UNIVERSITY OF GOTHENBURG

DEPARTMENT OF EDUCATION, COMMUNICATION & LEARNING

THE DESIGN OF EVALUATION FEATURE TO IMPROVE DEVELOPMENT OF LEARNING MANAGEMENT SYSTEM

Kristina Cordova

Thesis:	30 higher education credits
Program and/or course:	International Master's Programme in IT & Learning
Level:	Second Cycle
Semester/year:	Spring term 2022
Supervisor:	Elin Nordenström
Examiner:	Johan Lundin
Report no:	VT/HT22-2920-XXX-PDA699

Abstract

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Keywords:	LMS, Evaluation, Feedback, Learning System Design

Purpose: The main purpose of the project is to improve the evaluation processes in a post implemented learning management system. Recurrent and agile evaluation can improve user experience and establish good prerequisites for the users' learning. However, the user's feedback is essential in the improvement of the system. Therefore, the ambition of this project is to develop a prototype of a feedback feature that is designed to gather inputs from the users in a systematic and structured way to enable further analysis and system enhancement.

Theory: For this development project, the human-centered design and the Design Thinking process model were used as a framework for the design procedure to focus on the end-users and their needs as learners.

Method: The Design Thinking method was implemented to design an evaluation feature which involves empathizing, defining, ideating, prototyping and testing phases. Semi-structured interviews and observations were used for data collection. Thematic analysis approach was used for data analysis.

Results: During the project, three main premises for facilitating the end users' learning processes were identified that developers consider important in their development of LMS: 1) their own pedagogical experience and previously gathered educational knowledge. 2) feedback gathered from end-users, teachers and test teams, 3) recommendations produced by educational

authorities (e.g., Swedish National Agency for Education). The results of this development project indicated also that the evaluation feature in the learning management system can be designed through considering existing design elements, system context, the particular user group, the situation around the system, the requirements from the educational authorities and the developers' expertise.

Foreword

When I got submitted to this master program, I was excited about learning something new. Topics about learning was an unexplored field that I did not know so much about. My previous studies were within technical areas of IT development and I was used to writing very technical rapports. During the past two years in this program I learned to write other kinds of documents where I had to develop my analytical, critical and philosophical mind. I boosted my knowledge about the design processes of IT technologies and unlocked my potential as a designer. Also, I got some answers about things I was wondering before, how do people learn and how we can enhance learning. I believe that this kind of awareness will support me to learn new things in life and help other people to learn as well.

I want to give special thanks to my supervisor, Elin Nordenström. She guided me through these deep waters of writing and analyzing my work by being very helpful, thoughtful, concise and instructive. I also send my thanks to all the participants from the organization that I worked with: company's product owner, support manager, UX designer and chief executive. Finally, without the end-users my work would not be complete, so I take the opportunity to thank both children and parents that made it possible.

Kristina Cordova

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1. Introduction

The global digitalization accelerates and transforms society including educational sectors. According to the Swedish National Agency for Education (2018), the digitalization of school started with the implementation of digital calculators in the 1970s and was then developed further when the first computers started appearing in schools in the 1980s. Then it took a couple of decades for the computers to evolve from low to high quality screens, from small to large computer memories, from big to tiny constructions and so on. In recent years, the use of technology in education has increased significantly. While digitalization of society and school brings new opportunities and ways of working, it also places high demands on people to learn to use new technologies within communication, collaboration, learning and many other areas. Hence, both empirical and theoretical studies are needed to gain a deeper understanding about the digitalization of school.

The digitalization and the development of educational technologies have given rise to certain assumptions that lack scientific ground. For example, many people assume that the use of technology is always a "good-thing" because technological development generally improves and transforms most of areas of society and our everyday lives (Selwyn, 2011). However, as pointed out by Selwyn (2011), the digitalization of society is an external imperative that necessitates changes in education, while an educational imperative shape those changes. In other words, the digitalization and the use of technology impacts education and vice versa.

The digitalization of school cannot be understood properly without understanding the digitalization of society, because it changes the way people communicate, gain knowledge, participate and learn (Swedish National Agency for Education, 2018). Educational institutions and organizations face the need to reshape their learning and teaching practices in ways that meet the requirements and preferences of the society, which has been transformed by the information age and new technologies (Turnbull et al., 2020). Different tools, platforms and systems have been developed during the last decades to support and transform education. Learning management systems (LMS) are one of the most powerful tools implemented in current education (Echeverria et al., 2013). There are many different descriptions of Learning Management Systems (LMS). According to Turnbull et al. (2020) LMS facilitate courses with

provision over long distance, a web-based provider of interactive online learning environments that automate important educational processes, such as organization, assessment, collaboration and others. LMS are used for different purposes in education, such as planning, administration, assessment and even for web-based storage of course material. Furthermore, LMS are broadly used to enable communication between teachers and learners, distribution of information to the learners, scheduling, notification and realizing different learning activities.

In the context of higher education, Rerhaye et al. (2021) identified different functions of the learning management system: user administration, course management, communication tools, presentation of course content, ability to add own learning content, data storage and sometimes even personalized control. They also divide LMS into three different models: learners' model (information about the student, preferences, challenges, achievements etc.), the pedagogy model (strategies for teaching and learning, collaboration, feedback and assessment) and the domain model (context or subject related features, for example knowledge about the subject, i.e. mathematics, physics etc.). Functions of LMS can vary and it depends on different organizational and personal objectives but there are common functions, such as easy access to information, relevant data, effective interaction models and remote way in (Satyarthi et al., 2021).

LMS have been used regularly in recent years and during the pandemic their use was widespread also in secondary education. LMS are developed by software development companies with specialized development teams who put a lot of effort into designing and building them. However, as pointed out by Thoring and Müller (2011), developers are often forced to take a starting point in their own views of what constitutes optimal functionality and interface design rather than in feedback from the end users which may be limited due to different business regulations, budget, companies chosen guidelines and lack of time and resources. This despite the fact that feedback from the users is central for improving the system (Thoring & Müller, 2011), because it may approve or disapprove the requirement that the users' needs are met. Since the system is designed for the users, this requirement is essential (Norman, 2013). With these thoughts in mind, it makes good sense to improve the

development of the technological tools that are being used to gather feedback from end users in educational platforms.

Feedback systems or evaluation models designed to obtain user feedback and integrate into educational platforms can take different forms: questionnaires sent to users, star ratings, user comments from different input components in the system or even models where user support lines are involved (Zabala et al., 2021). The common purpose of all tools is to collect data that can be used as a basis for developing and improving the platform. According to Ireland et al. (2009) evaluation features should be included in the development of LMS to implement quality improvement practices.

This development project intends to design a prototype of a feedback feature that can be used to obtain feedback from the end users of a selected learning management system, and thereby contribute to the development and improvement of the platform. To identify which features of the LMS need to be evaluated, the technological and pedagogical design principles of LMS will be investigated through a literature review. As a basis to design a prototype of the feedback feature, data gathered from the software development company that has developed the LMS will be used. Furthermore, the data gathered during the project can contribute to existing research by adding a deeper understanding of a current business domain within LMS development and narrow down the gap between theoretical and practical narratives.

1.1 Aim and research questions

The ambition of this project is to develop a prototype of a feedback feature that is designed to gather inputs from the users in a systematic and structured way to enable further analysis and system enhancement.
This development project addresses the following research questions:

a) What premises for user interface development do developers of a learning management system consider important to facilitate users' learning processes?

b) How can a feedback feature be designed to help developers gather input from end users of a learning management system?

1.2 Outline of the thesis

This thesis begins with an introduction where rationale and background are presented. The introduction is followed by a literature review, where previous studies on design principles of LMS and evaluation models is presented. The method section starts with a project overview followed by a description of the used approach, the Design Thinking. After that the method for the data collection and the data analysis is explained. The method part ends with ethical considerations. Afterwards the detailed description of the design process provides further information about the development process and its details. Then it follows the discussion part and finally, the conclusion summarizes the results, brings the limitations and development recommendations.

2. Literature Review

This literature review will focus on two intertwined areas in system design and evaluation: design principles of LMS and evaluation of the system. The first section will review design elements of LMS, both of technological and pedagogical type. The second section will present evaluation techniques of learning management systems. Even though system evaluation is the main and final topic of this design project, underlying premises have to be included for perception, consistency and clearance. Different systems have different evaluation strategies and goals, and for that reason it is beneficial to examine the nature of the system that is being evaluated.

2.1 Design principles of LMS

Phongphaew and Jiamsanguanwong (2017) claim that a well-designed user interface of an LMS will enhance pedagogy's effectiveness, since it increases users' satisfaction and system's usability. Design principles of LMS that are discussed in this section can be divided into two groups: the technological approach and pedagogical approach. Both approaches together serve the same main purpose – to improve the learning prerequisites for the end user but their respective elements have different roles. In the next two sections both approaches and their elements will be presented.

2.1.1 Design element of the technological approach

The technological approach frameworks and models raise important technological objectives that need to be included in the design, for example user experience, usability and accessibility.

User experience and user interface

User experience (UX) is a wide term for human-computer interaction that includes all the aspects of perception and response between the user and a system (Zardari et al., 2021). During recent years the priority of system design has focused more on user experience, emotional and cognitive aspects (Bollini, 2017). Technological development grows rapidly and it generates new compound challenges for user interface design (Sanctorum et al., 2021). User interface (UI) can be explained as a set of displays and interaction techniques wrapped to

a package, i.e. it is part of a software that people can see and interact with by reading outputs and sending inputs (Galitz & NetLibrary, Inc., 2002). According to Phongphaew and Jiamsanguanwong (2017), the success of LMS depends on its user-friendly interface; a complex design minimizes user satisfaction and developers should therefore follow "easy-to-use" principles. The same authors also highlight that LMS are very specific and complex, therefore an intuitive and human-centered navigation should be preferred. Van Der Linden et al. (2019) use the Component of User Experience (CUE) model to describe core elements of UX (see Figure1).

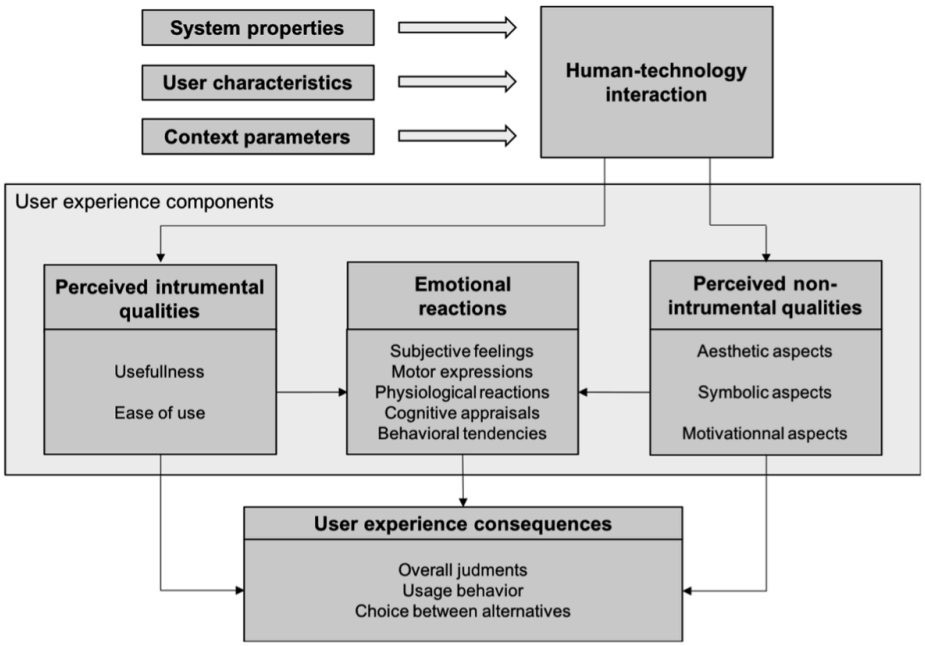


Figure 1. CUE-model

Usability and personalization

Wang (2017) describes usability as a means of reaching a goal that includes effectiveness, efficiency and satisfaction, in the user centered context. Usability stands for an ability of a system to deliver easy-to-use human-computer interface (Liaw & Huang, 2013). User interface is a navigation field and finding specific information in the accepted measure of time is essential, therefore usability has an instrumental part in this process as reported by Sørum (2017). Virvou and Katsionis (2008) suggest that usability plays an important role in learning effectiveness but it can also become an obstacle for the learner's satisfaction. For example, if they are not familiar with the design the application can be difficult to use. Prieto et al. (2015)

find in their study that digital tools in physical classroom learning environments are lacking well developed usability. Web-based learning systems often have such usability issues such as inappropriate naming of user interface components, inconsistent design, lack of user guidance, missing additional information, etc. (Jakobs et al., 2017). Personalized content can enrich user satisfaction and attract more and more learners (Motiwalla, 2007). Fischer (2021) defines personalization as a technique to avoid global user grouping and focus more on individual prediction. Some researchers believe that development of personalization can counteract dropouts (e.g., Bakki et al., 2015).

Accessibility

Accessibility stands for making content and platform's functions disposable for people with different disabilities (Satyarthi et al., 2021). In recent years, the growth of access to information has been improved for information and communication technologies for all people, regardless of their abilities (Laparra-Hernández et al., 2017) and development of learning management systems has created new opportunities for accessibility (Rai et al., 2021). There are different accessibility design guidelines for web-based applications, such as Web Content Accessibility Guidelines (WCAG), Web Accessibility Initiative (WAI), World Wide Web Consortium (W3C). Their aim is to adapt the system for users with different abilities, increase learning efficiency, boost efficacy and lower the probability of errors (Gil Urrutia et al., 2017). Recommendations from WCAG 2.0 include the following essential elements: perceivable (content should be presented for the user in perceivable way, for example alternatives to regular text, media, adopted layouts), operable (component of user interface should be operable, for example keyboard accessibility, readability, intuitive navigation), understandable(understandable content, components that operates in predictable ways, helping user to avoid and correct mistakes) and robust(maximize compatibility with current assistive technologies) (W3C, 2008).

2.1.2 Design element of a pedagogical approach

The pedagogical approach identifies important learning points, such as learner aspects, the interaction and communication of the learner with the system, behavioral intentions, etc.

Learner aspects

Jeong (2016) claims that there are unique characteristics of the learners and their choices that cause different learning preferences which in turn influence the actual learning. Hence, for effective design of learning management systems, the author emphasizes the importance of identifying both user characteristics and characteristics for e-learner satisfaction. User characteristics are the following: personality (age, gender, nationality), usability (perception awareness, flexibility, learnability, efficiency), user value (self-satisfaction, sociability, self-regulation), technological skills and learning value (experience, proficiency and learning level). Characteristics for e-learner satisfaction are learner dimension (attitude, self-efficacy, opinion and feelings), instructor dimension (attitude, response), system dimension (design, technology), course and environment dimensions (Jeong, 2016).

Behavioral intention

Behavioral intention is a user's will to perform a certain behavior, for example the willingness to decide to use a specific technology or use it in a certain way (Zardari et al., 2021). Altalhi (2020) claims that the behavioral intention plays an important role in the overall impact of the system on the user and it affects the factors that are responsible for how the user adopts the system. Park (2009) identifies four core categories of the behavioral intention to use information technology: individual context, system context, social context and organizational context. The social context is responsible for social influence on personal acceptance of the technology, while the organizational context involves organization's influence on the user's technology use (Park, 2009). The individual context includes the individual factors, for example self-efficacy and the system context includes the factors that are within the system, for example system accessibility (Park, 2009).

Interactivity

According to Violante & Vezzetti (2015), several empirical studies have proven that didactic effectiveness depends on interactivity disposition. Violante & Vezzetti (2015) also believe that interactivity is one of the most important building blocks of a web-based learning environment. Interactivity activates senses of meaningful learning, while guidance and reflection enhance cognitive processes of integration and organization (Moreno & Mayer, 2005). According to Salajan et al. (2009) interactive technologies show massive potential that

can significantly improve teaching and learning. Besides the positive effects of interactivity on learning performance, satisfaction, attitude and learning quality, there are also behavioral effects that are important to consider in the design of e-learning. Core elements of behavioral aspects are imagery, spatial presence, copresence and underlying flow (Rodríguez Ardura & Meseguer Artola, 2016).

Feedback

Long-term retention, memory performance and also correct responses can be enhanced by providing timely feedback from the teacher (Smith & Kimball, 2010). Winstone and Boud (2019) suggest that both instructors and students acknowledge that the main aim of the feedback is to facilitate the improvement of performed tasks or an assignment. They also note that it is not the feedback itself that influences learning but the feedback design (e.g., get the feedback promptly and have the possibilities to act upon it). Giving feedback frequently improves both specific task performance and overall learning (Lam et al., 2011). A recent study that was conducted by Chan and Ko (2021) suggest that learner satisfaction and the feedback are interrelated, and the feedback can neutralize negative emotions of students' boredom.

2.2 Evaluating a system

In the previous section a few design elements of learning management systems that are in need evaluation were presented. Al-Fraihat et al. (2020) combine a few evaluation models, such as Technology Acceptance Model (TAM), User Satisfaction Model and E-learning Quality Model in one, called EESS model (Evaluating E-learning System Success). The EESS model is very broad and includes many essential parts, such as educational system quality, technical system quality, information quality, support system quality, learner quality, instructor quality and service quality. Those aspects that are most related to the prototype that is being designed are going to be presented in the next three sections.

