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DISCOVERING TEACHER AND STUDENT NEEDS IN ONLINE COURSES FOR IMPROVING THE LEARNING MANAGEMENT SYSTEM (LMS) OF UNIVERSITIES

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ABSTRACT

The COVID-19 pandemic in 2020 caused a shift from traditional classroom learning to online learning in higher education institutions. This rapid environmental change confused teachers and students, due to their inadequate readiness and past experience with online learning. As synchronous learning had been the primary approach for universities, teachers encountered difficulties increasing asynchronous learning experiences for students, which occur in a Learning Management System (LMS). Therefore, it was apparent that LMSs should be further developed to help teachers ensure a high quality of education asynchronously.

This thesis investigates challenges that teachers and students faced in online courses, particularly during the pandemic. Thus, an improved workflow with user-interfaces is proposed that could support teachers to enhance work efficiency and asynchronous interactions with students. Ultimately, teacher and student needs are discovered to help with the development of the LMS that could incorporate digital technologies into teaching practices in an asynchronous learning environment.

The research adopts service design and user-centred approaches to collect and analyse qualitative data. The qualitative research methods include interviews and observations, and data analysis is conducted by affinity diagram. Moreover, the concept proposal is validated through a focus group with teachers.

Hence, three gaps between teachers and students are identified, reflecting thirteen challenges of online learning. Thus, a workflow is designed based on a teaching process which follows the journey of online courses, and four features that need to be improved are suggested including efficiency, flexibility, compatibility, and learnability. The research is expected to impact on future studies about the development of an LMS that could provide students with high quality of asynchronous learning experiences in universities.

ABBREVIATIONS

ELEC   The School of Electrical Engineering (at Aalto University)

HEI   Higher Education Institution

LMS   Learning Management System

MOOC   Massive Open Online Courses

PE   Pedagogical Engineers

PSP   Personal Study Plan

UID   Universal Institutional Design

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01
INTRODUCTION

The COVID-19 pandemic in 2020 disrupted the traditional practices of higher education. This global crisis caused the majority of courses in higher education institutions (HEI) to be transferred to distance learning, which was an inevitable consequence for universities. Schools were forced to close campus facilities, resulting in social isolation for both teachers and students. They were required to stay at home, and all the practical activities such as group work, laboratory work, and workshops were conducted remotely without in-person interaction. Both teachers and students encountered communication and interaction difficulties, due to the lack of experience with online learning and teaching.

This rapid environmental change confused university teachers, due to their inadequate readiness and insufficient knowledge of teaching regarding online higher education courses. Since few classes in higher education had been held online before the pandemic, the transition to the remote mode was a challenge for teachers who were not experienced in online teaching. For instance, they encountered technical issues that caused delays, felt overwhelmed when dealing with new digital tools, and lost direct communication with students (Ylirisku et al., 2021). Also, running a real-time class was complicated if they had "isolated" students in different time zones, who had different internet capabilities and speeds (Gillett-Swan, 2017; Jaradat & Ajlouni, 2021). As a result, these phenomena caused inferior education early in the pandemic, resulting in resentment and disappointment among students who paid the full cost of tuition and related expenses (Kulkarni & Chima, 2021). The decreased physical interactions between teachers and students only served to heighten the frustration.

As the pandemic continued, university teachers developed their own pedagogical approaches as they became accustomed to teaching online. However, despite their attempts to resolve the difficulties of online teaching, there were still issues to be addressed. For example, when students did not turn on their cameras during synchronous online lectures, teachers could not view their active responses (Sarnell, 2020). Moreover, there were insufficient discussions between teachers and students concerning the use of Learning Management Systems (LMSs), to enable asynchronous interaction. In order to address these issues, teachers have been obliged to establish an effective working relationship with students both synchronously and asynchronously. Furthermore, Rozitis (2017) and Toppin and Toppin (2016) insisted that the teacher's capability to plan, organise, and evaluate their teaching is crucial to create an significant impact on learner success within online courses. Therefore, teachers recognised the necessity of incorporating diverse online resources to ensure high-quality education and meet student expectations.

Asynchronous learning is as essential as synchronous learning in higher education.

Traditionally, asynchronous learning was the primary approach for online colleges, for example, Massive Open Online Courses (MOOCs) that provide thousands of video lectures on various subjects and allow students to discuss in a forum board. Those who attend these schools take courses remotely during their free time, alongside paid work asynchronously. However, this was not the case for traditional universities that provide academic degrees. They valued synchronous in-person interaction in classrooms, which had been treated as a critical element for traditional higher education. Subsequently, once the COVID-19 pandemic began, teachers and students encountered the difficulties of online courses not only synchronously but also asynchronously. Asynchronous learning, in particular, has received less attention in comparison than synchronous learning, which was important for higher education institutions. While attention had been focused on simultaneous interactions in which individuals speak in real-time, non-simultaneous interactions in which pupils study alone and engage with classmates have received relatively less attention. However, as students spend most of their time alone outside the synchronous lectures, more attention to asynchronous learning is also required for better online education services.

In particular, teachers and students have expressed their confusion on the use of an LMS, which is a crucial platform for asynchronous learning. They found that an LMS is not interactive, easy-to-use, and efficient. One of the fundamental reasons for the confusion was that the majority of initial LMSs were built by software engineers lacking in pedagogical knowledge (Colpaert, 2006). For that reason, LMSs, which did not reflect learning and teaching practices, had limited teacher and student involvement, creating a desolated atmosphere. Furthermore, it was difficult to track if students were focusing on their studies or not. Even for teachers, LMSs were complex to use to such an extent that they rarely adopted all the features of the platforms (West et al., 2007). Hence, these circumstances have given rise to the necessity of developing learning experience and interactivity in LMSs.

This thesis investigates the issues that have emerged for teachers and students in the online learning environment during the COVID-19 pandemic. The research is conducted using various service design and user-centred approaches such as stakeholder analysis, interviews, observations, service blueprint, affinity diagram, persona, and a focus group. Hence, this thesis explores the teacher and student needs that could help with the development of the LMS to support fluent asynchronous learning services, in consideration of a teacher's teaching flow.

