score between 0 and 100, whereby this is not a percentage. Experience and research show that scores above 68 are indicators for good usability.

Items from SUS (original text):

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 (CSUQ)

The CSUQ enables a survey of the subjective satisfaction of users with a system to be performed. Users answer a standard questionnaire online (http://hcibib.org/perlman/question.cgi), and can also make additional comments. The result is sent directly to an email address.

http://hcibib.org/perlman/question.html#abstract

ISOMetrics

This is a procedure for evaluating software based on ISO 9241-110. There are two versions of ISOMetrics processes, both of them using the same items.

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

- Is available in English and German language versions
- ISOMetrics S can be accomplished in approx. 30 to 60 minutes.
- ISOMetrics L will require at least 2 hours (including performing of test tasks) per participant.
- 7 subscales in accordance with the ISO 9241-110 design principles, with a total of 75 items that are scored on a rating scale
- The long version comprises an additions rating scale per item for evaluating the item's importance as well as free space for presenting concrete examples that describe the weaknesses of the system with regard to the contents of the specific item.
- Findings
  - Numeric evaluation in relation to the ISO 9241-110 design principles
  - Concrete notes pointing to malfunctions and weaknesses of the software system from a user's point of view
  - Weighting of problem categories acquired empirically from the users‘ point of view

Questionnaire for User Interface Satisfaction (QUIS; current version 7.0)

Origin: Shneiderman (1987)

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

- Online version
- Available in German, English, Italian, Portuguese, Spanish
- Long and short version
- 20/40 main questions and 5 items for a general evaluation
- Each item consists of two opposing adjectives
  e.g. “inconsistent” versus “consistent”
  The package comprises the following:
  - Demographic questionnaire
  - Evaluation of general user satisfaction on six scales
  - Four evaluation areas for separate system components, e.g. layout factors, system feedback, and learnability
  - Optional evaluation areas for separate components of the system under evaluation, e.g. handbooks, online help, internet access and system installation

Use of videos

Users or the screen are recorded by video as the task is performed. The video is subsequently discussed with the respective person. The person is encouraged to explain and justify what he/she did. This procedure is particularly helpful for complex systems when not everything can be noted down or questioned and analyzed during the test.

Eye tracking

Eye-Tracking relates to the recording of the eye movements of a person consisting of fixations (points that are closely looked at), saccades (fast eye movements) and regressions (back jumps). In

usability inspections this method is used in order to draw conclusions relating to the test persons' behavior and understanding, or to problems that the test persons encounter.
The eye-tracking data must be interpreted with utmost care. Overzealous misinterpretations occur frequently!
The realization that somebody for instance first looks at the header on a screen does not yet allow qualitative conclusions to be drawn as to why this is so – additional questioning of the test person or the "Thinking aloud" method are necessary.

Usability test

The usability test presents a "package" that involves future users performing well-defined tasks in a system or with prototypes. They are observed as they perform the tasks and their actions are analyzed and interpreted. In addition, questionnaires and/or interviews are mostly carried out before or afterwards. Other methods such as Thinking Aloud, Eye-Tracking or the use of video recordings can be employed to support testing and evaluation.

Such tests are suitable means to obtain an own first-hand impression from users and to draw conclusions from their behavior.

For conducting a usability test, it is optimal (but not compulsory) to have corresponding rooms and some technical equipment available so that valid usability testing can be performed, observed and evaluated. An external usability lab is an advantage but is not absolutely necessary.

Prior to the test, a test concept must be created. Test concepts typically include the following:

- Objective of the test
- Test duration
- Date and location of the test
- Required infrastructure
- Development state of the system at the time of the test
- Persons responsible for the test
- Test persons
- Tasks to be performed
- Amount and composition of available budget
- Test procedure

For a test, it is important that the test lead is appropriately trained or at least aware of how they can have an influence on the test!
These include e.g.:

- Developer effect, personal success/failure!
- Body language, clearing the throat, coughing slightly
- Unequal, improper assistance
- The desire to help users
- The user is demanding in his/her nature and one therefore hopes that he/she finishes quickly.
- Corrective justice *(he already had bad luck with the link, so I will now help him a little …)*

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

- A test lead performs the test with the test person.
- The test person receives the task in written form.
- The test person reads the task description and asks question if necessary.
- The test person then solves the task alone.
- If the test person incurs problem whilst carrying out the task, he/she should actively turn to the test lead.
- The test lead will then help in accordance with a predetermined scheme.
    - i.e. leading to the solution step-by-step

At this point in time, 120 minutes are allocated for exercises, reflection or discussion. In the handbook provided you will find a corresponding case study.

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

Terms

Summative evaluation, formative evaluation

Evaluation is the assessment of a test result in a usability test with regard to its impact on the user tasks, the user's attitude or the usage result. The requirements for evaluation are defined on the basis of evaluation dimensions from the analysis and concept phase.

Evaluation can be performed as a summative or formative evaluation. "Summative" means an evaluation is performed at the end, while "formative" represents an evaluation performed in the course of the development process in order to contribute to an improvement of the product quality.
A process can be evaluated as well, for example, the Usability Engineering process of a provider.

Examples of typical results of a laboratory test in a formative valuation:

- Usability problems in detail
    - Quantified (how many persons, etc.)
- Causes
- Evaluation (frequently through traffic-light system)
- Proposed solutions/corrections
- Evaluation report

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