2.2.1 Information quality

Information quality in the EESS model includes the following components: usability, accessibility, understandability, content design quality, up-to-date content, conciseness and

clarity. The information quality aspect is used in the DeLone and McLean Model (2003) that measures system success and connects user satisfaction to information quality. Lwoga (2014) claims that the success of the LMS system depends on learner acceptance and sustained usage, and it is therefore crucial to measure and analyze exactly what affects the learner's intentions to use the system. Demissie and Rorissa (2015) agree in their research that information quality affects user satisfaction. However, it also affects behavioral objectives in educational contexts, and they suggest that improving information quality leads to higher extent of behavioral intention to use the LMS. Orfanou et al. (2015) researched different methods that can evaluate usability and they recommend The System Usability Scale (SUS) questionnaire that consists of 10 short questions with five response options from strongly disagree to strongly agree. For the accessibility part Kumar and Owston (2016) argue that student-centered evaluation should be preferred such as unmoderated sessions, instead of automated evaluation techniques because automated tools cannot predict all the barriers students meet during the usage of a learning system. Alomari et al. (2020) developed a framework for UX evaluation where usability and content design can be evaluated with a help of cognitive walkthrough, i.e., the user has to describe the goal of every step, potential actions and interpretation of the screen content. To evaluate a learning application can imply high costs. However, Leino and Heimonen (n.d.) argue that increasing evaluation costs can enhance students' user experience.

2.2.2 Technical system quality

Technical system quality covers user requirements, ease of use, easy to learn, important system features such as availability, reliability, security and personalization. Almaiah et al. (2016) also studied different LMS design frameworks and identified the importance of the evaluation based on students' perception. According to Ghavifekr and Rosdy (2015) learning management system success is measured by its value and efficacy. Revythi and Tselios (2019) also mention efficacy and that it has a significant impact on both learners' perception and behavioral intention which leads to wider and better perception of ease of use and further improved learning.

2.2.3 Educational system quality

Communication, assessment, feedback and other learning attributes are combined in education system quality. Ireland et al. (2009) emphasize a few other core pedagogical factors that are important to consider in the evaluation processes: 1) learning application features should be adopted to a course level and discipline, 2) integrated feedback 3) interaction between students and content to enhance the engagement, 3) self-evaluation. According to Yaw Obeng and Coleman (2020) there are many other important factors that were found in the previous research and the massive amount of them make it very challenging to design and evaluate learning management systems. They also suggest that the level of the significance of educational challenges is affected by the educational context. Therefore, the design and evaluation process should include recognition and analysis of conditions around the system. Other researchers call it disciplinary differences (Ahmad et al., 2021).

3. Methodology

This section will present the method that is being used to generate the results to answer the research questions, in other words a research design. Firstly, a project overview will be introduced including a description of the company and the context of this development project. Secondly, the research approach, which is called Design Thinking will be discussed. Thereafter, the data collection and analysis will be explained in detail. Finally, ethical considerations will be considered.

3.1 Project overview

The development project was conducted together with a software engineering company that works together with teachers and school administrations to develop LMS and applications. The company's learning platforms are being used by 830.000 users in 2000 schools. Their users are teachers, students, administration and parents. The company develops whole support solutions for learning, school administration, communication and activities optimization. In this study, I focused on the company's development processes of the LMS user interface that is being used by children from the sixth and seventh grades. This project studied the functionalities of the LMS that are included in the user interface for this group of users. In consultation with the company when we identified their needs, I decided to develop an evaluation tool that can help developers to gather feedback from users in a systematic and structured way. The tool was intended to evaluate the user interface, user experience and user satisfaction which, according to previous studies, play an essential role in successful development of LMS (Satyarthi et al., 2021).

I started this project by doing a literature review to identify important elements of the LMS design and evaluation (section 2.1). Thereafter, I gathered data from both developers and users on their perspectives. This data was used to design a prototype of the evaluation tool. The design process implemented the Design Thinking approach that is described in more detail in the next section. Also, personas were created to identify the end user and facilitate design processes. The prototype was presented for the end users to receive their feedback, which are included in a test section.

3.2 Design thinking

The Design Thinking (DT) approach is quite broad, and has been used in different contexts and areas. There are many interpretations of Design Thinking and most of them have one thing in common: behind the product that is being designed, there is a human that uses it (Norman, 2013). Companies often use DT processes to focus on the end-user and develop better products and services. Norman (2013) describes DT as a complex process to solve a certain problem by implementing human-centered design (HCD) and the double-diamond diverge-converge model of design. I used the Design Thinking approach in a way that meant that every step in the development process should be verified by learner-centered thinking, i.e. the focus was always put on the learner, not on an innovation or "pretty" interface but on the student that uses the application or the teacher that designs the learning.

3.2.2 Human-centered Design

Human-centered design (HCD) is the process that includes the following important steps: making sure that the user's needs are met, that the developed product is understandable and usable, the product is doing what it is supposed to be doing, the users' experiences are positive and they enjoy the product. Also, other technical considerations are involved in HCD, such as shapes and forms of the product, costs, efficiency, usability, effectiveness etc. (Norman, 2013). Human-centered design is also included in the ISO standard for interactive systems (ISO 9241-210:2019) where human factors are mentioned as essential. I followed those recommendations and steps during the whole project.

The company's customers are not the students, but the municipality or school administration. Therefore, I used personas to have an image of the end-user, and select them out from the group of stakeholders that includes investors, suppliers, employees etc. A persona is an archetypal user that is developed by UX designers by seeking key trends in the potential behavior of the user (Getto & Moore, 2017). Personas can be created by observation or some kind of research and it is not a real individual but more as a character that represents thousands of individuals. The designers often use personas to design for specific somebody instead of designing for generic everybody (Goltz, 2014). Good design reduces uncertainty but a good system does not eliminate it, it only tries to make the usage of the system natural

and predictable (Cooley, 1987). For that reason, I used physical, semantic and logical constraints in the design, as suggested by Norman (2013).

Physical constraints are easy to see and interpret, they help the user to guess possible operations. To provide an example, a big ball cannot go into a small whole. By using physical constraints in the design, I tried to lower the risk for interruption and reduce time spending. Semantic constraints involve a meaning, i.e., the meaning of the situation controls the users' actions, and it is based on the user's knowledge of the world and earlier experiences. These constraints pushed me towards using icons and visual components that are familiar to most users. Finally, logical constraints implicate natural mapping (something that has a logical relationship between the spatial and functional aspects), for example number two comes after number one and number three comes after two). I implemented a few natural mapping concepts in the design of the user interface. The implementation of these three constraints is described further in the design process section.

3.2.3 The Double-diamond model of Design

The Double-diamond model of Design was introduced by the British Design Council in 2005 and it is divided into four stages: discover and define, develop and deliver. In other words, the design process starts with an idea and then goes through different researches, identification of issues, understanding underlying problems, exploring fundamental points and then moves towards the development phase where the prototype is being developed and evaluated (Norman, 2013).

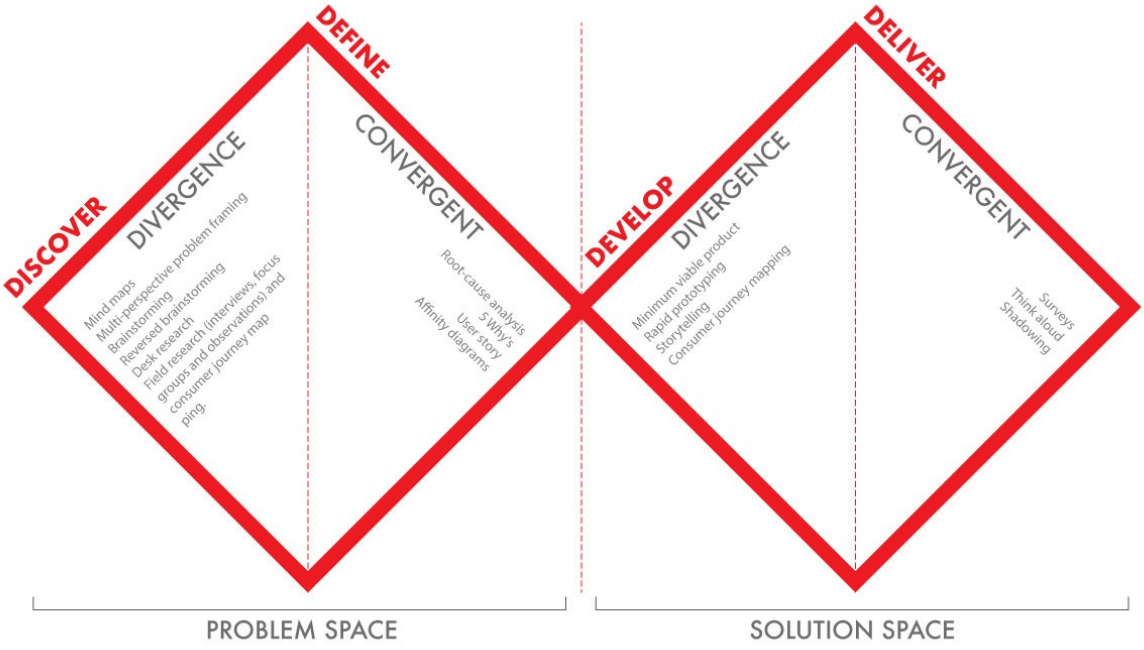


Figure 2. The Double-diamond Model of Design

The first phase of the double-diamond model was dedicated to discover and explore the problem. I applied theory analysis (section 2.1) to understand the requirements and expected outcomes in this step. The defining step means concretization of a problem, where all the findings should be narrowed down to a clear and compressed definition. I wrote a few definitions of the problem and presented them in the design process section. The developing phase of the double-diamond model is dedicated to prototyping that leads to delivery. However, the current project does not include any delivery to the customer.

The main point behind the double-diamond model is divergence and convergence. Divergence can be compared to expanding, enlargement, exploring the issue on the broader level, while convergence is scaling down or compressing the issue. This model is effective because it helps designers to think outside the box, but it is still a little bit abstract. Therefore, the Design Thinking process with concrete steps is recommended to implement within the double diamond model (Norman, 2013).

3.2.4 Design thinking process

This development project implements the following 5 steps of the design thinking process that was proposed by the Hasso-Plattner Institute of Design at Stanford (Stanford, 2010) (and they are d.school): empathize, define, ideate, prototype and test. These steps do not necessarily follow a strict timeline order, they are all part of an iterative process (Figure 3). Stanford's five-step model is very well defined with available detailed guidelines, which makes it easier to adopt and use quickly (Kwon et al., 2021). The steps are described in the following subsections.

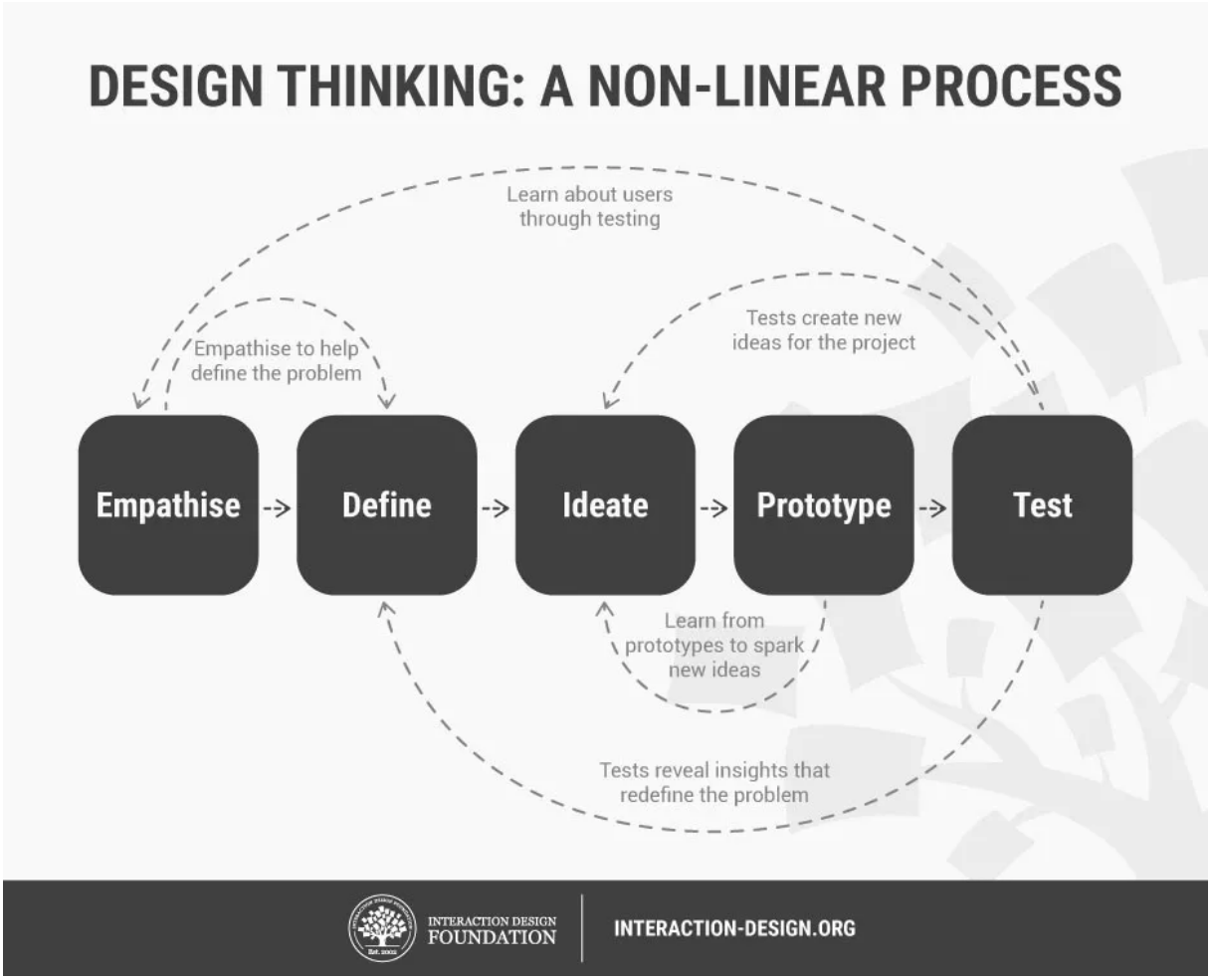


Figure 3. Author/Copyright holder: **Interaction Design Foundation**. *Copyright licence: CC BY-NC-SA 3.0*

Empathize

The first step of the Design Thinking process starts with empathy for the people within the context of design challenges, which are learners in this case. The empathizing process involves analysis of people's thinking, reasoning and acting. Also discovering their physical and emotional needs, values and given meaning. Empathy is about another individual or group of people in most of the cases, and very rarely about the designer. It means that the designer has put aside their own assumptions and tries to comprehend what is important for the user. This can be done in various ways like observing, watching, listening and engaging with people (Stanford, 2010). According to Norman (2013), it is essential to study the mind of the user before doing the design, otherwise there is a risk to create an overcomplicated design that is prompt to fail or lead to an unnecessary error. Designers should not forget that the aim of their work is to enhance the user's life and add to it pleasure and enjoyment (Norman, 2013).

I used observation of the end user to create empathy. More detailed information about the participants and the procedure are presented further in the section 3.4.1 Participants. I used the empathy mapping model as a guiding tool during the observation (Figure 4). Also, I needed to analyze the problems that users face, and for that I identified four user stories, the possible scenarios of the user-system interaction. To gain knowledge about the context I collected field information from the developers of the LMS application with the help of semi-structured interviews.