1.1. Personal Motivation

Since I arrived in Finland in 2020 for a master's degree, the majority of courses have been run remotely. As a student from outside the EU who was liable for the tuition fee, the online learning experience had fallen short of my initial expectations. Even though my apartment in Finland was near the campus, I mostly spent time at home, which eventually caused physical and mental distress. Consequently, I was seeking an opportunity to tackle these difficulties in online courses from the standpoint of receiving education services as a student, and this passion motivated me to undertake my thesis project.

Furthermore, this project appealed to me since its ultimate aim was to discover teachers' and students' actual needs in the online learning environment through service design methods. Hence, it was motivating to use service design as an innovative approach to address the current challenges we faced during the pandemic.

1.2. Objectives and Research Questions

This thesis explores challenges teachers and students faced in a university during the COVID-19 pandemic and suggest feasible ways of improving teacher efficiency and their interactions. As this thesis was based on the joint project funded by Aalto University and FITech Network University, it focuses on outlining a vision that could be utilised to inform the development of MyCourses, the LMS of Aalto University, and digitally mediated pedagogical workflows. Hence, this thesis aims to answer the following research questions:

- **What were the challenges that teachers and students encountered in online courses during the COVID-19 pandemic?**

- **What workflows of an LMS could help teachers improve work efficiency and asynchronous interactions with students?**

- **What user needs were discovered through exploration of an improved user-interface proposal?**

02
BACKGROUND

2.1. Online Learning and Teaching

2.1.1. Online learning

Starting with the spread of the internet and the World Wide Web (WWW), online learning has prevailed as an alternative to face-to-face learning. Online learning typically refers to a new form of learning that occurs remotely, rather than in a physical classroom. Over the decades, technological development has vastly leveraged learning methods more efficiently by enabling learners and teachers to be connected to each other over the internet. In the wake of advanced technologies, new forms of online pedagogy and methods have emerged.

There is some debate about the exact definitions of "e-learning", "distance learning", or "online learning". "E-learning" is often associated with learning activities with the help of electronic resources (Tsai & Machado, 2002). "Distance learning" is an umbrella term for any learning that occurs distantly via CD-ROM, e-mail, televised broadcast, computer, or mobile phone (Keegan, 2013). Moreover, it is frequently described as a method of interaction between teachers and learners from different places and time zones (Moore et al., 2011). "Online learning" refers to an accessible approach for learners supported by technological tools, and it has been the most popular approach today (Benson, 2002; Conrad, 2002). "Online learning" can be included in "distance learning" or used interchangeably in different countries and institutions. The term "online learning" is used throughout this thesis to refer to learning in higher education that occurs in an online environment.

COVID-19 had been a catalyst for universities to adopt online resources. Previously, online learning, particularly in traditional universities, had not been used widely before the pandemic. It was mainly used in online colleges and schools, for example, with Massive Open Online Courses (MOOCs) (Daniel, 2012). They provided lectures for adult learners who either already graduated from their previous studies or want to obtain degrees, or certificates with lower requirements. Lectures in online colleges were typically pre-recorded by teachers for self-study. By contrast, the majority of traditional universities, which refer to 4-year degree universities that require students to attend full-time, did not include online degree programmes prior to the pandemic. Moreover, as a characteristic of traditional universities, they possess a campus with several buildings and real estates where educational programmes take place. However, the physical facilities such as classrooms, laboratories, libraries, and offices are restricted in the case of remote learning. This restriction caused students to feel resentment towards schools.

Once the COVID-19 pandemic began in 2020, it instantly and dramatically forced traditional universities to transition into an online teaching environment. According to UNESCO, all education institutions were shuttered in 185 countries due to COVID effects impacting more than millions of registered students worldwide (Marinoni et al., 2020). The pandemic has significantly shifted the teaching practices of teachers who had only used traditional classroom teaching (Zhang et al., 2020). Yusuf and Ahmad (2020) discovered several challenges which are as follows: online learning distracts students' attention; the teaching medium is inadequate; unstable internet access for teachers disrupts classes; and students do not engage in the lecture as planned. Ylirisku et al. (2021) identified three key findings by conducting interviews with faculty members: 1) low interaction; 2) limited edu-tech knowledge; and 3) confusion with dealing in new pedagogical approaches. They also interviewed students, which brought three insights which are: 1) boredom and a lack of concentration; 2) disengagement; and 3) confusion about poor digital sources. Furthermore, Lewis and Price-Howard (2021) illustrated that some students, for instance, should have taken care of their families to be away from the virus, and eventually all these kinds of situations did not allow them to fully engage in the live-time learning environments. Thus, they recalled this moment as "the instructional worlds collided". This radical disruption encouraged universities to advance their systems to ensure high-quality education through digital transformation and technology advancements (García-Morales et al., 2021) . In 2022, two years after the COVID-19 outbreak, many courses are returning to the classroom. However, the effects of the pandemic have made it difficult to revert back entirely to a traditional classroom environment.

Online learning entails new pedagogical changes beyond the traditional theories and methods. Mukhtar et al. (2020) reported that online learning is a convenient, accessible, efficient, and time- and resource-efficient way of learning and teaching. They identified online learning advantages and limitations as shown in *Table 1*. On the other hand, technical requirements and infrastructure are demanded to operate online courses smoothly (Carr-Chellman & Duchastel, 2000). For example, keeping the video off would be helpful to make the connection stable for students without consistent high-speed internet (Sarnell, 2020).