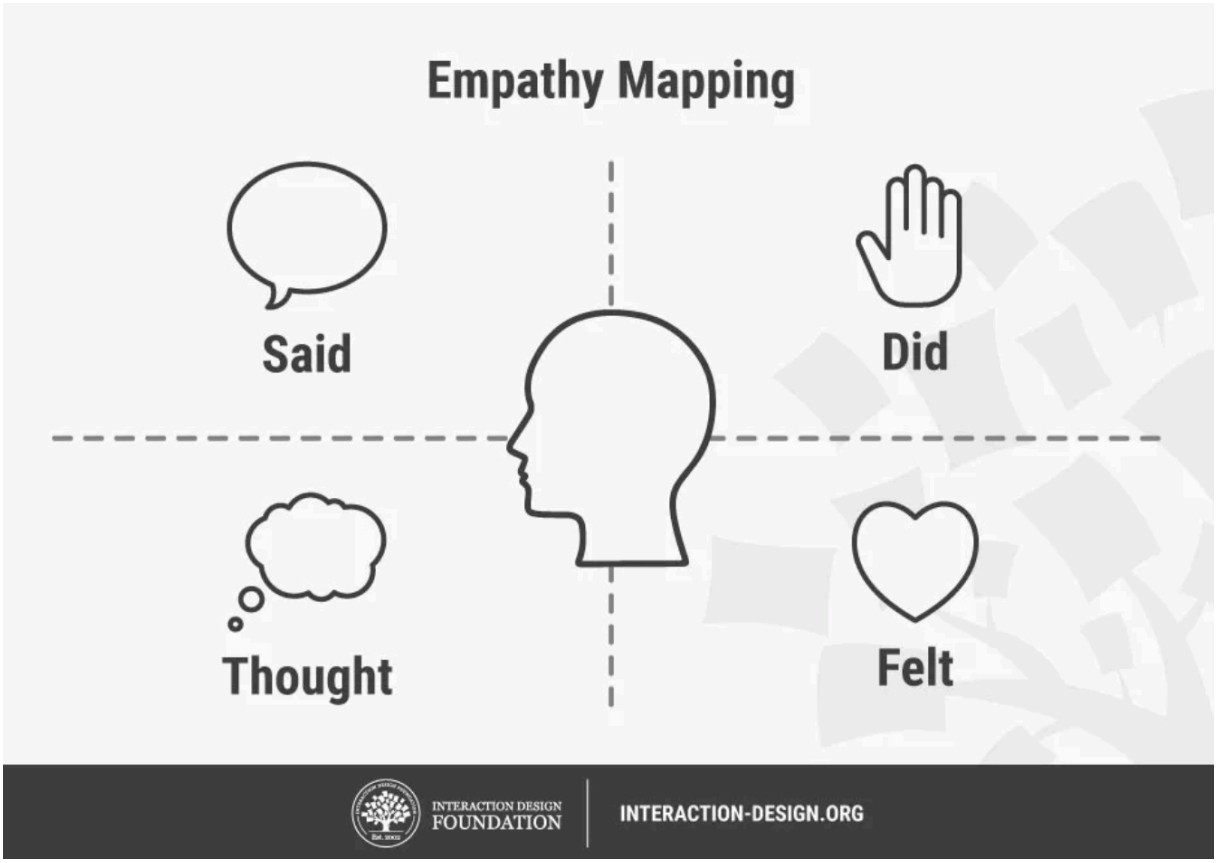


Figure 4. Empathy mapping. Teo Yu Siang and Interaction Design Foundation. Copyright terms and licence: CC BY-NC-SA 3.0

Define

According to Cassim (2013), initial issues are often very loosely defined by the customer and it leads to that both the design problem and design solution are very unclear in the beginning. It can be challenging for the designers to formulate the problem and frame it at hand. The defining phase is a sensemaking, i.e. to put together gathered knowledge about the user along with the context and create a meaningful and applicable problem statement. This statement should be focused on the needs of the user and synthesize the insights from empathizing activities (Stanford, 2010).

This stage of the DT process was dedicated to explore the problem. Initially I applied field research to understand the requirements and expected outcomes of the learning management system. Then I gathered the information from the empathy phase and created 3 personas to visualize the user. The defining step means concretization of a problem, where all the findings

should be narrowed down to a clear and compressed definition. I used post-it notes to write down, cluster and sort the ideas, which were divided into two categories: a set of user's needs and a set of insights from the context.

Ideate

Design Thinking can also be described as a process of realizing and testing creative thoughts to improve something or handle the issue. The ideating process can include gathering and then grouping and sorting different ideas (Washington et al., 2019). It is recommended to create as many ideas as possible and use them as fuel and the source for the next step, the prototyping. There is no need at this stage to find a best solution, because what is best will show during the evaluation and testing phase (Stanford, 2010). Creativity and a widely spread point of view are handy at this stage, because unusual methods of solving the problem open doors to innovation and new discoveries (Dam & Siang, 2018).

Ideating requires decision making, especially if there are many ideas but you have to pick one. I used sketching to draw a few design suggestions and pick one that I considered the most usable and pleasant for the user. During this process I went back to the empathizing stage many times to confirm that the design was user-centered.

Prototype

The prototyping process means creating a simple and cheap product that can be tested to see if there are any problems with the design. In this stage the designer has a chance to bring the ideas to life, see if the suggested design is practical, useful and pleasant for the users. Prototyping and testing go hand in hand because an early prototype may need modifications and then repeated testing, it is an iterative process. When it comes to software engineering the designers may produce a paper prototype for demonstration and evaluation purposes to save time and expenses (Dam & Siang, 2018). Prototyping can help answering questions on the main issue and also refine the solution design. Stanford (2010) identifies some important argumentations for prototyping: communication with the user, quick and cheap failure, early test possibilities and managing a solution-building process.

Building a prototype or a mock-up can help to evaluate the idea and ensure that the problem is well understood (Norman, 2013). In the early stage of prototyping cheap and quick solutions are enough to gather feedback from the user or the colleagues that are in the same project. However, it is important that the user can interact with the prototype in some way, for example, to touch, read, or make some inputs (Stanford, 2010). The prototyping is also intended to minimize the failing costs. Therefore, working on a prototype should not take too much time. It is also essential in this phase to keep the user in mind and associate with expected user behavior (Stanford, 2010).

In the developing phase I built the prototype of the feedback feature using different prototyping and drawing tools (Adobe Photoshop and Illustrator). The prototype showed the designed user interface, possible actions, outputs and inputs. The prototype is a realistic solution that is possible to develop with different programming languages.

Test

Testing helps developers to learn more about the designed solution and the user. During the testing, empathizing mode is activated again and new insight may bring more light to the potential solution. Testing should not be reduced to a simple question about liking or not, instead the designer should focus on "why-questions" and observing the interactions. Real context testing is the best but it is not always possible, therefore the most realistic situation is advantageous to organize (Stanford, 2010). In this stage it is essential to have a critical mind, because the design in most of the cases requires refining of the prototype. Successful testing may require three testing approaches: creating an experience for the user, showing instead of telling, and asking the user to compare different solutions(Stanford, 2010). The testing stage may also take the designers back to the defining stage if some crucial insights were found and the main problem statement has to be modified. For that reason, flexibility is beneficial (Dam & Siang, 2018).

I conducted testing with three real end users. During the testing phase I presented three different solutions for them. The user had to rate all the solutions and motivate their choices. All the feedback was registered for improvements and refinement purposes.

Finally, there is a combined model of Design Thinking process that was presented by Thoring and Müller (2011) based on method engineering within the educational context. The model is described in detail and includes inputs and outputs for each phase. This model is especially developed for IT-based solutions and supports software engineers in their Design Thinking. I used it as a guide through the whole development process. The overview of the model is presented in Figure 5, and an overview of goal, how-to, input, and output for each process step is shown in Figure 6.

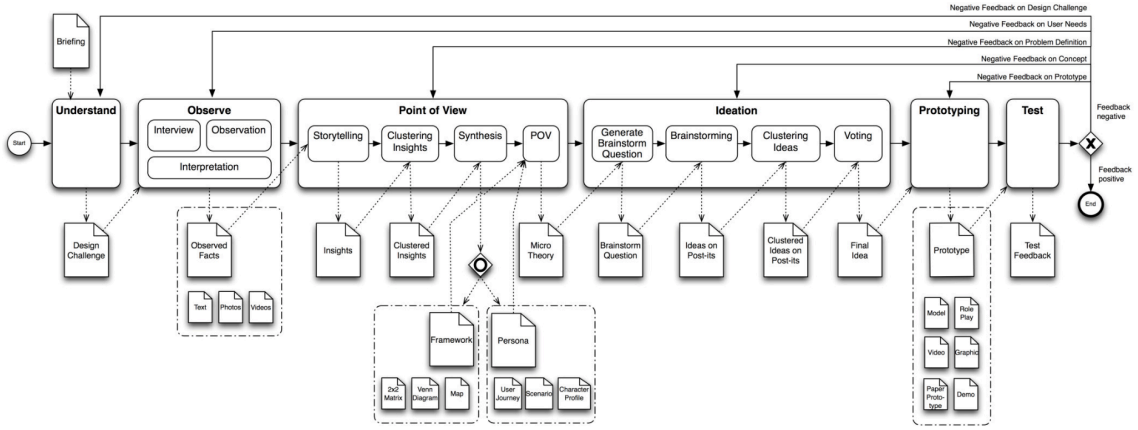


Figure 5. Process Model of Design Thinking by Thoring & Müller(2011)

Process Step	Goal	How-to	Input	Output
1. Understand	Collect existing information, become an expert	Secondary (desk) research	Briefing, media	Collected materials printout, documentation
2. Observe	Gather insights about user's needs	Qualitative Research (interviews, observation)	Problem definition, design challenge, questionnaire, the subject of the project (specific product or service)	Photographs, videos, interview transcripts, documents, audio recordings, notes
3.1 Storytelling	Bring every team member on the same level, exchange research results	Storytelling (verbal narration/report, concurrent writing down by the other team members)	Insights about user's needs (photographs, videos, interview transcripts, documents, audio recordings, notes,)	Written insights and sketches on post-it notes
3.2 Clustering insights	Structure all insights	Grouping of similar insights, finding titles for each group	Insights and sketches on post-it notes	Re-arranged insights; groups of post-it notes
3.3 Synthesis	Condense insights into a visual representation, about the user's needs, identifying 'pain points' as room for improvement.	Clustering, visual alignment of insights in frameworks or as a user stereotype	Written insights and sketches on post-it notes	Framework or persona
3.4 Point of View	Micro theory about user's needs	Searching for analogies and metaphors	Framework or persona	Point of View as a metaphoric user perspective
4.1 Brainstorming question	Generate brainstorming question that addresses the previously defined problem/user need	No formal method, everybody suggests a phrased brainstorming question	Point of View	Brainstorming question, phrased as "How might we…"
4.2 Ideation	Generate ideas for possible solutions to the defined problem or needs	Brainstorming, brainwriting, etc.	Brainstorming question, post-it notes	Many ideas written or sketched on post-it notes
4.3 Clustering ideas	Structure all ideas	Grouping of ideas, according to specific criteria (e.g. most useful, most feasible, etc.)	Ideas and sketches on post-it notes	Re-arranged ideas; groups of post-it notes
4.4 Voting	Decide on one idea to develop further	Voting of all team members, stick labels to favorites	All ideas	One idea
5. Prototype	Self-explanatory representation of the concept	Prototyping, modelmaking, role-playing, etc.	Selected idea, tools, materials	Prototype
6. Test	Gather feedback from users and stakeholders about concept and prototype	Show the prototype to potential users and stakeholders; let them work with it, try it out	Prototype, maybe questionnaire	Positive or negative feedback, quotes, documentation of the testing

Figure 6. Overview of Goal, How-to, Input, and Output for each Process Step by Thoring & Müller (2011)

3.4 Data collection and analysis

Semi-structured interviews and observations were used as data gathering tools in this project. According to Thomas (2017) most people are willing to share their opinions, and talking to participants can thus give quantities of valuable data. Before the interviews expected data

should be outlined and associated with purpose, research questions, method and project frame. Reading between the lines can help to form extra questions during the interviews and extract more data (Thomas, 2017).

3.4.1 Participants

I had two groups of participants in the interviews: the development team and the support team. For the observations I had one group of the end users. The development and the support teams were accessed through the organization that I was cooperating with. The design team included a product owner and a UX designer. The support team included a support manager. The users' group included three end users of the system and they were found through the social media contact groups. Two of the participants are going to the same school. The ages of the participants in the user group were between 12 and 15 years old.

3.4.2 Semi-structured interviews

Semi-structured interviews combine a structured (where questions and order are the same) and unstructured (that has no pattern) approach, which can bring flexibility. However, as emphasized by Thomas (2017), flexibility is not always positive, the context and the objectives are there to decide. For this project, semi-structured interviews fit best because I could have the flexibility to ask more follow-up questions during the interviews and gather extra valuable data. I composed an interview schedule with prewritten main questions and optional follow-up questions. I also made a list of issues or important points that I wanted to cover. I did not follow the order of the questions strictly, but rather tried to get a natural flow in the conversation. Some people are more engaged in topics they like, while others choose to talk about something they know, or something that is related to their experiences and work. I chose to let the participants talk about what they considered important and then tried to frame the conversation around the project i.e., making the conversation related to the main subject and initial problem. The interviews were audio recorded and then summarized. The duration for each interview was around one hour. The audio recordings were fully transcribed. The participants from both teams were interviewed through the communication tool called Microsoft Teams.

According to Cohen et al. (2007) the type of data that is being collected affects the interview's structure. I gathered qualitative data for this research and therefore, I followed

some guidelines on how to conduct the interviews for qualitative data presented by Cohen et al. (2007).

- Engage. Make the participants feel that what is being said is understood.
- Use natural language during the conversation
- Be able to explore in more detail some nuances of the conversation
- Look for uniqueness rather than generalization
- Adopt and be open to new terms and phenomena
- Be flexible but stay focused
- Be able to accept the contradiction and uncertainty
- Participants may change their mind during the conversation
- Be positive, social and enriching experience for the participants

3.4.3 Observations

According to Thomas (2017), observation is one of the most important ways to gather data for social science research. I used structured observation in my project. Structured observation means observing some certain behavior. In my case I observed how the end user interacted with the system. I did not make any recordings but instead I wrote some notes, because the data from the observation was intended to be used only for empathizing purposes (see section 3.2.4). The observations took place in the children's homes and I had two sessions with each child. In the first session, I observed the user's behavior during the usage of the existing learning management system. The user was instructed to perform the following three tasks in the application: find materials for the English class studies, check the grades for the assignments, and navigate to the schedule of the current week. I observed and made notes on the user's behavior. The second session took place during the testing phase, where the user tested the prototype. The users were instructed to use three different solutions, choose the one that they preferred the most, and provide arguments for their choices. During the test section I made audio recordings of their responses and made notes for the behavior.

3.4.4 Data analysis

I used the thematic analysis approach to analyze the collected data. Braun and Clarke (2006) suggest that thematic analysis is a flexible, accessible and widely used approach to analyze

qualitative data. It is a method for identifying, analyzing and presenting patterns (also called themes) that is found in the data. The thematic analyses approach differs from other data analyze methods in that it searches for themes (patterns) that have social meaning through the entire data set. These themes capture important relationships with the research question and represent a patterned meaning (Braun & Clarke, 2006).

There is a step-by-step guide for thematic analysis approach, presented by Braun and Clarke (2006), that I used during the data analysis:
1) Familiarizing yourself with your data. Read and re-read the data. Use the transcribing process to write down the initial ideas.
2) Generating initial codes. Highlighting interesting data in a systematic way.
3) Searching for themes. Collate codes into possible themes with close reference to the research questions, gather relevant data to each possible theme.
4) Reviewing themes. Cross-check if the themes are related enough to the codes and create a thematic map of the analysis to address the key areas from the research questions.
5) Defining and naming themes. Refining the themes and continuing with the coding.
6) Producing the report. Writing the notes, or tables, visualize the results.

A similar approach but with a more specific description of underlying words' analysis is presented by Thomas (2017), named constant comparative method. Constant comparison involves going through the data over and over again and it can be done with coding and theming. Coding stands for highlighting things that are important and theming captures and summarizes the content. The themes are important building blocks of the analysis and they help to emerge with a meaning that was created during the interviews (Thomas, 2017). Codes and themes were identified, sorted and presented in tables and sticky notes boards. This process is also called theme mapping, where the relationship between themes are illustrated with arrows or network diagrams (Thomas, 2017). These approaches were found suitable to analyze the qualitative data that was collected in this study.

3.5 Ethical considerations

All research should be conducted in a responsible manner, honest and open in all the dealings with the participants (Thomas, 2017). Therefore, I explicitly informed the participants about what was being done and how the data would be used. They were informed that the study followed the research purposes only and that they could withdraw all the information that was going to be published. Also, they were informed before the interviews about the ability to withdraw at any time during the interview without feeling uncomfortable. The draft version of the project description and data analyses was sent for review before the publication. A consent form was signed by the parents of the user group before the participation. All the information that was gathered was treated confidentially. I maintained anonymity by not revealing the names of any respondents and the organization. Informed consent principles were implemented in this study by providing the participants with information about the nature of the study, possibilities to agree or disagree for audio recording, expected benefits, possible harms, information about how data will be kept and later destroyed, and my full name and contact details.

4. Description of the project

This section will present the design procedure in detail to give a deeper understanding of how the project was conducted and what steps were taken. In the methodology section I presented three models of Design Thinking: The Double-diamond Model of Design (Figure 2), Process Model of Design Thinking by Thoring & Müller (Figure 5) and the five-step guide by Hasso-Plattner Institute of Design at Stanford (Figure 3). The combination of these models I presented in the Figure 7 down below. I will describe my design process further in 5 steps as I mentioned in previous section but I want to emphasize that the understanding, creating and delivering parts are overlapping those steps.

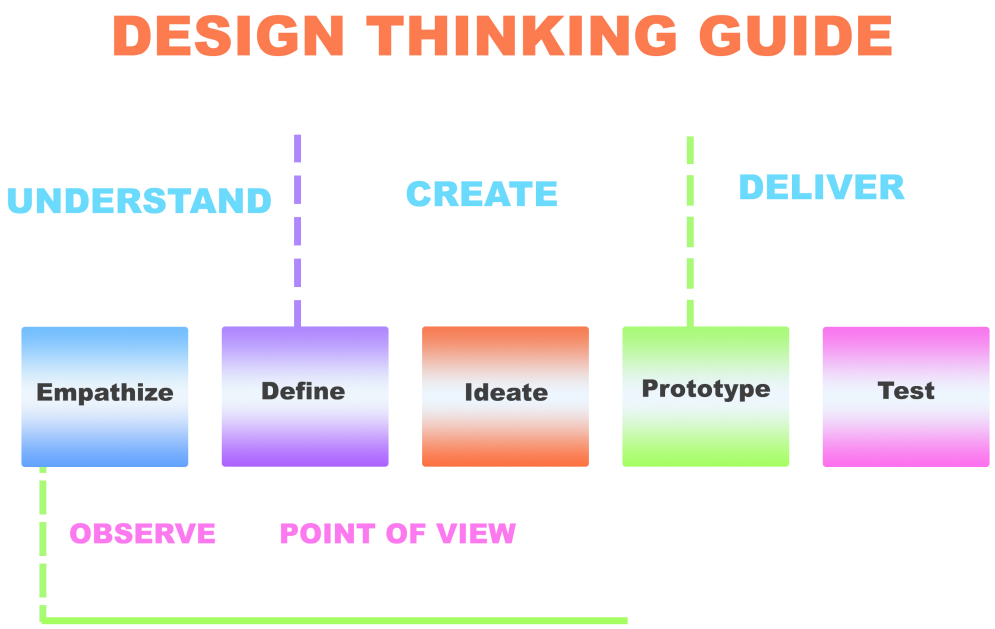


Figure 7. Design Thinking guide

4.1 Empathize

This section will describe the first step in the design process that involves gaining empathy towards the people I am designing for and understanding of the situation. In this case understanding the system and the user that is interacting with it. During the empathize phase I tried to gather important information about the user, the context and the work of the developers to understand the scale of the design issues. As mentioned before, this development project is intended to prototype the feature that can be implemented on the

existing and deployed LMS. Therefore, the data that was gathered during the empathize phase was divided into two categories: the data from the observations of the users and the data that was gathered from the developers of the system

I had an empathy session with the users where I asked them some general questions about their preferences, the devices they use, their goals and interests. I also made my own notes to capture their personalities. The data that I gathered in this first session was used to create personas, which will be presented in the define phase (see section 4.2).

4.1.1 Context

After creating some empathy for the user, the next step was to analyze the context. In other words, to understand the users of the system I needed to understand the situation and the problems they were facing. For that reason, I started with exploring the existing application. I analyzed core functionalities of the system and wrote four typical scenarios that the user comes across.

1. The user is logging in to the application and checks the start page. The start page displays a calendar, announcements, bookings and different navigation bars. The calendar is filled with actual lessons and it is editable where the user can add their own activities, click on the events to get more information about the lesson, teachers' names and their contact information. The overview of the start page in the system is presented in Figure 8.

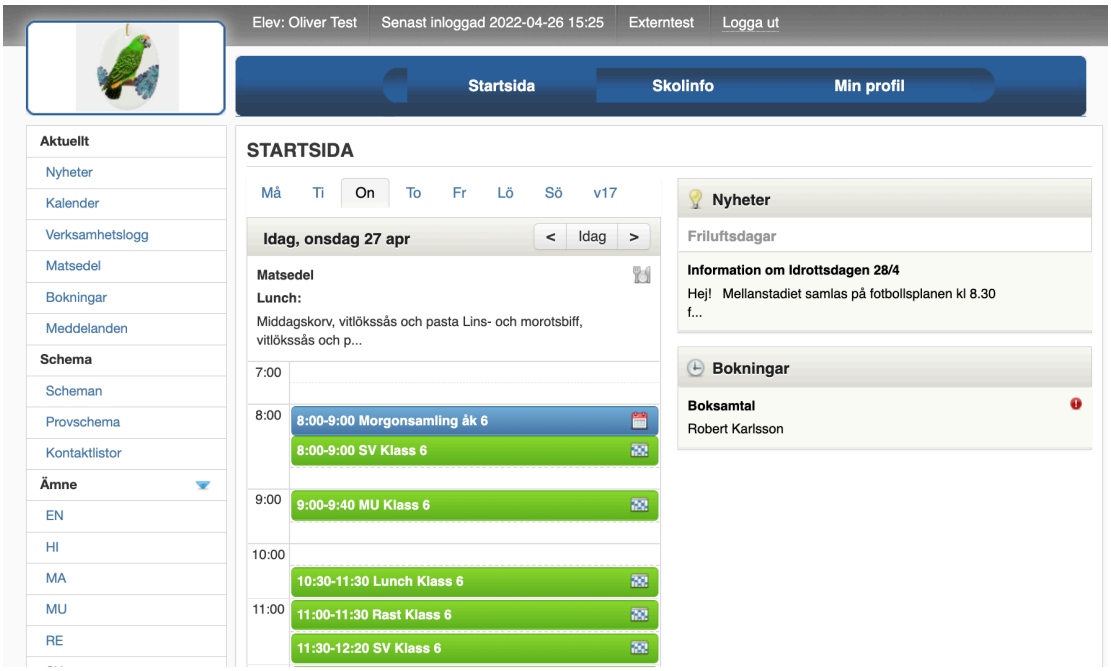
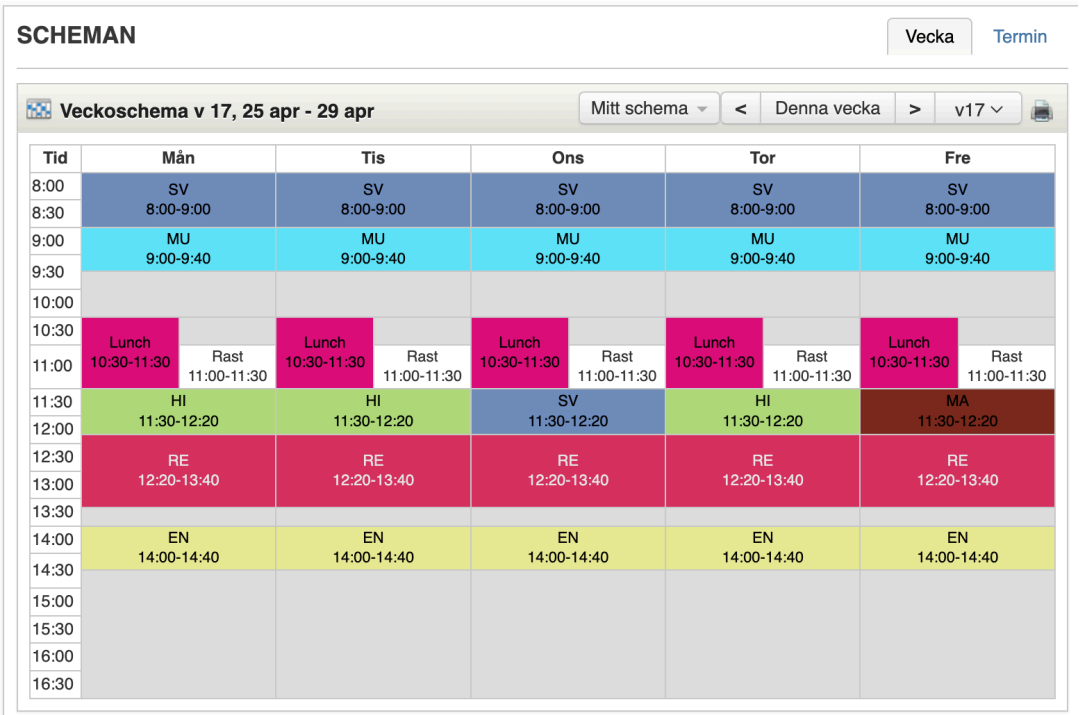


Figure 8. The overview of the start page in the system

2. The user is using the system to check the schedule for the classes. The schedule is divided into hours, days, weeks and months. The user checks the schedule to see the lessons and their times. The schedule is intended to help the user to plan and be prepared. The overview of the current schedule functionality in the system is shown in Figure 9.



Tid	Mån	Tis	Ons	Tor	Fre
8:00	SV 8:00-9:00	SV 8:00-9:00	SV 8:00-9:00	SV 8:00-9:00	SV 8:00-9:00
8:30					
9:00	MU 9:00-9:40	MU 9:00-9:40	MU 9:00-9:40	MU 9:00-9:40	MU 9:00-9:40
9:30					
10:00					
10:30	Lunch 10:30-11:30	Lunch 10:30-11:30	Lunch 10:30-11:30	Lunch 10:30-11:30	Lunch 10:30-11:30
11:00	Rast 11:00-11:30	Rast 11:00-11:30	Rast 11:00-11:30	Rast 11:00-11:30	Rast 11:00-11:30
11:30	HI 11:30-12:20	HI 11:30-12:20	SV 11:30-12:20	HI 11:30-12:20	MA 11:30-12:20
12:00					
12:30	RE 12:20-13:40	RE 12:20-13:40	RE 12:20-13:40	RE 12:20-13:40	RE 12:20-13:40
13:00					
13:30					
14:00	EN 14:00-14:40	EN 14:00-14:40	EN 14:00-14:40	EN 14:00-14:40	EN 14:00-14:40
14:30					
15:00					
15:30					
16:00					
16:30					

Figure 9. The schedule overview in the system

3. Fetch learning materials. The user may try to download or read the materials for some particular lesson, class or the subject, for example a text for the English class. It can be an assignment as well, syllabus or some media. Regularly it is around 8-16 different subjects or classes that are registered in the system for one user. The overview of the subjects and the materials are presented in Figure 10.

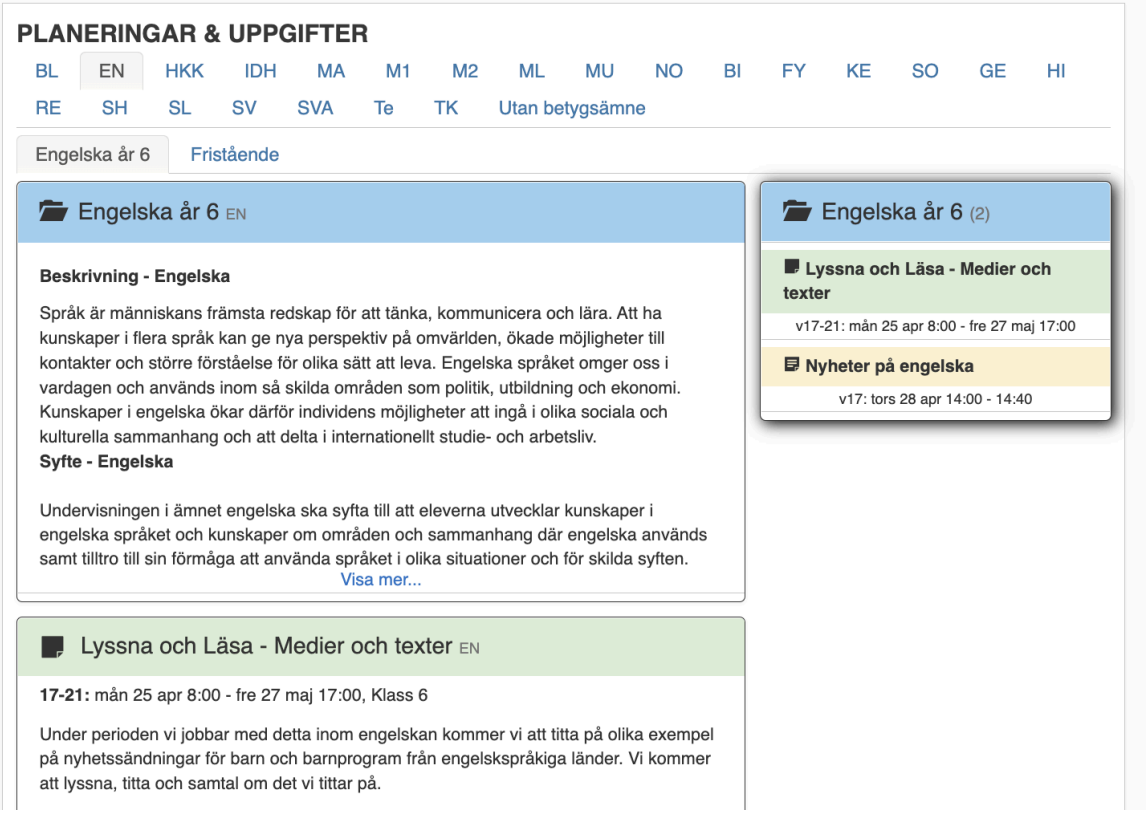
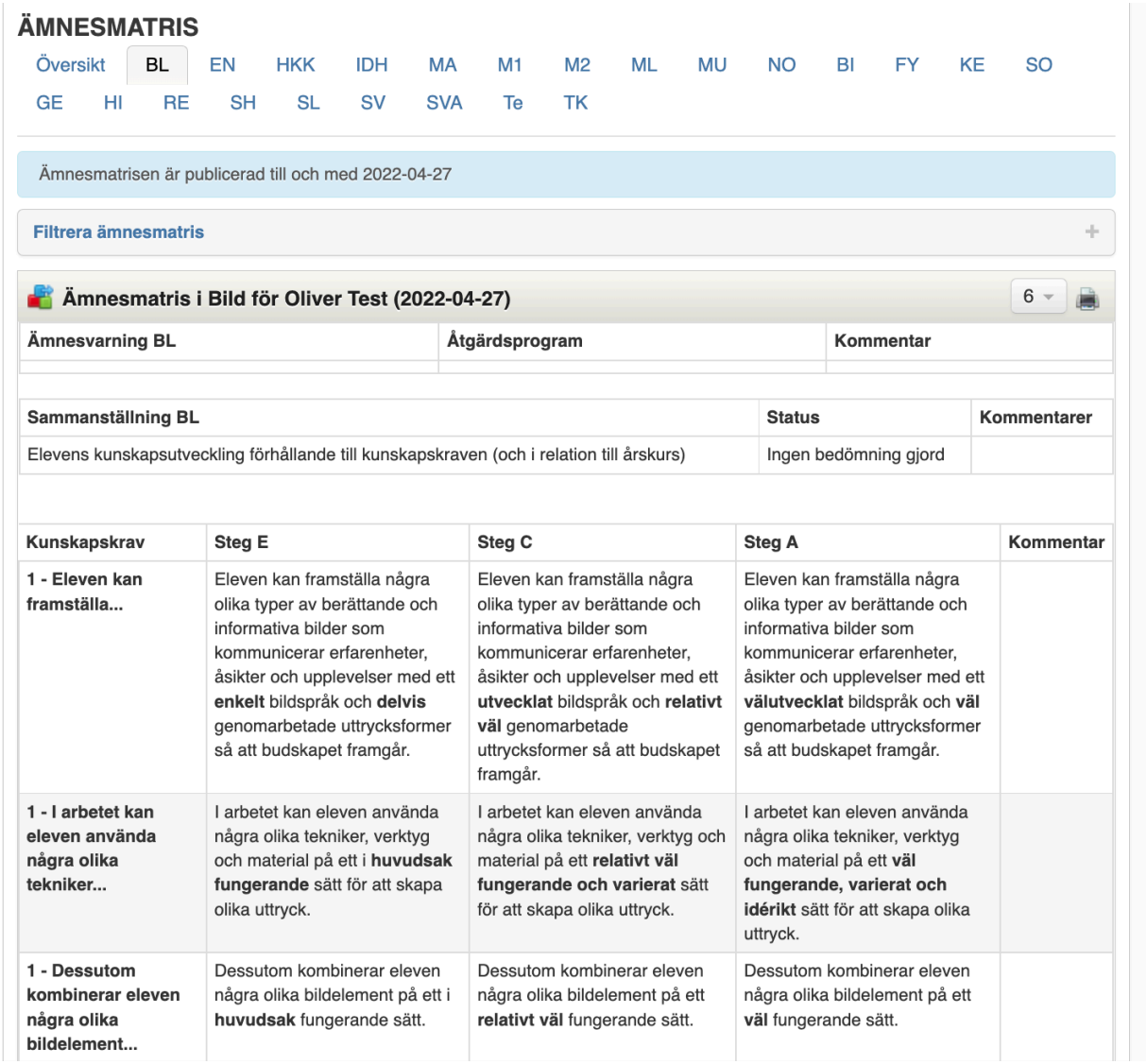


Figure 10. Subject material overview

4. Assessment criteria. Every subject has an assessment criteria where the learner can read what is needed to get a certain grade. The grading scale is presented in the table with an explanatory text. The overview of the assessment functionality is shown in Figure 11.



ÄMNESMATRIS

Översikt | BL | EN | HKK | IDH | MA | M1 | M2 | ML | MU | NO | BI | FY | KE | SO | GE | HI | RE | SH | SL | SV | SVA | Te | TK

Ämnesmatrisen är publicerad till och med 2022-04-27

Filtrera ämnesmatris

Ämnesmatris i Bild för Oliver Test (2022-04-27)

Ämnesvarning BL	Åtgärdsprogram	Kommentar

Sammanställning BL	Status	Kommentarer
Elevens kunskapsutveckling förhållande till kunskapskraven (och i relation till årskurs)	Ingen bedömning gjord	

Kunskapskrav	Steg E	Steg C	Steg A	Kommentar
1 - Eleven kan framställa...	Eleven kan framställa några olika typer av berättande och informativa bilder som kommunicerar erfarenheter, åsikter och upplevelser med ett **enkelt** bildspråk och **delvis** genomarbetade uttrycksformer så att budskapet framgår.	Eleven kan framställa några olika typer av berättande och informativa bilder som kommunicerar erfarenheter, åsikter och upplevelser med ett **utvecklat** bildspråk och **relativt väl** genomarbetade uttrycksformer så att budskapet framgår.	Eleven kan framställa några olika typer av berättande och informativa bilder som kommunicerar erfarenheter, åsikter och upplevelser med ett **välutvecklat** bildspråk och **väl** genomarbetade uttrycksformer så att budskapet framgår.	
1 - I arbetet kan eleven använda några olika tekniker...	I arbetet kan eleven använda några olika tekniker, verktyg och material på ett i **huvudsak fungerande** sätt för att skapa olika uttryck.	I arbetet kan eleven använda några olika tekniker, verktyg och material på ett **relativt väl fungerande och varierat** sätt för att skapa olika uttryck.	I arbetet kan eleven använda några olika tekniker, verktyg och material på ett **väl fungerande, varierat och idérikt** sätt för att skapa olika uttryck.	
1 - Dessutom kombinerar eleven några olika bildelement...	Dessutom kombinerar eleven några olika bildelement på ett i **huvudsak** fungerande sätt.	Dessutom kombinerar eleven några olika bildelement på ett **relativt väl** fungerande sätt.	Dessutom kombinerar eleven några olika bildelement på ett **väl** fungerande sätt.	