As the meaning of learning in traditional universities has transformed the Learners beyond just knowledge acquirers, universities were required to investigate learning services to ensure a supportive learning environment for students and teachers (Hardika et al., 2020). In particular, since the virtual environment does not include physical activities such as having lunch with peers, using campus libraries and even moving from one place to another, it is relatively difficult to establish an appropriate communicative environment. To alleviate its weak points, universities must pursue

Table 1. Online learning advantages and limitations (Mukhtar et al., 2020)

	Theme	Sub-theme
Advantages	Flexibility	Remote learning
		Easy administration
		Accessibility
		Comfortable
	Student-centred learning	Self-directed learning
		Asynchronous learning
Limitations	Inefficiency	Unable to teach skills
		Lack of student feedback
		Limited attention span
		Lack of attentiveness
		Resource intensive

the online learning environment to meet the new learning goals in the digital domain. Moreover, Brown (1997) identified that learner-centredness and collaborative learning are essential to encourage university students to be active in online learning.

2.1.2. Teaching an online course

An online course is an internet-based programme of learning that is structured around a syllabus. The programme includes all the basic components surrounding online learning such as a curriculum, a study plan, course content, and resources, but it all occurs in the digital world. During the course, students focus on learning itself, while teachers focus on organising the programmes by planning, teaching, and evaluating. Moreover, different formats of online courses exist. For instance, a self-paced online course is an asynchronous programme where learners study in their own time and schedule. They can access pre-recorded lectures and online content that teachers generated in advance. It is particularly in higher education institutions, where online courses have been actively used synchronously and asynchronously since the COVID-19 outbreak. Moreover, new formats of mixed approaches have emerged such as hybrid, blended, and flipped courses, which combine in-person classroom learning with online learning.

Researchers have studied teaching practices that could be a useful foundation for improving student learning in online courses. Gunn (2001) provided for teachers, the basic principles and guidelines for online learning practices, including a list of twenty-four attributes, which has been cited the most. Recently, after the COVID-19 pandemic, Noor et al. (2020) suggested four online teaching practices: Human

capital development, Interpersonal development, Technology management, and Communication strategies. Those practices refer to 1) managing teacher's knowledge, 2) consulting students' surroundings, 3) communicating via social media, and 4) technological adoption. Particularly, research on student-centred learning and teaching in online courses have been on the rise (Gunn, 2001).

Preparing to teach and learn online is a crucial stage for a successful online course. Ragan (1999) stated that teachers in online education must be well-prepared, well-organised, and able to communicate with students in novel ways. Feldman and Zucker (2002) also illustrated that having a clear structure and plan with flexibility is important for online courses. Sometimes students may believe that online learning might be easier than traditional ways, but in reality, students find covering the learning content on their own to be a heavier workload (Feldman & Zucker, 2002). Also, Wolcott (2003) argued that new motivation, reward, and incentive systems are required to motivate teachers to invest their efforts into the preparation and thus their instructional growth.

2.1.3. Teachers in an online learning environment

First of all, since there are different terms for a teacher, it is necessary to clarify the one universally representative term. Most of the time, a teacher is just someone who teaches and helps young students learn something at school. Higher education institutions often use the words "lecturers," "instructors," "professors," "educators," and "tutors" interchangeably, so this thesis uses the word "teachers" to cover all of these people.

There have been studies examining the essential roles and competencies for teachers to succeed in an online learning environment. Beck and Ferdig (2008) state that the role of the teachers changed from teacher-centred to one that was more student-centred, high-interactive, and low-initiator. Moreover, roles as online teachers necessitate a paradigm change in terms of the ability to engage students through online communication, time and space for instruction, and online administration techniques (Easton, 2003). Recently, Farmer and Ramsdale (2016) identified five competency areas for new teachers, including facilitation, instructional design, tools and technology, community and netiquette, and leadership. Gunn (2001) highlighted that online teachers must develop the receptive cultures and communities of learning to succeed in online learning services. Buzzetto-More (2007) also mentioned that the role of teacher shifted from lecturer to course developer and course facilitator. Martin et al. (2019) found that the roles of online teachers vary according to the

different steps of an online course and available institutional support structures. And they identified five different roles of online teachers: course designer, facilitator, subject matter expert, content manager, and mentor. Teachers are required to not only teach, but also facilitate, design, consult, encourage, manage, and interact with students. However, as modern teacher roles require many duties other than teaching, teachers have faced difficulties in performing their role efficiently (Burgess, 2015; Thormann & Zimmerman, 2012).

2.2. Asynchronous Learning Environment (ALE)

2.2.1. Asynchronous learning and interaction

Regarding the nature of learning itself, learning does not occur merely during lectures but also in any formats of settings throughout the everyday life, such as self-study and group work. According to the National Education Association (2020), online courses should be synchronous and also allow easy access for students to activities "24/7" asynchronously. As brain regions develop in an asynchronous environment, learning effectiveness can be maximised (Bransford et al., 2000), and such a type of asynchronous learning was used actively in the late 1900s, when the internet began to spread to each household, since learning through recorded audio and postal system. With the advantages of asynchronous learning that students could study at their own pace, without being constrained by synchronous classroom lectures, online schools and higher education institutions based on this method started to appear one after another (Glavin, 2018).

In contrast to synchronous learning, which is learning that takes place in the same space with students in real-time, asynchronous learning refers to non-face-to-face learning in which students learn independently with flexible schedules. The term is typically given to different kinds of online learning in which students learn from teaching that is not presented in person or in real-time, such as pre-recorded video lectures or game-based learning assignments that students complete on their own (Sabbott, 2013). It often indicates a wide method of communication and instructional activities through various online means such as e-mail, discussion boards and Learning Management Systems (LMS) that exchange instructional materials. Furthermore, self-study in which students learn alone with given course materials is also a part of asynchronous learning, but without human interactions (Mayadas, 1997).

There have been many debates regarding the positive effects of asynchronous

learning. The fact that students are freed from classroom constraints gives rise to the potential for new pedagogical strategies for teachers (Jaffee, 1997). The primary strategies for asynchronous learning are discussions and reflections through a web-based platform (Woo & Reeves, 2008). Hsiao (2012) documented that the more teachers give an unspontaneous response as asynchronous communication, the more students think over a subject with in-depth learning and critical thinking, enabling students to discuss and reflect. Furthermore, as the distance mode reduces shyness and pressure, students can be more active to participate in learning with flexibility, and also can enjoy "e–tivities", which refer to activities with digital tools (Perveen, 2016). Thus, online courses with more asynchronous learning activities may be associated with high levels of interaction between teachers and students (Greenland, 2011).

2.2.2. Advantages and limitations

In contrast with types of e-learning in online schools which had relied on asynchronous means of lifelong learning, learning in traditional universities had primarily focused on synchronous means. Traditional universities encountered problems in the asynchronous learning environment particularly due to the COVID-19 pandemic. Basri et al. (2021) analysed students' perceptions in implementing asynchronous learning with software during the pandemic. They listed several challenges as follows: difficulty to operate different software together; the chance of cheating; and limited internet access, which were rated as the most critical obstacles when implementing asynchronous methods. Some researchers also stated that creating a good asynchronous learning environment is complicated. Palloff and Pratt (2007) outlined that the asynchronous online learning environment should encourage students to participate in many types of activities for reflecting, studying, and developing their own identity as an independent learner. Moreover, Hiltz (1998) argued that asynchronous online learning needs to be interactive and collaborative by establishing a community and aid in sharing of knowledge, information, and emotions among the community members. They indicated that this kind of collaborative learning is a labour-intensive way of course delivery for teachers. Elias (2010) also insisted that teachers must create and foster an inclusive atmosphere in the discussion forums by posting, asking questions, and encouraging students to be actively engaged. Following these hurdles, different modes of teaching methods like blended learning have appeared.

Blended learning (also referred to as hybrid learning) began to be actively utilised

in traditional universities after the pandemic to provide good quality learning and to compensate for the shortcomings of synchronous and asynchronous methods. Blended learning enables students to interact with teachers through a physical classroom and also an online platform. Perveen (2016) mentioned that blended learning is a new model of combining synchronicity with non-synchronicity that can address many problems which emerge in either the classroom or online. However, the challenges that have emerged for asynchronous learning and interactions have not been solved fully, and required acknowledgement even in the blended learning mode.

2.3. Learning Management System (LMS)

2.3.1. Learning management system

Learning Management System (LMS), also referred to as Course Management System (CMS) or Virtual Learning Environment (VLE), is an online learning platform for learning resource management, administration, and the delivery of instructional content. LMS initially emerged on the market in the late 1990s for managing digital learning resources asynchronously, developed simply as a means of "delivery" (Davis et al., 2009). LMS's purpose has evolved from being a delivery tool for teachers and administrators to an interactive resource tool for students. Most higher education institutions now adopt LMSs to support students' learning activities through a comprehensive and integrated set of services and resources (Zanjani, 2017).

LMS can be divided into Closed-source and Open-source LMSs. Closed Source LMSs, such as Blackboard, Apex Learning, SAP Enterprise Learning, Saba Software, and Intralearn, allow customers to buy standardised premade management systems. In contrast, Open Source LMSs such as Claroline, A tutor, Dokeos, ILIAS, Sakai, and Moodle allow customers to choose practical programmes with free software licenses or at a minimal price that suit their needs. Also, customers can manage the system with flexibility and accessibility. For that reason, Open Source LMSs are rising in popularity for universities as they can customise learning services for their students with low cost. For example, Moodle (Modular Object-Oriented Dynamic Learning Environment) based LMSs are one of the top-ranked open source LMSs for many organisations (Davis et al., 2009). However, Open Source LMSs require organisational knowledge of software and the ability to develop customised programmes, and this knowledge may need to be improved in universities (Berking & Gallagher, 2016).

An LMS has become an essential university software for resource management and

teaching activities. Also, it has been attributed to multiple benefits for operating online courses. Six primary benefits of LMSs are listed based on the findings by Berking and Gallagher (2016) and other researchers as follows:

- *Self-paced learning*

Students can select learning activities and resources that best fit their own backgrounds and interests. According to Beam and Cameron (1998), LMS-based learning results in more active student engagement than traditional classroom instruction. Furthermore, students can study independently without time and space limitations in LMSs (Bradford et al., 2007; Heirdsfield et al., 2011).

- *Scale of learning materials*

LMS can store a huge amount of digital materials and resources in the digital domain, through which thousands of students can access the content at the same time.

- *Flexibility in managing learning materials*

Learning content can be updated, modified, and configured on an LMS immediately and easily according to its administrations. Moreover, teachers can track students' progress on assigned tasks and assignments through an LMS.

- *Enhancement of interaction between teachers and students*

LMS plays a bridge role to connect teachers with students to form an online learning community. It can be designed to engage students to express their opinions freely and share ideas more easily through a conversational virtual classroom. According to Greenland (2011), the design of learning activities within LMS significantly influences student interactions. LMS also enables students to participate in digital activities such as discussion with peer students in online forums (Alias & Zainuddin, 2005).

- *Efficiency*

Berking and Gallagher (2016) reported that LMS helps teachers with managing the assessment process efficiently. Also, other research shows that LMS allows students to be better prepared for real-time lectures with asynchronous activities, such as discussions by reading resources in advance (Lonn & Teasley, 2009).

- *Teaching standards and uniformity*

LMS can enforce standards and uniformity in teaching. Consistent learning services uploaded on the digital space ensure that everyone gains the same information in the same way. It also allows teachers to save time by changing certain content at once.

As the next generation of LMS, researchers emphasised the importance of user-

oriented approaches. Since the majority of initial LMSs were built by software engineers lacking pedagogical knowledge (Colpaert, 2006), existing LMSs are missing the user's point of view. Davis et al. (2009) insisted that next-generation LMSs should accommodate user-navigated resources utilising both commercial and user-generated content, and should be held together through social connections based on pedagogical foundations. They also argued that the new LMSs should help learners create content and share knowledge to influence each other. This is because, a learner is the most crucial stakeholder in the new learning environment, and they can participate in the teaching process as a "prosumer", who not only consumes but also produces learning content (Schaffert & Hilzensauer, 2008). Furthermore, Murad et al. (2019) identified Chatbots as an intelligent model of LMSs, that can increase interactions with students through real-time dialogues 24/7.