Figure 11. Assessment criteria

4.1.2 User interaction

In the next step, I did an observation where I could see the user actually going through some of the scenarios mentioned in section 4.1.1. I identified the following things that I considered important to note during the empathize session.

a) The users try to discover the system's functionality by "clicking around". I noticed that when the user wants to do a certain action (for example checking the materials for a mathematics class), it does not necessarily happen directly. The user feels comfortable quickly clicking different pages and choosing the right page by eliminating the wrong ones.

This pattern happens even when the user knows from the previous experiences where to find certain pages. I could therefore note that the user follows their own instincts rather than the text descriptions that are written on the links, buttons, tabs etc. Consequently, the descriptive text can have a secondary role in the system's usability and the natural mapping can have the primary role.

b) The users do not show a lot of interest to stay very long in the system. They have a task and they try to perform it without paying much attention to other things in the system. In other words, they do not show curiosity to investigate and discover new pages, new announcements, messages, uploaded materials and so on. It feels like they only do what they have to do. In this case it can be advantageous to record what pages or functionalities that are not visited at all

c)The user frequently uses a certain set of functions or steps. I could note that one user navigated in the system by using the navigation side bar while another user navigated through the start page. For example, if there is an assignment to do, the user can find the assignment through the navigation sidebar, where the list of all the classes presented. By clicking on the certain class, the user finds the related assignments. But this is also possible to realize by clicking on the planning tool on the start page. However, each user uses their own set of steps and navigation techniques. This can be important to consider for the designer to develop a multidimensional perspective.

4.1.3 Development

After I gained the empathy for the user and gathered the insights of the user-system interactions, the next step was to understand how the developers do their job and what they consider important in the development of a learning management system to create good prerequisites for learning. The development and the support team of the company participated in the interviews, which were recorded and transcribed. Thereafter, I applied a thematic analysis approach to identify the codes and the thoughts of the participants. Finally, I sorted them into themes by meaning and relationships. The results are separately presented for the development team in Figures 12, Figure 13 and for the support team in Figure 14.

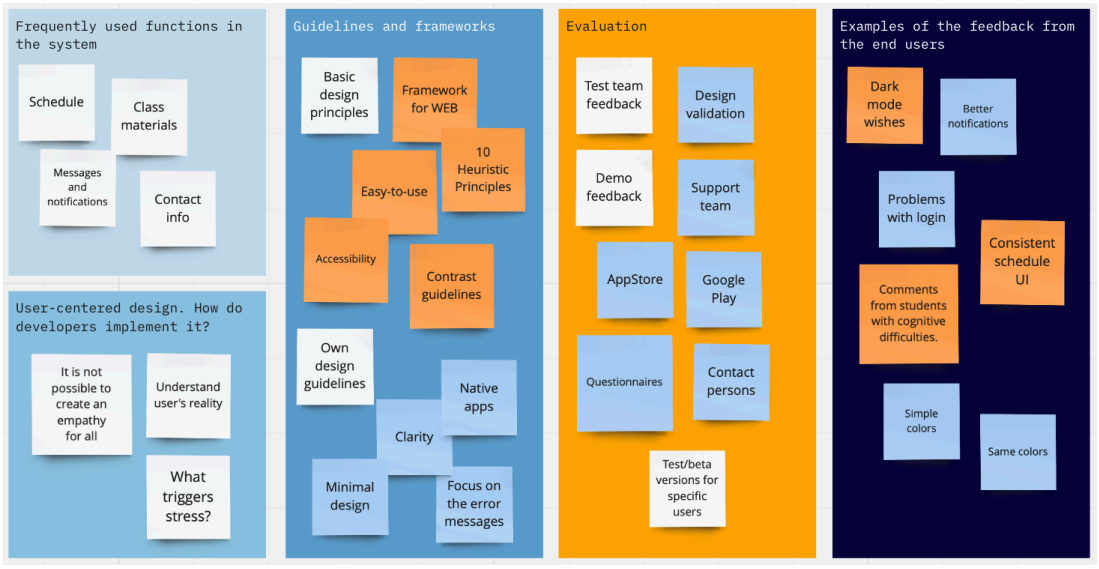


Figure 12. Development and evaluation processes of the system

As shown in Figure 12, there are five themes with different codes from the data that was collected from the development team. The themes are: 1) frequently used functions of the users in the system according to the developers, 2) some key points of the implementation of user-centered design, in this case particular emphasis on the learning aspects and the learner, 3) guidelines and the frameworks that are used by company, 4) description of the evaluation processes of the system and some key points, 5) examples of the from the end user. The results are broad and scattered but they will be narrowed down in the define stage.

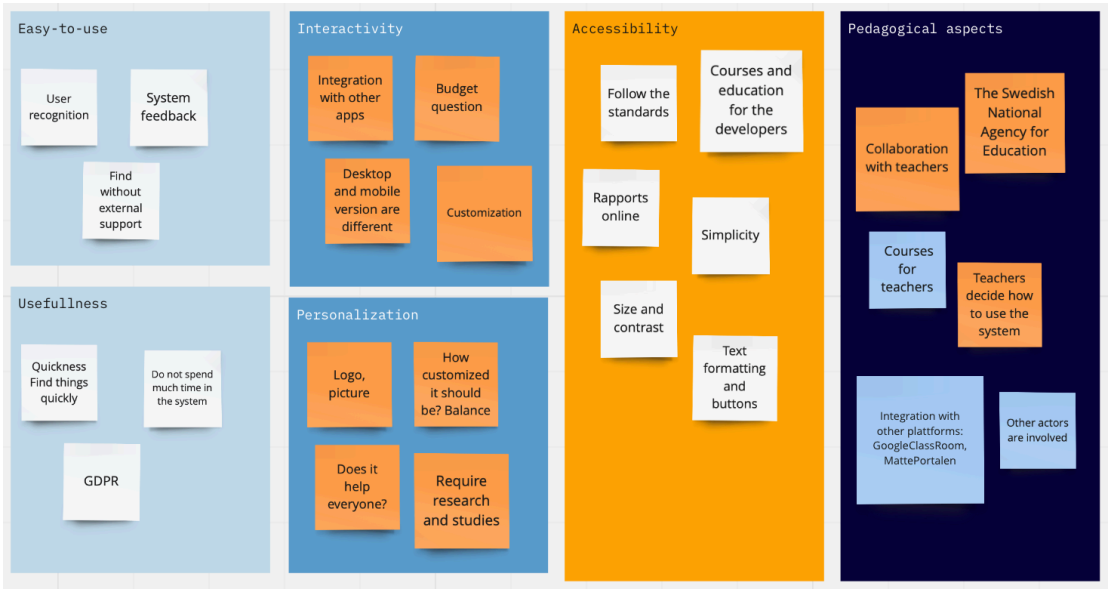


Figure 13. UX design principles of the system

During the interviews with the development team I could identify six additional themes (Figure 13) that refer to design principles of LMS. These are the developers' own premises, starting points and requirements that are being used in the development of the system: 1) ease of use or how to ease the use of the system for the learner, 2) usefulness or what is important to consider in the development of learning management system, 3) interactivity, 4) personalization or how to increase user satisfaction, 5) accessibility or how the company consider these aspects in their design, 6)pedagogical design aspects, also is a context theme where the developers described how they design the system that facilitate learning. The data that was gathered in these sessions will be used in the definition and the ideation phases that follow after the empathize phase.

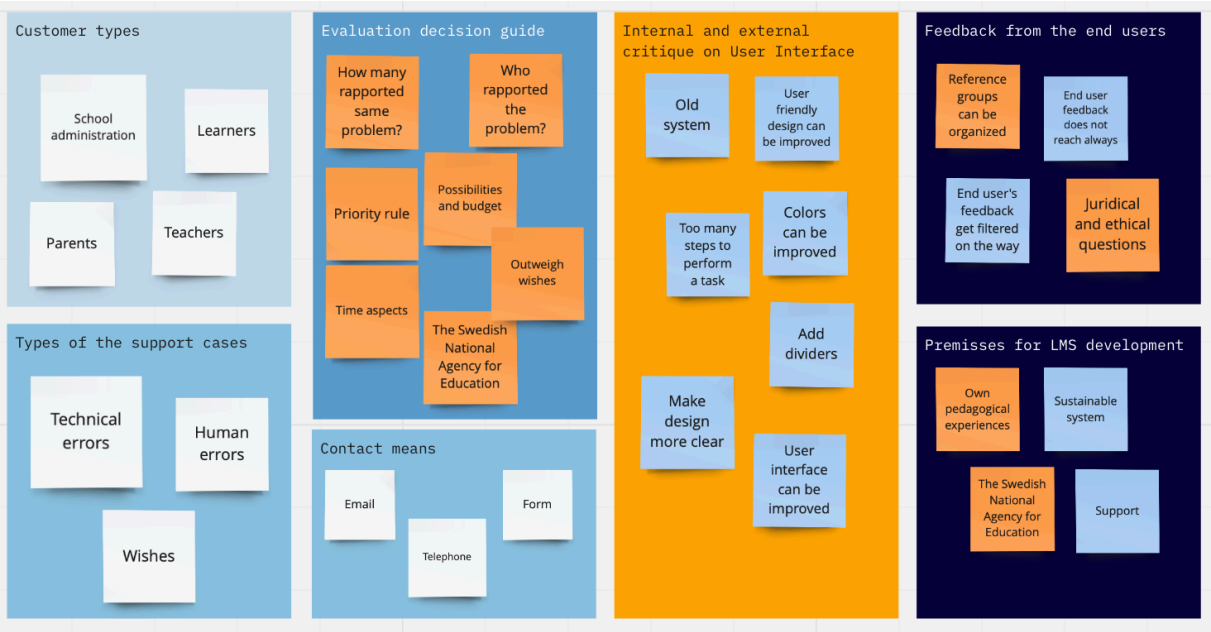


Figure 14. Support and evaluation of the system

I could identify seven themes (Figure 14) through the interview with the support team: 1)types of the customers that contact support, 2) types of the support cases that come into the support desk, 3) decision guide or how the developers prioritize and sort the support cases, 4) contact means, 5)internal and external critique on the User Interface, 5) the issues and possibilities of the feedback from the end user, 6) development premises of the learning management system according to the support team. Likewise, these themes need to be narrowed down in the define phase.

4.2 Define

The define phase encourages the design thinker to narrow down the challenges and the insights from the data that is gathered in the empathize phase about the user and the context (Stanford, 2010). The problem statement and the clear point of view should be presented at this stage through synthesizing the connections and patterns of the collected data (Stanford, 2010). Therefore, I divided the define stage into 3 steps: 1) creating the personas, 2) defining a limited set of user's needs that has to be fulfilled and 3) creating a set of insights from the context, in this case the learning context. Finally, I articulated the point-of-view as an applicable problem statement.

4.2.1 Personas

The personas that were created are presented below in the Figures 15, 16 and 17.

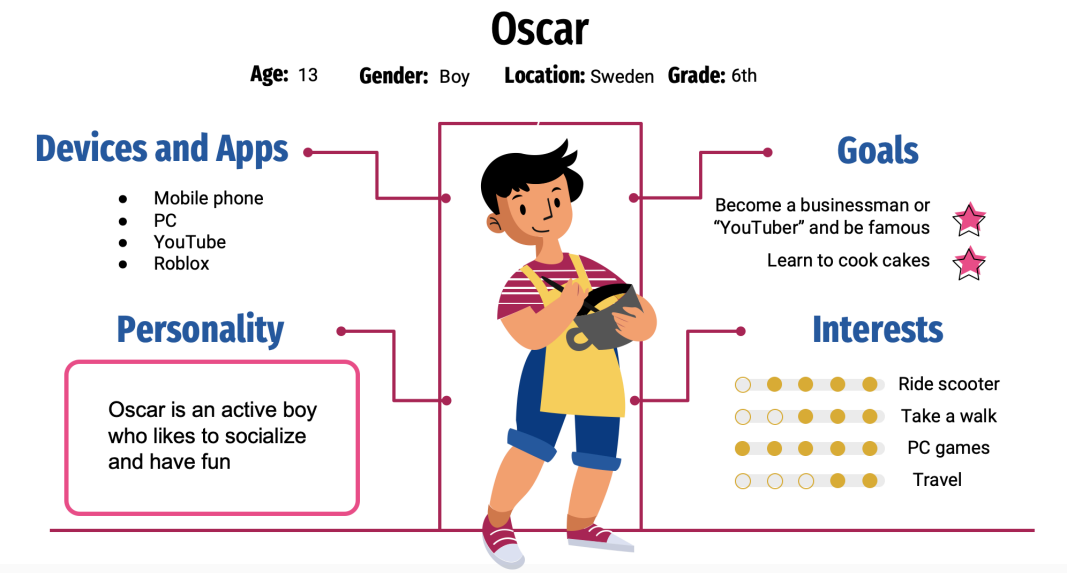


Figure 15. Persona 1

The first User Persona is Oscar. He is a 13 years old boy that goes to the 6th grade. He was born in Sweden and he went to the same school for 6 years. He has a lot of friends in the class, probably because he is social and creative. He and his friends use to play football during the school breaks. Oscar is an active kid that prefers physical education classes rather than mathematics classes. He is very verbal and has difficulties writing long texts. Therefore,

he prefers to write his school work on the computer instead of paper. He is very intuitive and quick while using technological devices.

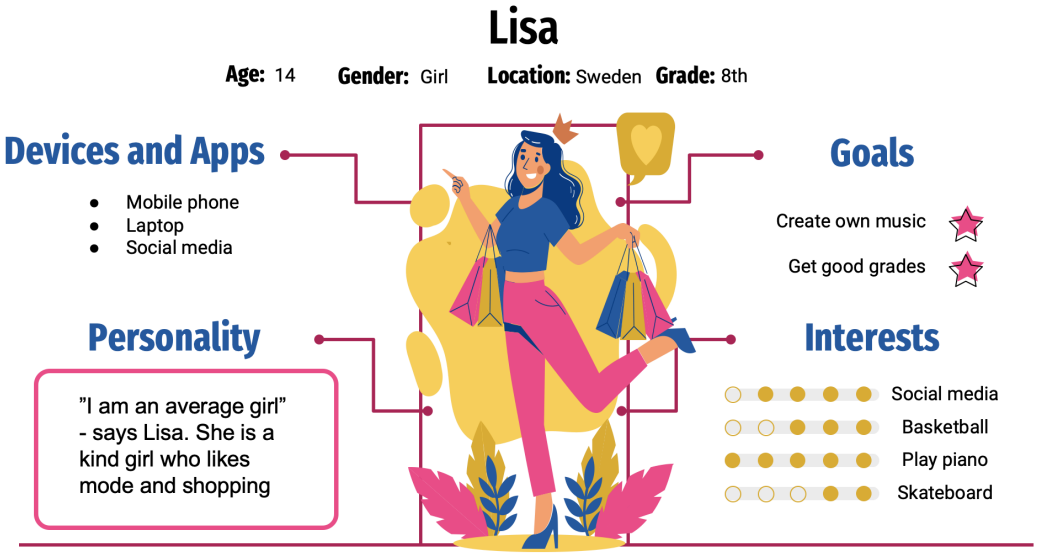


Figure 16. Persona 2

The second User Persona is Lisa. She was born in Sweden but her mother comes from Spain. Therefore, her mother tongue is Spanish. She is a social girl who likes to chat with her friends online, share with them pictures, videos and memes. Lisa likes to wear nice clothes and accessories because she is interested in fashion and actual trends. She follows many celebrities on social media and often discusses their pictures with her friends. Lisa also likes all kinds of music and wants to master the piano in the future. She describes herself as an "average" girl who wants to finish school with good grades. Lisa likes web surfing and therefore is very good with finding things online.