2.3.2 Designing an LMS

Guidelines for designing an LMS have been researched for decades. Elias (2010) recommended practical strategies and tools that could implement eight principles of Universal Instructional Design (UID) tailored to distance education, which was developed based on Connell (1997) and Scott (2003)'s universal design principles. The principles include: 1) Flexible use; 2) Equitable use; 3) Perceptible information; 4) Simple and intuitive; 5) Low physical and technical effort; 6) Tolerance for error; 7) Instructional climate, and 8) Community of learners and support. Zanjani (2017) characterised four important elements of LMS design, which are: 1) a user-friendly structure; 2) avoidance of too many tools and links; 3) aid for privacy and anonymous posting; and 4) more customisable student-centred tools. Moreover, Ramakrisnan et al. (2012) identified interface design guidelines applied in an LMS by analysing a student's eye tracking pattern.

Simplicity is a key element of an advanced LMS design, reducing time-consumption in complex tasks. Research has demonstrated the value of shortening the time required to learn how to utilise LMS and eliminating operational errors (Bousbahi & Alrazgan, 2015; Khoa et al., 2020). Elias (2010) mentioned that the LMS interface could be simplified by providing a series of accessible buttons and links.

2.3.3 Challenges

Despite technological development, LMS still needs to be compatibly integrated

into the pedagogy domain. In particular, COVID-19 has brought the challenge to the surface. Some scholars discovered that academic teachers are more reluctant than others to embrace new technologies in their teaching practices (Alias & Zainuddin, 2005; Yueh & Hsu, 2008; Bennacer et al., 2021). And teachers tend to only adopt some of the features they can utilise in LMS (West et al., 2007; Alhazmi & Rahman, 2012). To overcome the low familiarity with LMS features, training programmes are required for teachers to adapt to its practices (Bennett & Bennett, 2003), but it is difficult to support all teachers with few trainers and pedagogical engineers (PE) at universities (Bennacer et al., 2021). Moreover, teachers have experienced diverse technical challenges in LMS that decreased time, efficiency, and motivation, thus they ended up struggling to integrate the LMS features into their teaching practice and routine (Wolcott, 2003; Lee et al., 2006).

Researchers also discovered many challenges on usability in LMS. Usability is a crucial criterion for teachers and students to teach and learn effectively through LMS. Teachers should be able to use LMS to work efficiently and productively while students should be able to use LMS to access course content easily and communicate with others interactively. Particularly, Yueh and Hsu (2008) pointed out that LMS designers should consider the entire teaching process which is complicated, but could also support teachers to work efficiently using various features of LMS. However, LMS has yet to be developed, considering the teacher's pedagogical process.

03
METHODS AND EMPIRICAL DATA

3.1. Project Overview

Like other universities across the world, in the wake of the pandemic in 2020, Aalto University, one of Finland's largest universities, was also unavoidably forced to shift their courses to the digital world. Since both teachers and students from Aalto university had no experience and readiness for online courses, it caused a lot of confusion in the beginning. Participating in lectures and activities via online means, brought about isolated students who struggled to stay mentally healthy. Moreover, those who were liable for paying tuition fees and living expenses appealed to be provided the high-quality education as the previous in-class ways did. In the meanwhile, teachers including professors, lecturers, and any faculty members struggled to address low student engagement and participation.

There was an evident need that teachers were required to develop the same high-quality online learning services as conventional ways. And teacher-student interaction had to be enhanced in the online learning environment. Furthermore, sufficient support with online resources and an efficient working environment for teachers had to be guaranteed by the school. In order to meet these demands, practical research was needed with the lessons learned from the pandemic.

Accordingly, a project set out to develop new solutions for better online learning services by utilising service design approaches. The project was conducted from November 2020 to April 2021 as part of the two joint projects from two institutions: The School of Electrical Engineering (ELEC) at Aalto University and FITech Network University. Aalto University is a Finnish higher education institution and FITech Network University is an open university primarily for adult learners that had already provided online courses prior to the pandemic.

To summarise, the project explores issues emerged in the online learning environment during the pandemic, using service design and user-centred approaches, and proposes feasible visions that can address the challenges. The objectives of the project were as follows:

- To discover the real needs of teachers and students through service design research methods, that can be utilised for two different ongoing projects. It will especially be subject to the School of Electrical Engineering at Aalto University.
- To illustrate a workflow or process of the new learning service system, which could be spread into wider use at Aalto University.
- To suggest a vision of a new learning service model, which could follow future education trends.

3.2 Data Collection

Primary research approaches were used to obtain data. Qualitative research methods principally collected primary data, including interviews and observation. To complement the qualitative data, I also harnessed service design techniques such as stakeholder analysis, service blueprint, and persona. Consequently, the collected data was analysed through an affinity diagram method.

3.2.1 Stakeholder analysis

A stakeholder analysis is a technique to identify all relatable stakeholders and relationships within an ecosystem where a product or service operates, aiming at developing strategies that each stakeholder can use to achieve their goals (Golder & Gawler, 2005). For this project, a circular stakeholder map was created visually based on the asynchronous and synchronous environment in order to understand the context and justify target interviewees, as shown in *Figure 1*. Different direct and indirect stakeholders surrounding online learning services were put on the map. All stakeholders were placed in their respective areas according to the legend which was determined by the different environment.

Stakeholders were mainly categorised into two actors: teachers and students. Also, teaching assistants as a sub-actor existed to play a role in supporting interactions between teachers and students.

- *Teachers*

Teachers refer to people who have responsibility for teaching in courses. In this context, teachers encompass all faculty members such as lecturers, teachers, coordinators, and professors. They are learning service providers who instruct and teach students in certain subjects based on their own pedagogical principles. They exist in different forms depending on their titles and roles. For instance, professors have different duties other than teaching such as advising students, operating lab projects, and conducting academic research.

- *Students*

Students, as learners, are actors in the form of end-users who receive learning services offered by teachers. They are also categorised by their education levels and study programmes. In the online learning environment, due to the effects of the pandemic, some students took courses remotely from their home countries or wherever they preferred to be.