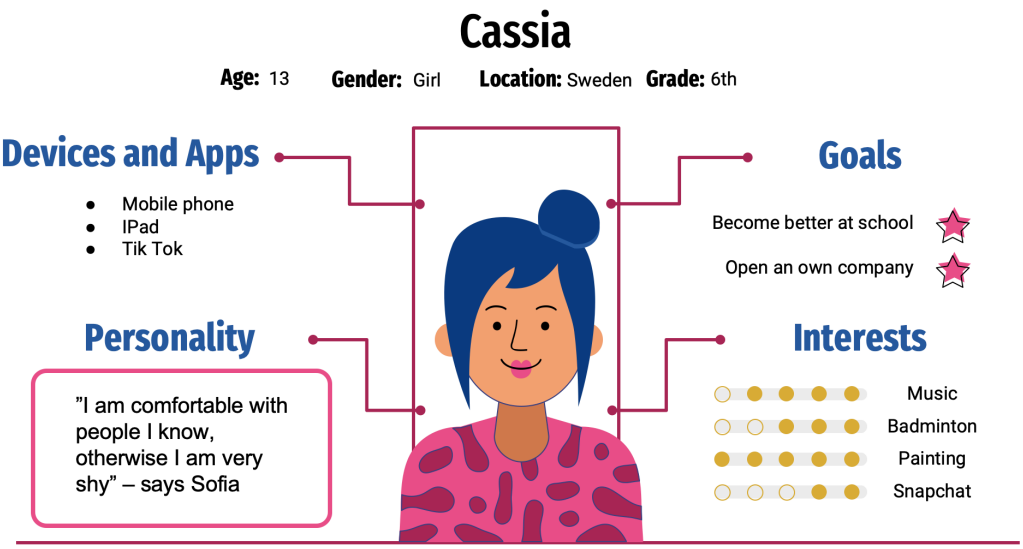


Figure 17. Persona 3

Cassia is the third User Persona. She came to Sweden from Greece 3 years ago. Cassia had difficulties finding many friends at school, but she has one good fiend from another class. She considers herself as a shy person who is not very comfortable with people she doesn't know. She prefers to read books and do her homework during the school breaks. Also, she paints and draws a lot at home. Cassia is not very comfortable with the school computer because she thinks there is too much information on the screen that she needs to translate.

4.2.2 Technological and pedagogical aspects

After going through the collected data from the observations of the users and interviews with the developers I created a list of user needs. The list that represents the user needs for the UI development is shown in Figure 18.

Figure 18. User's needs

Then I created a set of the important context aspects, the premises that should be considered in the development of the LMS. The main goal in the development process of an LMS is to create better prerequisites for learning. For that reason, I identified and created a set of essential pedagogical aspects that need to be included in the design, see Figure 19.

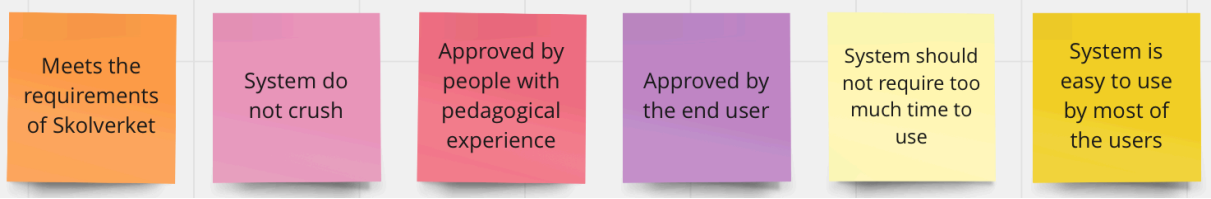


Figure 19. Pedagogical premises of the development

4.2.3 Problem statement

To identify the concrete and concise problem statement I started with writing down the main problems that I could catch during the observations and interviews. They are presented in Figure 20.

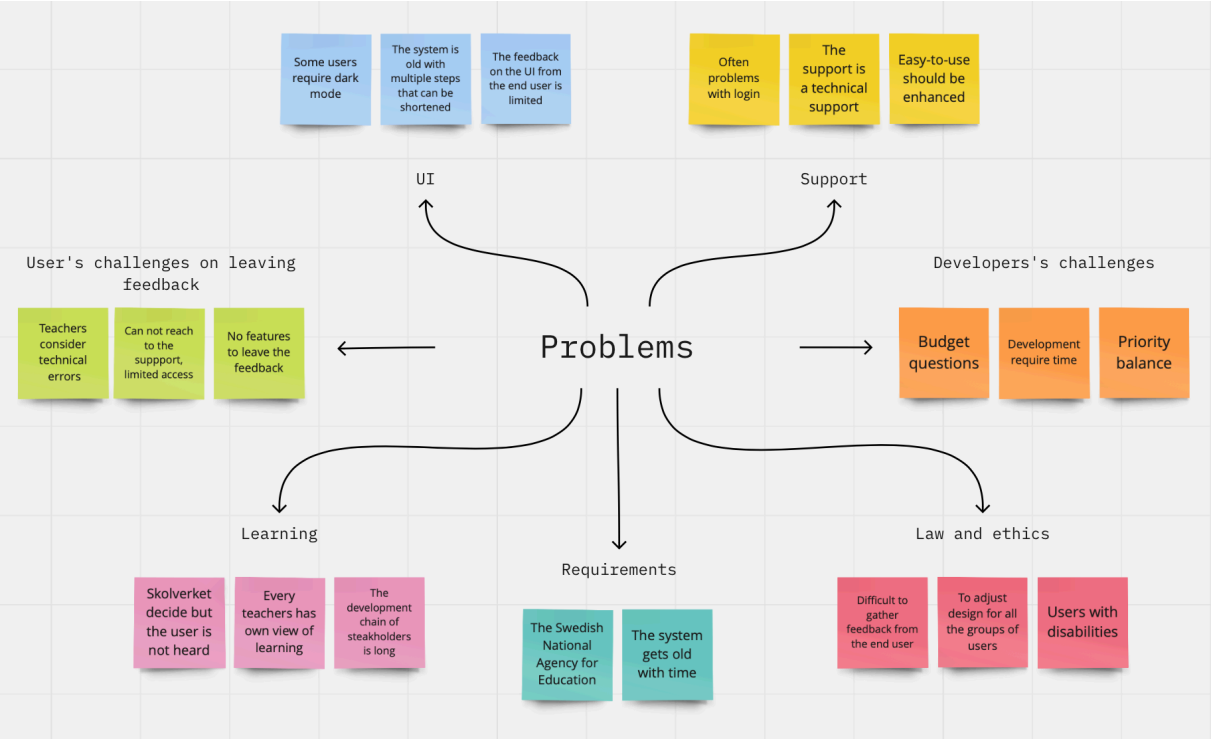


Figure 20. Identified problems from the interviews and observation

There are different groups of problems: UI related issues, challenges of the support and development teams, law and ethical considerations that are very important to consider, requirements from the customers and officials, problems connected to the learning processes and challenges that users can face when they want to leave their feedback. I tried to combine all these problems and could state three main problem definitions.

1. The balance between the wishes and the possibilities. How can the system or parts of the system be developed with high quality and user approval and at the same time cost less and take less time?
2. Customer versus user. How should the development team work towards user satisfaction, gather users' feedback and also meet all the ethical requirements and requirements that are presented by the customer and the Swedish National Agency for Education?
3. Feedback chain. According to the collected data from the developers the feedback from the end user can involve the following chain links (persons): learner, parent, teacher, administrator, supporter, developer, product owner. How can the feedback chain be shortened to gather more valuable feedback from the user that can otherwise be lost in the long chain of the participants?

With these three problem statements, I proceeded to the next phase, which is to ideate.

4.3 Ideate

The ideate phase is a solution generator where the problem statement and the user that was studied in the previous stages are in focus (Stanford, 2010). According to Stanford, 2010 the designers should generate as many solutions as possible without thinking about finding one best solution, because the best solution will be discovered later, during the testing phase. To ideate also means to uncover the unexpectable, step beyond the obvious, create flexibility and variety in the options, be open minded and objective (Stanford, 2010).

Since I am designing a feedback feature for an existing LMS, the main functionality is input from the user. There are two types of UI components, inputs and outputs. The outputs are what the user reads on the screen or hears with audio outputs: texts, videos, audios, multimedia etc. The inputs are what the user sends to the system. It can be text inputs, audio

recordings, pictures and so on. The feedback feature is more like an input from the user that is being sent to the system for further processes.

4.3.1 Input components

The system always contains the outputs and in most of the cases the inputs. They are like small building blocks. Together they create a system, and a good designer knows where to put the inputs and where to place the outputs. I started my ideating process by designing different possible inputs. I chose to design small UI components first and then put them together. Since I have previous experience of UI development with a programming language JavaScript and React, I used the React library that is called Material UI where I could use the standard inputs and customize them according to my context. The list of the customized input components that I decided to use in the design are presented in the Figure 21 below.

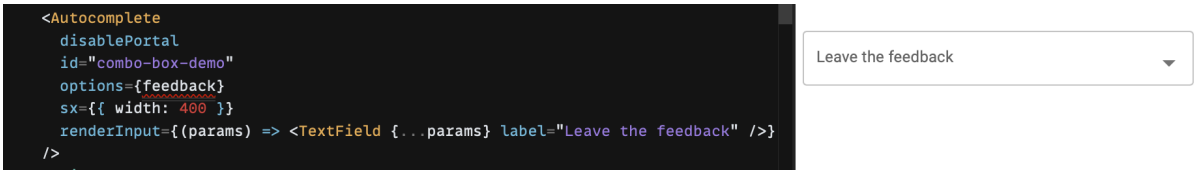


Figure 21. Auto Complete component

Auto Complete component (Figure 21) is a dropdown menu, where the user chooses prewritten options. The chosen option is being saved and sent to the system.

Figure 22. Button component

All the buttons (Figure 22) are also part of the inputs. A button can have the confirmation or save purpose.

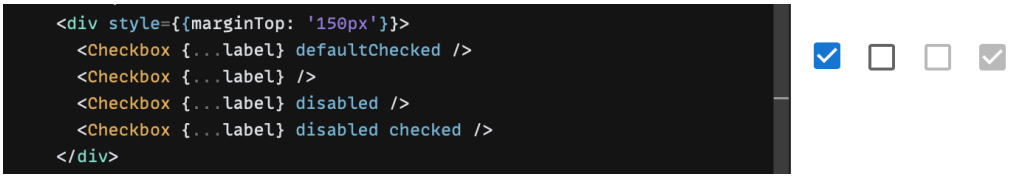


Figure 23. Checkboxes

Checkboxes (Figure 23) can also be also used to pick an option or selected item.

```
<FormControl style={{marginTop: '160px', padding: '20px'}}>
  <FormLabel id="demo-radio-buttons-group-label">Was it easy to use?</FormLabel>
  <RadioGroup
    aria-labelledby="demo-radio-buttons-group-label"
    defaultValue="female"
    name="radio-buttons-group"
  >
    <FormControlLabel value="easy" control={<Radio />} label="Easy" />
    <FormControlLabel value="ok" control={<Radio />} label="Ok" />
    <FormControlLabel value="difficult" control={<Radio />} label="Difficult" />
```

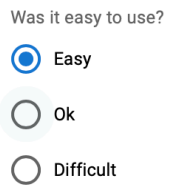


Figure 24. Radio buttons

The radio button component (Figure 24) has the same function as the checkboxes. Radio buttons are intended to be used to choose between different options.

```
<div>
  <TextField
    id="filled-multiline-flexible"
    label="Feedback"
    multiline
    maxRows={4}
    value={value}
    onChange={handleChange}
    variant="filled"
  />
```

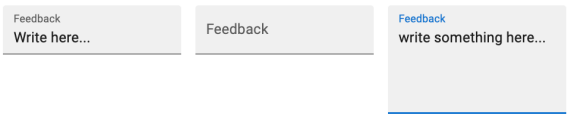


Figure 25. Text Field

The Text Field component (Figure 25) is a very powerful one because it can either be filled with default values, editable values or the users can write their own values in it. Inputs in the form of text is one of the most used components to gather the data from the user.

```
<Typography component="legend">Are you satisfied with the schedule?</Typography>
<StyledRating
  name="customized-color"
  defaultValue={2}
  getLabelText={(value: number) => `${value} Heart${value !== 1 ? 's' : ''}`}
  precision={0.5}
  icon={<FavoriteIcon fontSize="inherit" />}
  emptyIcon={<FavoriteBorderIcon fontSize="inherit" />}
/>
<Typography component="legend">Can you rate the design?</Typography>
<Rating name="customized-10" defaultValue={2} max={5} />
<Typography component="legend">What do you think about the calendar?</Typography>
<Rating
name="highlight-selected-only"
defaultValue={4}
IconContainerComponent={IconContainer}
highlightSelectedOnly
/>
```

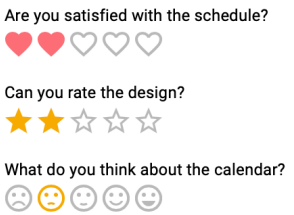


Figure 26. Rating

The rating component (Figure 26) can be very powerful in the design of a feedback feature, because it is being used by many other applications and systems. The user will probably recognize the format and follow it intuitively, which can be very advantageous.

4.3.2 Elements to assess

Now when I had some building blocks to work with I started to design the whole evaluation feature with all the functionalities in it. Firstly, I made a list of possible critiques from the user, the data that is valuable for the developers to have. There can be positive comments as well as negative ones. For that I had to go through the data I collected and also the literature review, to narrow down the important design elements of the LMS and convert them to user narratives. These essential design elements that were mentioned earlier in this study (section 2.1) require feedback from the end user for enhancement and evaluation of the whole system. I pointed out 14 aspects that could be assessed:

- User experience
- User interface
- Usability
- Personalization
- Easy-to-use
- Accessibility
- Usefulness
- Satisfaction
- Interactivity
- Self-regulation
- Simplicity
- Clearness
- Sustainability
- Integration

4.3.3 Concept ideas

After creating some building blocks (UI components) and identifying potential content (elements to assess), I had to go back to the define phase and recall the distinguished problem statements. There are three problems that I have to try to solve with my design: 1) build a feedback feature that is good but at the same time does not require a lot of resources, 2) find a balance between the customers' and users' expectations, and 3) reduce the data flow chain so that the valuable data reaches the final destination. Subsequently, I sketched a few design suggestions that I could develop further in the prototyping phase.

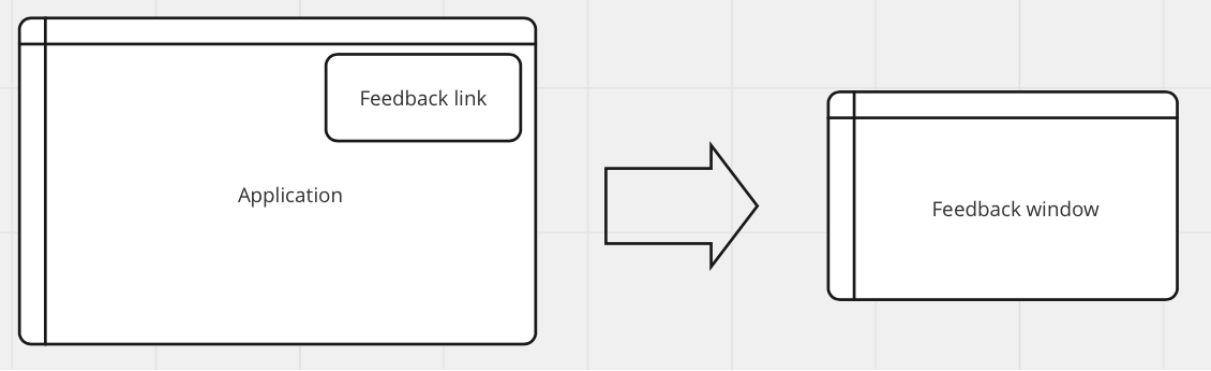


Figure 27. Solution 1

The first suggestion (Figure 27) shows how the user can navigate to the feedback feature is about the direct link from the start page. A new window will open where the user can type or select the inputs.

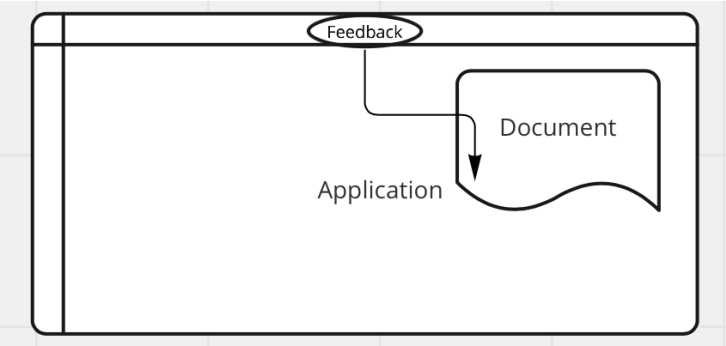


Figure 28. Solution 2

The second suggestion (Figure 28) is about the component inside the start page. The user will not be redirected to another page but leave the feedback in the subcomponent, a little window or drop-down menu, which can be easily exited.

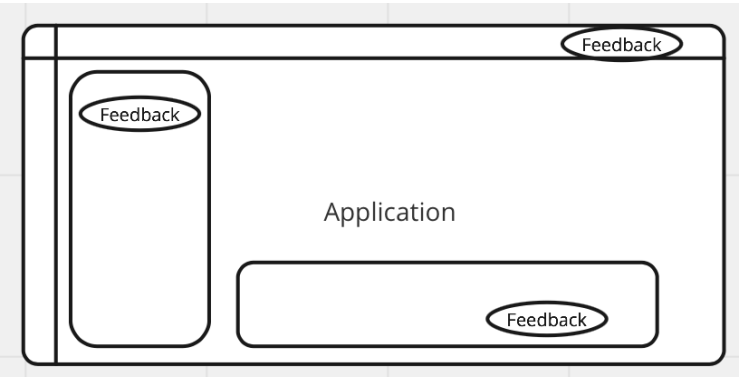


Figure 29. Solution 3

The third suggestion (Figure 29) offers the user to leave the feedback on each little component in the system. In this case the feedback feature is spited through the application. Now when I had a few ideas to work with, I proceeded to the prototyping phase where I expanded the design ideas and presented the advantages and disadvantages of the solutions.

4.4 Prototype

I decided to prototype all three design suggestions from the ideate phase and then decide which one was the best during the testing phase. The feedback feature that I designed had to be well integrated to the existing platform, which was web based. For that reason, I had to begin with designing a starting point, where the user could access the feedback feature that was being designed. The first suggestion that is shown in Figure 27 accessed the feature through a link, which was placed on the start page of the platform. The link was in a button format (Figure 30).

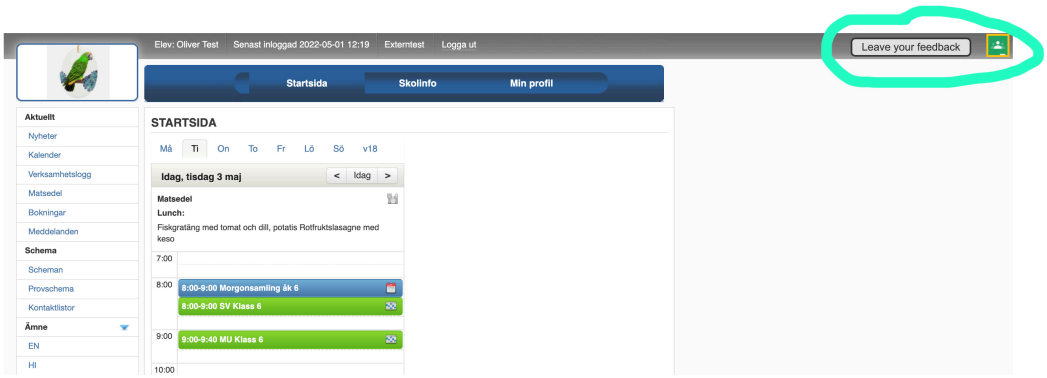


Figure 30. Start page of the platform

Once the user clicked the button the application redirected the user to the feedback page (Figure 31)

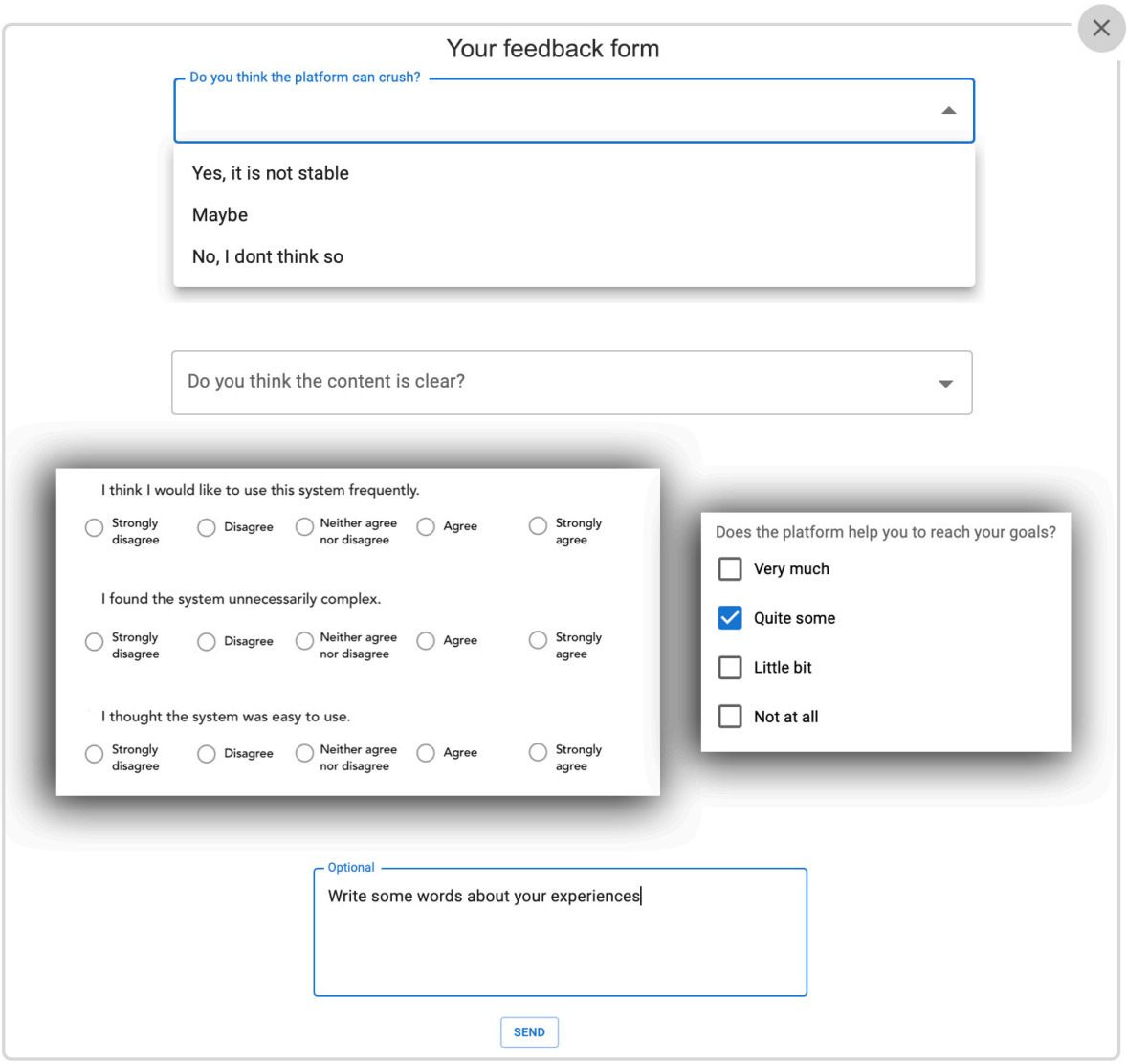


Figure 31. Feedback page 1

The biggest advantage with this solution is that the new window can gather a lot of feedback because it is specious and can contain a wide range of inputs and outputs. However, it can also have negative effects, like low participation scale. The user can regard the feedback feature as too large and difficult. Another solution that can be perceived as less extensive is presented in Figure 32. The user presses the same type of button as is shown in Figure 30 to be redirected to the feedback feature.

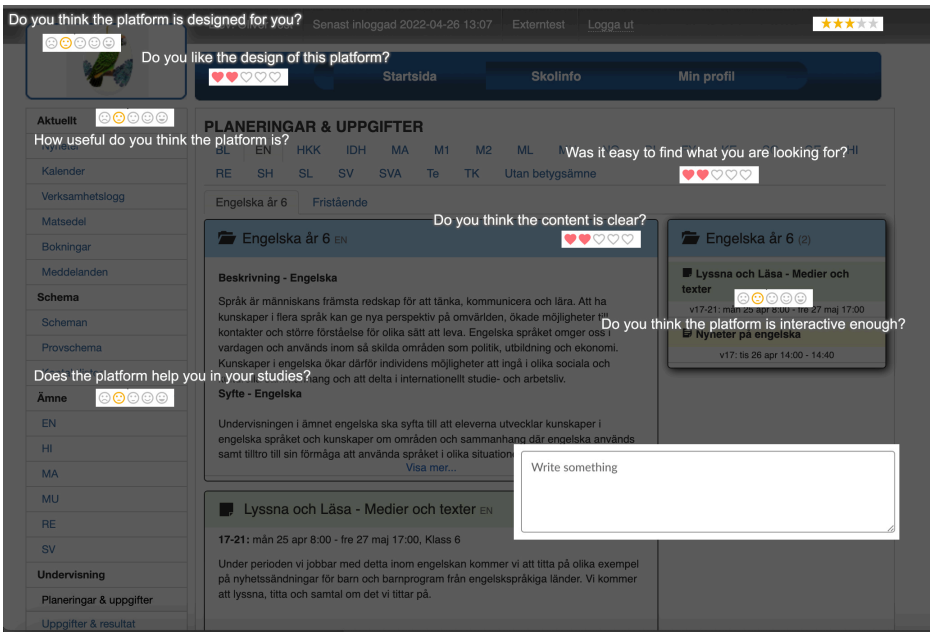


Figure 32. Feedback page 2

The main screen is shaded but only to the point that it is still visible, in order to visually present the feedback questions to the user. When the user leaves one rating it disappears from the screen and another one comes up in a different place. The number of questions on the screen are limited to 5-7 at a time. The advantage with this design is that it is more interactive and fun because the questions are moving around the screen which creates a feeling of a game. The disadvantages are that the questions can be difficult to read and the user may just leave the rating feedback without even understanding a question (Virvou & Katsionis, 2008).

The third design suggestion is similar to the first one but more compressed. When the user presses the “leave feedback” button the dropdown menu appears in the main window as shown in Figure 33. The zoomed version of the dropdown menu as shown in Figure 34.

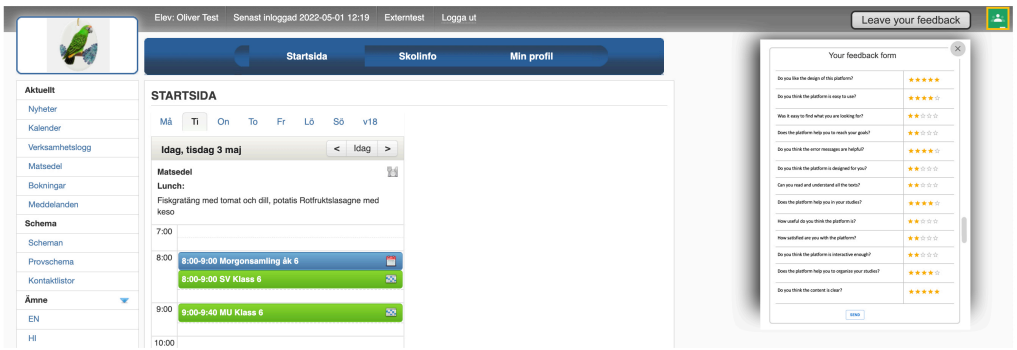


Figure 33. Start page with dropdown menu

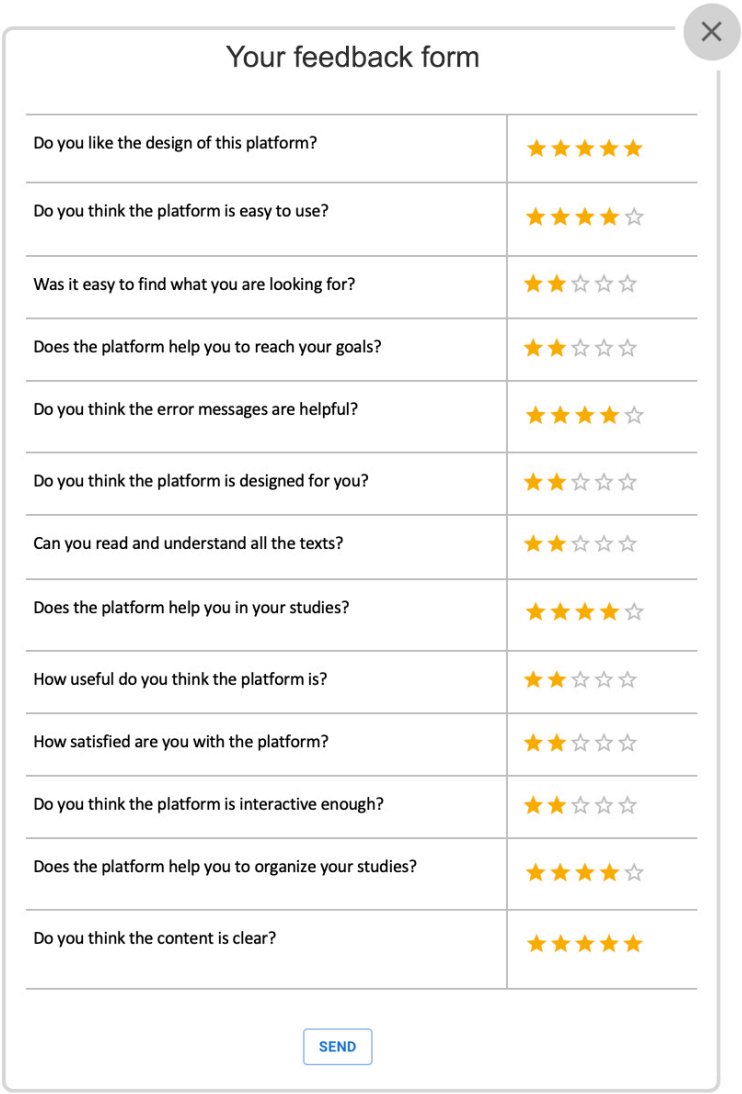


Figure 34. Zoomed dropdown menu.

The advantages of this solution are that the feature is very simple and clear, it does not take much time to fill in and the user can exit from the window with just one click on the main page. Also, the feature is built to only accept ratings from 1 to 5 and the developers can analyze very big amounts of data in a short time using quantitative data analysis techniques. The disadvantages are that the user cannot leave free text feedback, which may cause a limited or one-sided evaluation (Norman, 2013). In other words, in this case it is the developers who decide what is being evaluated. These three design suggestions require testing and further consideration which will be described in the next section.

4.5 Test

For testing, Norman (2013) suggests gathering a small group of people for whom the product is intended and let them use the prototype in a way they would actually use it. Observation in person should be done behind the user to minimize distraction or through video recording (Norman, 2013). I chose to observe the user from the side because I also needed to assist the user and give the instructions while the user was interacting with the prototype. The main intention of the prototype testing was to find the best solution out of possible three and then evaluate this solution to suggest the enhancements.

I started the testing by explaining to the user the purposes of the designed feature and the reasons why we were testing it at this point. Then I presented the first solution and let the user explore it, followed by the second and finally the third one. To make the users focus more on the design and functionality of the feature I tried to guide them a little bit by explaining that the aim was not for them to answer the presented questions, but to choose the most likable, simple and functional of the three solutions. They had to rank the solutions and choose the best, second best and the least good one. The results from the test with the three users are shown in Table 1 below.

	User 1	User 2	User 3	Results
Solution 1	1	1	3	5
Solution 2	2	2	1	5
Solution 3	3	3	2	8

Table 1. Results of the solution rating

The third solution gathered eight points and the other two solutions gathered five points each. After the rating activity I asked the users to motivate their choices. The first user said that the third solution looked simple and was easy to answer, the second was fun and the first one looked complicated. The second user had difficulties choosing which was the best of the second and third solution. According to this user, the third solution was nice but lacked free text feedback, which was the feature the user liked in the second solution. The third solution was considered as difficult to comprehend by the second user. The last user rated the first

solution as the best one because it had “many buttons” and the free text input option. The average rating went to the last solution and only one point for the second solution from the third user.

The testing phase has several purposes: refine the solution, gain more empathy for the user and to evaluate the problem, in other words check if the problem was properly framed (Stanford, 2010). To refine the solution, I used the users’ comments as a starting point. They all mentioned that they would like to write some text in their feedback, but the solution that gained the most points did not have this functionality. Therefore, I added the text field component to the design of this solution, see Figure 35 and Figure 36.

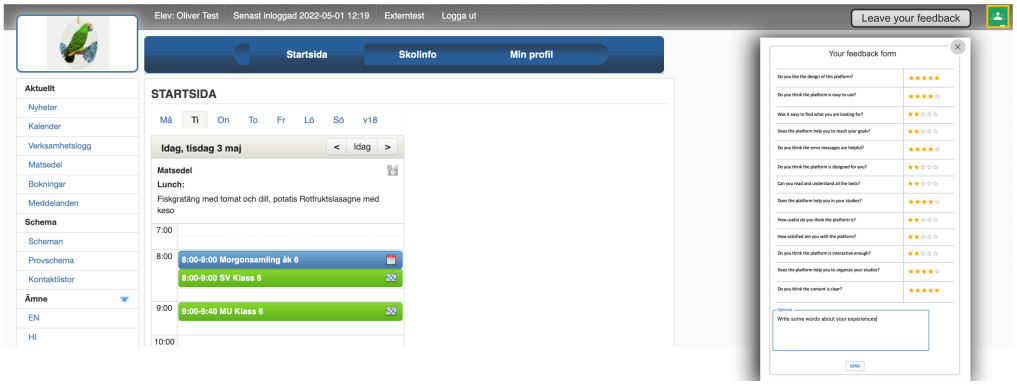


Figure 35. Enhanced solution 3

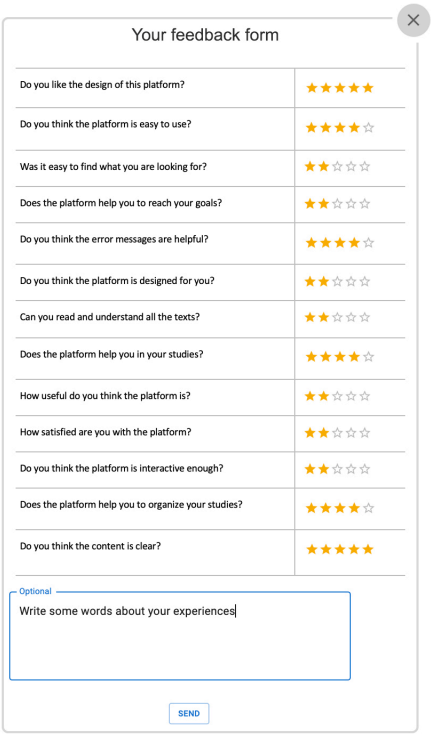


Figure 36. Zoomed enhanced solution 3

During the test phase I also had another opportunity to gain further empathy for the user. Since the prototype was not fully developed I was expecting some difficulties during the test. However, the users showed me how intuitive and skilled they were in perceiving the limited technological feature. I also looked at the problem statements from the defining phase and could note that the cheapest solution actually got the most votes from the users, which was a positive thing for the budget issues. A balance between the customers' requirements and users' needs could be found but it requires further investigation, since the test was limited to a very small number of users. Finally, the feedback chain from the end users to the developers could easily be shortened and the feedback data could be stored and presented in a well-structured way. However, other improvements and further development are needed for that.