Figure 1. Stakeholder map
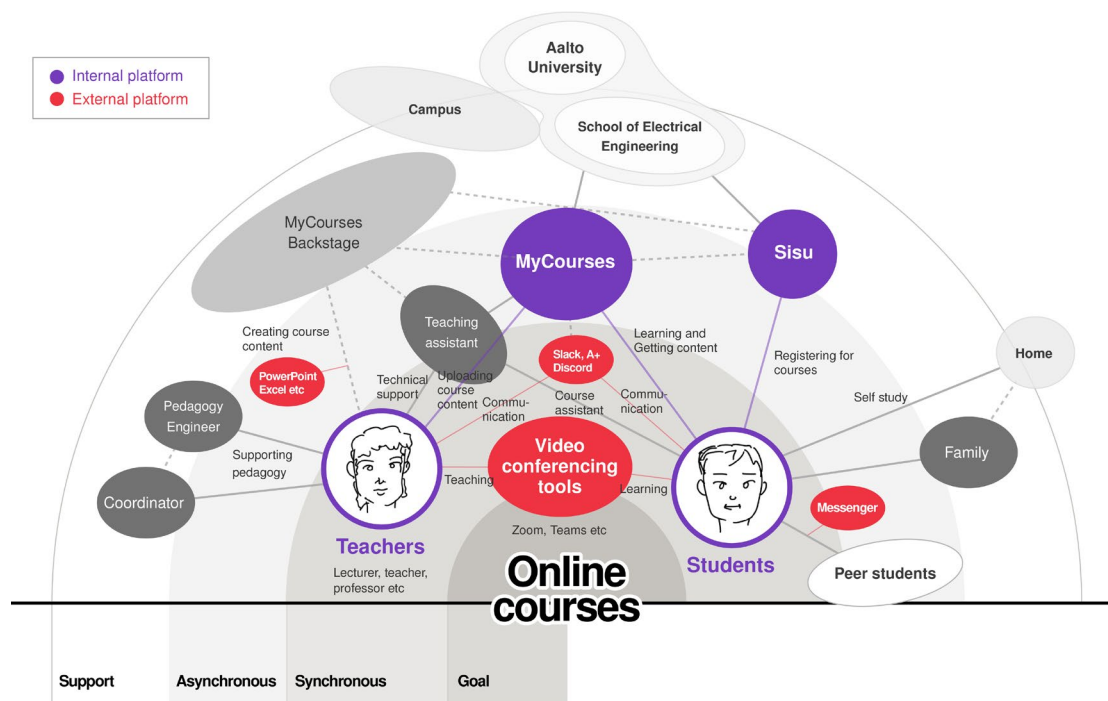
- *Teaching assistants*

In most cases, students are selected as teaching assistants by faculty members depending on the course initiative. Teaching assistants are typically paid, and they play the primary role of supporting technical issues as well as student-teacher and student-student interactions. For instance, they help teachers by creating course materials, supporting synchronous lectures, establishing a course page on LMS, and communicating with students via platforms such as e-mail.

Also, non-human components including digital platforms and contents were essentially placed on the stakeholder map. These digital means are to enable actual online courses synchronously and asynchronously, and play a crucial role in stimulating interactions between teachers, students, and teaching assistants from different locations.

- *Digital platforms*

The university uses different online platforms for different purposes — communicative platforms such as e-mail, MyCourses, and Sisu. My Courses is the Moodle-based LMS of Aalto University, and Sisu is the study plan platform of Aalto University. Also, various external platforms are used such as Slack and Discord, which link teachers with students within the digital domain. Video conferencing tools such as Teams and Zoom are also popular for real-time lectures and meetings. The software which are

used for a course are selected by the teachers' pedagogical decision and preference. Outside the synchronous lectures, students use informal tools such as WhatsApp and Telegram to communicate with other peers freely.

- *Digital contents*

Digital contents are learning materials and data that teachers share with students through digital platforms. These contents can be course assignments, videos, exams, presentations, and any forms of digital resources. For instance, PowerPoint and Excel are the popular tools to create digital contents for courses and pre-recorded lecture videos are the primary digital content in MyCourses. Furthermore, students also can be involved in the process of content creation by discussing in forum boards.

3.2.2 Interviews

An interview is a research method for collecting qualitative data that enables researchers to study the behaviours, thoughts, and attitudes of interviewees. For this project, interviews were planned, recruiting suitable interviewees based on the stakeholder identification. In total, fourteen participants including eight teachers and six students were interviewed individually. Most of the interviewees were from the School of Electrical Engineering where the project was initiated. I also interviewed one lecturer from the business sector who received high praise from students for his online teaching. Teachers consisted of four lecturers, one teacher, one professor, one digital learning specialist, and one coordinator. They had different teaching experiences ranging from one year to over ten years. Moreover, the students consisted of four Bachelors' and two Masters' students. The lists of interviewees for teachers and students are described in *Table 2 and 3*, respectively.

I conducted the interviews remotely due to the pandemic. In comparison with traditional face-to-face interviews, online interviews were conducted through Zoom and Teams, video conferencing software. A well-prepared interview setup was required to be as effective as the face-to-face interview method because collecting data from online interviews is simple, but complex (Curasi, 2001).