5. Discussion

In this section I will discuss some important issues that are related to the research questions and make some professional judgments that could contribute to further development of LMS. I will discuss three main areas: development premises, design elements of LMS and the design procedure.

5.2.1 Development premises

During the interviews, both the design team and support team pointed out that the company's own pedagogical experience is useful for the design and developing processes. Some of the developers had earlier work experiences as teachers while others had some kind of educational background. The system where the end-user is a learner requires as much knowledge as possible about the important pedagogical aspects. Jeong (2016) and Lwoga (2014) emphasize the importance of identifying user characteristics and analyzing the learner's intentions. Nevertheless, recognizing the conditions around the system is also very important (Ahmad et al., 2021). To have a developer with a teacher background is very advantageous in many ways. A teacher has pedagogical education and experience that can help the development team to both empathize with a learner and gain deeper understanding of the context. People with different pedagogical backgrounds can contribute with their expertise to the system by accentuating on the substantial need of the learner.

Another critical premise that empowers the development of LMS is feedback from the end-user. The effects of the end-user's feedback are crucial in the development processes and especially in the evaluation phase since this is the only way for the developers to know that the actual needs of the users are met (Kumar & Owston, 2016 ; Thoring & Müller, 2011). However, gathering feedback, analyzing it, making sense of and using the accumulated data is not an easy task. There is a quite long list of different challenges that developers may face. First of all, if the system is developed for children, the gathering of user feedback can be an ethical issue, according to the support team of the company. It means that a pre-study should be done and all the ethical considerations and the informed consent should be up-to-date, since the rules and requirements for it may change with time. Another challenge is that

leaving the feedback takes time. If the feedback feature is an optional thing to do, most likely most of the participants will skip this step. The design team mentioned that the system is designed in a way that enhances usability by decreasing the time of the usage. It means that the user should spend less time on the platform. The observations that I made during the project could confirm that the users have a goal when they enter the system. It can be downloading an assignment, checking the schedule or submitting some work. The user in most of the cases does not use the platform just to explore it. Therefore, pulling the feedback from the users and encouraging them to participate can be problematic. Another challenge that I would like to mention is that the feedback is not easy to analyze. The quantitative data can be redundant and the qualitative data can be too complex, especially if it is gathered from children. However, Kumar and Owston (2016) argue that automated evaluation techniques are not very effective to identify all the problems that users may face during the usage of LMS. The evaluation of the prototype showed that the users did not prefer the automated technique either. Gathering and analyzing user's feedback may require finding a balance between automated evaluation with quantitative data and more expanded input possibilities with qualitative data.

The developers strictly follow the recommendations that are issued by the Swedish National Agency for Education. From one point of view it is beneficial to have a centralized system that gathers all the prerequisites, needs and technical specifications for the development of the LMS. It saves money, resources and makes the system recognizable by the user. If there are other learning applications that follow the same standards, natural mapping can be actualized, which enhances user-centered design (Norman, 2013). But from another point of view the flexibility lessens with all the conditions that come from a third part. The ambitions and the inspirations of the developers that may lead to the innovative thinking (Dam & Siang, 2018) could be halted by the given limitations.

5.2.2 Designing LMS

I found it challenging but interesting to comprehend the connection between UX and UI, the design elements of technological approach. These two different but closely linked terms were important to implement in the design, according to Phongphaew and Jiamsanguanwong

(2017). The designer should think about both perspectives, what the user sees on the screen and how the user perceives what is visible. The users gave positive feedback on the design that was not over complicated, even their solution rating could confirm that the simple design increases user satisfaction (Van Der Linden et al., 2019).

Virvou and Katsionis (2008) mentioned that good design helps the user complete the task quickly and effectively, this is a role of the usability in the system. I suppose this was the main reason why the third solution was preferred by the users. Because the usability of this particular prototype was well thought out, as well as ease-of-use. I also tried to adopt the personalized content, shaping the component differently: emojis, hearts and stars (Figure 26 and Figure 32). However, the users did not really mind if the component had more personalized content, the ease-of-use and usability played more important roles in this particular case. Therefore, the statement that personalized content enriches user satisfaction by attracting the user (Motiwalla, 2007) should be considered together with ease-of-use (Sørum, 2017).

Without meeting the requirement of the context even technically the best possible solution will never be successful. The pedagogical design elements have to be included and considered strongly during the whole process. Therefore, I emphasized characteristics of the learner (Jeong, 2016) during the ideation phase. The personas helped me to design for children of a certain age, experience and perception awareness and the result of the test showed that the users didn't have any problems at all using the feature. Although, it could be different with another group of users that do not have previous experiences of using LMS. The mapping of learner aspects (Jeong, 2016) and applying them in the design may exclude some users. Therefore, I assume that the list of user characteristics should be created with precautions.

Another interesting finding that I would like to discuss is the interactivity. The second solution was intended to catch the user's attention by being interactive. However, the users did not appreciate this solution so much, they simply did not show much of the spatial presence (Rodríguez Ardura & Meseguer Artola, 2016). Probably, the second prototype had too much focus on the interactivity and compromised other important elements such as usability, personalization and usefulness. I could note that it is not an easy task to design and

develop an LMS that is interactive and at the same time easy to use. The interactivity is a complex design element that requires a lot of resources and competencies.

5.2.3 Design procedure

The interviews with the developers helped me to stay focused as a designer. I had a list of requirements in mind and I thought that implementing all of them in an advanced way should be the right thing to do. However, I noticed that the developers try to find the balance between what is required and what is feasible. The ambitions of the projects can be very high but the resources tend to be limited (Thoring and Müller, 2011). Therefore, every design element should be considered, but how much of it should be implemented is up to the developers to decide. There is a tight relationship between design elements and considering one may favor another. For example, usefulness (Van Der Linden et al., 2019), ease-of-use (Virvou & Katsionis, 2008; Revythi & Tselios, 2019), usability (Jakobs et al., 2017) and personalization (Bakki et al., 2015) work together towards user satisfaction.

According to Lwoga (2014), it is important during the evaluation phase to analyze and measure user's intentions to use the system. I could identify few aspects that affect user's behavioral intention (Demissie & Rorissa, 2015; Altalhi, 2020; Zardari et al., 2021) and they were related to the group of different contexts that were presented by Park (2009), such as individual, system, organization and social context. During the testing phase, the user showed willingness to actually use the feedback feature in real context, there was no personal barrier or system interruptions that could negatively affect users' behavioral intentions. However, the social context was dominated over the personal context because of the circumstances of the testing environment. Therefore, I assume that emphasizing social and organizational contexts may increase behavioral intention (Park, 2009), for example an encouragement from the school administration to use the feedback feature.

Evaluating the system by using different models (Al-Fraihat et al., 2020) can definitely enhance the design and create better prerequisites for learning, but to implement the models in a real testing environment can be too expensive (Leino and Heimonen, n.d.). I believe that the core functionality such as information quality, technical system quality and educational system quality (Al-Fraihat et al., 2020) should be fulfilled regardless. The developers confirmed also that the system shall not crash and the information should be clear and correct.

However, the pedagogical factors that were listed by Ireland et al. (2009) are often not up to the developer to fulfill. LMS are often just a frame with needed functionalities and the teacher designs learning processes themselves, according to the developers. I found some interesting nuances, while doing thematic analysis, that the teachers have different points of view. An experienced teacher who has good knowledge of the LMS could make better use of the pedagogical aspects of the system. Therefore, organizing courses for teachers, as the company is doing, is a good way to facilitate learning and carry out important functions of the LMS (Rerhaye et al., 2021).

6. Conclusion and recommendations

The first research question was the following: what are the premises that developers consider important in their user interface development of a learning management system to facilitate learning processes? During the project, I could identify three main premises for facilitating the end users' learning processes that developers consider important in their development of LMS: 1) their own pedagogical experience and previously gathered educational knowledge. 2) feedback gathered from end-users, teachers and test teams, 3) recommendations produced by educational authorities (e.g., Swedish National Agency for Education).

How can a feedback feature be designed to help developers to gather inputs from the end users of a learning management system? Both previous research and the data collection in the current project were used to answer this question. The important design elements that were presented in the literature review, both technological and pedagogical, can be implemented in the design of the feedback feature. Nevertheless, those elements are more like considerations that the designer can consider. The context, the particular user group, the situation around the system, the requirements from the educational authorities and the opinions of the developers influence the design as well.

This development project has designed an evaluation feature for an existing learning management system. The feature is intended to gather end users' feedback that can help the developers to evaluate the design and functionality of the platform. The evaluation of the system is an important phase that never really ends but works recursively while the system develops and upgrades. The feedback from the user is requested by the developers. The development of this feedback feature implemented Design Thinking methodology that involves perception of the context and the problem, developing and testing. This project suggested and presented the whole development process of the integrated feature in the existing LMS that could be used as an illustration for the designers or as an empirical case for the future research.

6.1 Development recommendations

A few things that were discovered during the project could serve as recommendations for developers of LMS. First of all, it was discovered that a designer can assume things about the user that do not necessarily match real life. Testing is a very good activity to eliminate false assumptions. However, before entering the prototyping phase the designers should interact, observe and gather more information about the user so that the evaluation activity does not force the developers to remake the prototype but enhance it instead.

The second significant discovery was made on the user experience. The observations on how the user perceives the system or the feature explored some complexity. Important design elements of LMS that were identified during the project are a little bit contradicting and therefore complicate the development. Therefore, I would recommend not strictly following all frameworks, guidelines or even requirements. The deeper analysis of the context and the user experience can actually dissuade the designer from following some rules. As Norman (2013) mentioned, the designer should not try to solve the given problem but discover the unknown. Furthermore, there are a lot of things that are unknown and unrecognized in the learning context. The user experience varies greatly from one context to another. For example, the users between 10-13 years old have different system perception than the users between 14-17 years old. The user experience and its context should be analyzed before the designer makes any assumptions or decisions on the UX design.

Finally, I would like to add to the recommendation that the evaluation of the system or parts of it should not be limited to yes-no questions. In other words, the designers should not be satisfied with the feedback from the users that gives only them liking or disliking. Surprisingly, the users can bring a lot of valuable data that could be used in the evaluation of the system. It requires more recourse to process qualitative data but the designer can definitely find a lot of benefits by accessing it. In this project the users had to rate three different prototypes and then they motivated their choices, which was very valuable. However, if there is only one system or one prototype, then the users should be able to

express their opinions in a more advanced way. This kind of feedback can enhance LMS and help the developers to create better prerequisites for learning (Thoring & Müller,2011).

6.2 Limitations and further development

This project included data collection from observations of the users and interviews with the developers of an LMS. The number of the users that participated in this project is small, only three. For future research and analysis observations should be done with more participants to create a more nuanced picture of the problem. Also, different groups of participants can be used. This project was limited to a group of children between twelve and fifteen years old. Other groups of users, such as learners in higher education or older children can probably accumulate different results. For that reason, further empirical studies are needed.

The design element that is responsible for the accessibility was difficult to test because I did not have the possibility to observe users with disabilities. However, I believe that the developers of LMS often face the same issue. Prewritten requirements such as WAI and WCAG are beneficial, but the actual testing should be implemented if possible.

Another limitation of this project is that the feedback feature that was designed is embedded in the existing learning platform. A suggestion for future development is to design an independent evaluation feature that collects users' feedback. Such a feature could be implemented in different learning applications by adding a link to the evaluation form. However, this kind of development requires more resources and deeper studies.

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Appendix A: Consent form for parents

Samtycke - föräldrar till barn i 13-15 års åldern

Samtycke till att låta mitt barn delta i projektet

Jag har fått muntlig information om studien och har haft möjlighet att ställa frågor.

- Jag samtycker till att låta mitt barn delta i projektet om ##FöretagsNamn## utvärdering

Plats och datum	Vårdnadshavares Underskrift
	Vårdnadshavares Namnförtydligande
Plats och datum	* Vårdnadshavares underskrift: _____ *Namnförtydligande: _____
Barnets namn	

* Vid delad vårdnad krävs samtliga vårdnadshavares medgivande

Appendix B: Interview guide for design team

Presentera sig, berättar om min uppsats, syfte, ethical considerations osv

Låt de andra presentera sig

Intervjufrågor:

Obs; inleda varje fråga med förklarande information vid behov

- Har ni några design principer eller ramverk som ni använder, kanske några riktlinjer?
- Hur utvärderar ni? Ni har designat nånting och sen implementerat, hur utvärderar ni det ni har designat?
- Skulle du kunna nämna ett par stycken kommentarer som användarna har sagt om user interface?
- User experience. Det händer väldig mycket ihop med UI som klart men om man fokuserar på deras upplevelser, de ska vara positiva, de ska ha positiva känslor när det använder systemet. Jag undrar hur ni tänker kring det?
- Vilka funktioner används mest av elever, bara elever?
- Plattformen ska gynna bättre läromiljö. Hur vet ni att den verkligen gör sitt jobb? Skapar den bättre förutsättningar för lärande?
- Hur tar nu fram de rekommendationer till pedagoger. Är det något som utvecklarna tar fram eller någon annan?
- Easy-to-Use. Hur vet man att implementerat plattform är lätt att använda? Finns den några särskilda tekniker att göra system lättare att använda?
- Usefullness. Man ska nå målet och målet är de ska lära sig snabbare, effektivare osv och den berättade ni tidigare om. Men hur skiljer eran plattform från andra plattformar?
- Men om man tänker på interaktivitet som kanske hänger ihop med UX. Har ni funderat något på det? Att något som är lite med interaktiv plattform?
- Om man tänker på User-centered-design eller Human-centered design i vårt fall är det Learner-centered-design. Om man har elever i fokus (här berättar jag om emphaty…) Hur försöker ni skapa empathy?
- Har det hänt nån gång att eleverna klagat på att vissa knappar sitter fel plats eller har konstig namngivning? Eller om det inte finns feedback från systemet vid viss tidpunkt?
- Personalization. Du nämnde att vissa vill ha annorlunda färg. Är det något bra att ha? Är det kostnadsfråga?
- Accessibility. Finns det några riktlinjer hos er hur man utvecklar plattformen för barn med funktionsnedsättningar?
- Varje person lär sig olika. Hur hittar ni den här balansen att utveckla samtidigt för alla och anpassa till olika grupper? (Förklarar vad jag menar)

Läroplan

- Så läroplaner rekommenderar om vad som ska med och vad som ska undvikas?
- Rekommenderar läroplanen hur man ska utveckla digitala läroplattformar?
- Utvärdering. Vi har pratat om det mycket. Men vill ni lägga till något? Kanske utvärdering av en funktion som är redan implementerat? Hur utvärderar man en plattform som är redan implementerat?

Runda av

Appendix C: Interview guide for support team

Presentera sig, berättar om min uppsats, syfte, ethical considerations osv
Låt de andra presentera sig
Intervjufrågor:
Obs; inleda varje fråga med förklarande information vid behov

- Kan du berätta lite hur funkar det med utvärderingsprocessen hos er och vilka steg den omfattar? Vägen från användare till utvecklare.

- Kan du berätta lite mer om vilka typer av felanmälan kommer mest från elever, både som direkt kontakt och genom administratörer?

- Om man tittar lite mer på den pedagogiska. Om vi skiftar fokus från elever till lärare. Har det hänt nån gång att lärare eller kanske vårdnadshavare har klagat på hur systemet är strukturerat och det är inte på något sätt är bra för lärandet?

- Har ni fått några önskemål eller klagomål om användargränssnitt? Kanske någon knapp eller färg som är inte önskvärd eller nåt liknande?

- Har ni fått någon kritik om tillgänglighet/accessibility från elever med någon form av funktionsnedsättning.

- Ni får säkert väldigt mycket feedback från användarna. Behövs det lite strukturerar eller automatiserad sätt att samla in användarnas synpunkter?

- Skulle ni vilja ha mer feedback från elever?

- Vad tror du själv, filtreras deras feedback på något sätt så att allt inte når fram?

- Vad är viktig att tänka på när man utvecklar en läroplattform? Ni följer skolverkets riktlinjer men om man tänker mer generellt, vad är viktigt att tänka på när man skapar bättre förutsättningar för lärande?

- De som sitter i support, fokuserar de mest på den tekniska delen eller även andra typer, som användarupplevelse, pedagogiska moment eller annat?

- Hur registrerar de feedback och önskemål som handlar om användarupplevelser eller pedagogiska moment?

- Så de hamnar i olika grupper (önskemål, teknisk fel osv)?

- Vem är det som tittar på de sen? Utvecklare, produktteam eller?

Runda av