The interviews in the online learning environment were carefully planned so that the participants could feel comfortable. After I generated a list of interviewees, interview invitations were sent to them individually. The invitation included the objectives of the interview, a link for a video call, and possible interview dates. It also included some potential questions to be given during the interview in order to encourage them to think over their answers in advance. The interview scripts for teachers and students

Table 2. A list of interviewees: Teacher

no.	Position	Academic field	Experience
1	Lecturer	Electronics and Nanoengineering	>10
2	Teacher	Electronics and Nanoengineering	2
3	Lecturer	Management Studies	1
4	Lecturer	Electronics and Nanoengineering	>10
5	Associate professor	Electronics and Nanoengineering	7
6	Lecturer	Electronics and Nanoengineering	>10
7	Digital learning specialist	Learning Design	6
8	Coordinator	Electrical Engineering	>10

Table 3. A list of interviewees: Student

no.	Position	Academic field	Year	Nationality
1	Bachelor's	Electrical Engineering	2	South Korea
2	Bachelor's	Electrical Engineering	2	Vietnam
3	Bachelor's	Electrical Engineering	2	Finland
4	Bachelor's	Electrical Engineering	2	South Korea
5	Master's	Electrical Engineering	2	India
6	Master's	Electrical Engineering	1	Finland

are stated in *Appendix A and B, respectively.*

In contrast with face-to-face interviews, I needed to consider the potential limitations of an online interview; that is difficult to interpret the interviewee's non-verbal communication, such as body language. As people tend to be easily distracted in cyberspace, I as an interviewer encouraged the participant to talk in an open discussion. At the beginning of each interview, I started with a small conversation for around five minutes in an ice-breaking manner to generate a personal connection before the actual questions (Derrett & Colhoun, 2011). Moreover, to overcome the difficulty of ensuring that interviewees keep maintaining their concentration in an online environment, sensitive and ethical issues were carefully considered during the process (O'Connor & Madge, 2003).

3.2.3 Observation

Observation methods were used to get closer to the situation in realistic detail for its verisimilitude. Considering the different types of online learning, I observed dialogues in a real-time online lecture and course pages in MyCourses. For each observation,

different methodologies were utilised in accordance with the learning environment. A non-participant observation method was employed for the observation of the synchronous interactions because this approach is useful when observing an open space where looking at the context from a new perspective is needed (Ciesielska et al., 2018). On the other hand, for observing asynchronous interactions in MyCourses, I selected the participant observation method which allows me to engage in the context and experience. (Marshall & Rossman, 2014) stated that participant observation requires first hand involvement in the study, since the researcher serves as an instrument, hearing, seeing, and experiencing reality as the participants do.

- *Non-participant observation for synchronous interactions*

This method refers to a non-reactive approach of observing naturally occurring data online. It was conducted with the help of two teachers from the School of Electrical Engineering at Aalto University. They agreed on observing their real-time online lecture, but not in a way that the lecture is not disturbed by the observation. The course was about microwave engineering which teaches mathematical theories for Masters students. It was conducted remotely via Zoom, taking for an hour to observe. During the observation, I turned my camera off and muted my microphone while the lecture was being taught. In the meanwhile, I recorded and took notes of what was happening in the lecture. *Table 4* describes the brief information about the non-participant observation, and *Image 1* shows how the actual observation was performed.

- *Participant observation for asynchronous interactions*

I also observed interactions in MyCourses which take place outside of the synchronous lectures. As the teacher's and student's interface in MyCourses showed and used differently, I investigated the portal by exploring the entire process of courses from both set-ups. Particularly, various course pages were observed while taking notes about any issues that need to be addressed.

Table 4. The overview of non-participant observation

Time	09:00 - 10:00 (1 hour)
Course	Microwave Engineering
Level	Master's
Language	English
Teacher	1 associate professor, 1 lecturer
Participants	32 students

Image 1. Non-participant observation
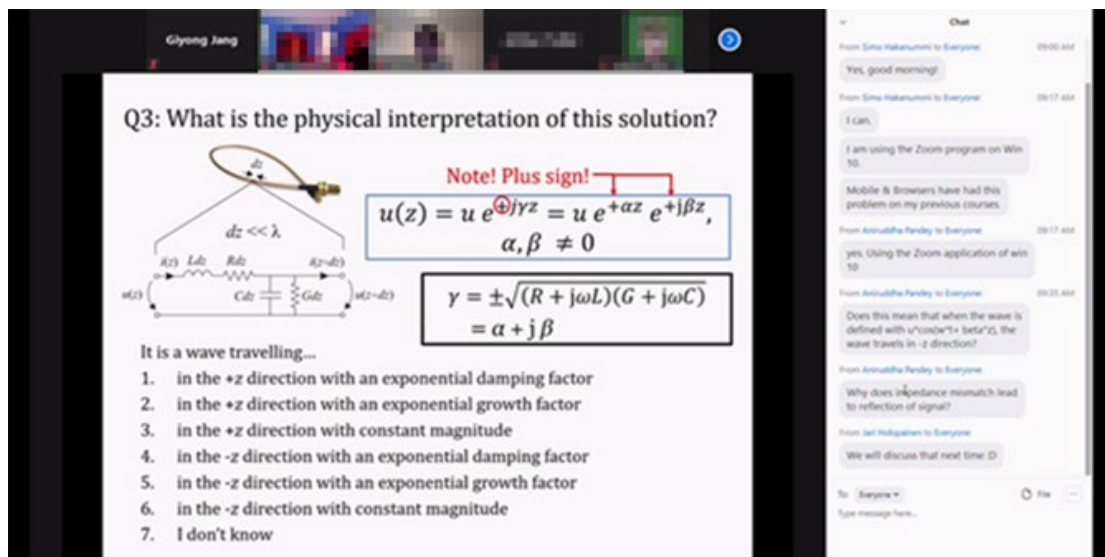
3.3. Data Analysis

The data gathered from interviews and observations were converged to be analysed. A service blueprint technique was utilised to bring all information together in a visual map. It helped to clarify the key issues to be addressed following the sequential steps taken by a teacher and student in taking an online course. Thus, an affinity diagram, a qualitative data analysis tool, was used to identify noteworthy findings. The detailed results are described in Chapter 4.

3.3.1 As-is service blueprint

A service blueprint was created to clarify the existing issues through sequential processes of user actions according to the research data. Service blueprinting has become one of the most effective techniques for visually depicting the entire service process that a user takes (Bitner et al., 2008). I used the technique to define current challenges in the scenarios of teaching and learning processes. Based on the collected data, the sequential steps were divided into three phases: 1) before the course; 2) during the course; and 3) after the course, whereas the vertical axes were split into three stages: frontstage; interactions; and backstage. Teacher-student interactions constantly occur with different digital means throughout the course cycle. For instance, students interact with teachers in a real-time online lecture synchronously. Otherwise, students communicate continuously via MyCourses and e-mail with

Figure 2. As-is service blueprint

PHASE

| BEFORE COURSE | DURING COURSE | AFTER COURSE |

STUDENT JOURNEY

| MAKE PER-SONAL STUDY PLAN | REGISTER FOR COURSES | STUDY PRE-MATERIALS | JOIN AN ORIENTATION | TAKE REAL-TIME LECTURE | DO ASSIGN-MENTS | STUDY FROM HOME | TAKE EXAMS | LEAVE FEED-BACKS | GET GRADES | PREPARE THE NEXT PERIOD |

PAIN POINTS

- Can't see previous course works
- Confused which platform students have to use (My-courses, sisu, into, Weboodi, etc)
- Insufficient description for courses
- Hard to find information students want to get
- Low usability of platform
- Different curriculum rather than student's expectation
- No penalty, easy to drop out
- Boring, not attractive, technical problem, etc
- Get distracted, Other peers are not active
- Hard to find the link everytime
- They want to study in basis of their own pace
- Low level of concentration
- Feel sense of belongings
- Hard to use the platform pages
- Too formal survey, lazy to do
- Discrepancy between students feedback and their behaviour

FRONT STAGE

MyCourses
- Check course description
- Check updates
- Pre-content provided
- Check Zoom link
- Course materials provided
- Discussion & communication
- Submit deliverables
- Check grades each course

Sisu
- Register courses
- Mange course schedules
- Drop out courses

Zoom / Teams (Video conferencing tool)
- Real-time lectures and Q&A sections

E-mail
- Question via e-mail
- Request feedback survey

BACK STAGE

TEACHER JOURNEY

| PLAN COURSE | BUILD COURSE CONTENT | POST COURSE DESCRIPTION | PREPARE COURSE | INTERACT WITH ASSISTANTS | GIVE ASSIGNMENTS AND ACTIVITIES | GIVE FINAL EXAMS | EVALUATE GRADES | UPDATE COURSE CONTENT | PREARE THE NEXT PERIOD |

SUPPORT

Teaching assistant technical and teaching support

PAIN POINTS

- Difficulty to convert contact teaching into digital teaching
- Difficulty to create contents online
- Didn't know when the student registration starts
- Hard to get effective support from teaching assistant
- don't know what is good digital tools
- A lot of email questions
- Difficult to use LMS effectively (low interactivity)
- Hard to distinguish student achievement
- Don't have time to update
- Need more practical support
- Lack of knowledge and information
- Hard to interact with students
- Student's low engagement
- Hard to see each student's contribution
- Need more motivation to improve the course
- Hard to find proper assistants

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teachers or teaching assistants. The whole journey is an iterative process which is continuously repeated for both teachers and students. So, this activity of mapping the whole course journey was helpful to interpret the existing context and interactions. *Figure 2* shows the visual map of the service blueprint, and the details are illustrated in the following paragraphs.

- *Before the course*

The first intercommunication takes place already before a course starts. In the beginning, teachers typically take a step of preparation. This phase takes a longer time than others to plan the course by discussing them with the university and department in the long term. The course needs to comply with its programme curriculum. During this phase, teachers put their pedagogical knowledge into generating a syllabus, including learning outcomes, credits, schedules, the language of instruction, content, assessment methods and criteria, and lastly, workload. Afterwards, they build course contents and materials through digital tools such as PowerPoint, Excel and so forth. The study curriculum changes every two years at Aalto University, but the content can be simply updated with the similar form of content that teachers used to teach in the previous year. According to the course plan and schedule, all information regarding the course must be uploaded on MyCourses, so that students can look at the course description beforehand and end up registering for the course. In this process, students need to access two different portals: Sisu and MyCourses. Sisu (previously Oodi) is used for students to manage their Personal Study Plan (PSP) and register for courses. And then they check the practical information on the course page of MyCourse where the actual teacher-student interactions occur asynchronously. Prior learning can be conducted before the course starts. For instance, students look through the course resources and contents, and ask questions to the teachers in charge regarding the course via e-mail or MyCourses. Moreover, sometimes students receive pre-assignments or tasks to get familiar with the content depending on the course plan. In the meanwhile, teachers may hire their teaching assistants among students who took the course previously or through any manner and give a role to support technical and communicative issues. Teaching assistants can respond to student inquires on behalf of the course.

- *During the course*

Aalto university has their own academic calendar that consists of five teaching periods with six weeks for each period during an academic year. During the first lecture as an orientation day, teachers present a basic description about the course, and they count the number of student attendees making sure whether or not students will continue the course. The orientation is an important day for students because

they can examine the attitudes, atmosphere and teaching ways of teachers as well as decide if they want to continue or drop out of the course with the flexibility. Once the course begins, actual teaching and real-time interaction occur actively. Depending on the types of courses, teachers run courses either completely online, offline or combining both of them. In the last week of the course, final activities such as exams, presentations, assignments and essays are given to students, and students submit the deliverables via the same platform.

- *After the course*

Once the course ends, a course feedback survey is automatically sent to students from the school level, while some teachers try to gather students' informal feedback with their own way. Afterwards, teachers evaluate student grades according to the given criteria. When the course is completely finished, teachers look into students' feedback on the courses and come up with ideas to further improve their course. In the meantime, students receive their grades through MyCourses and if they are not satisfied with them, they can send an email to teachers to discuss this issue.

3.3.2 Affinity diagram

An Affinity Diagram is a clustering technique with a visual manner that helps researchers analyse qualitative data (Lucero, 2015), which is also referred to as the KJ method. The method allows researchers to organise data in a contextual way and to identify key findings and pain points collectively.

For the project, I clustered all the data from the qualitative research, and thus created top-level categories, putting similar ones together on Miro board, an online whiteboard. Comparing two incompatible voices of teachers and students, I identified key issues as a result of the affinity diagram as shown in *Figure 3*. The detailed findings are demonstrated in the Chapter 4.

Figure 3. Summary of affinity diagram
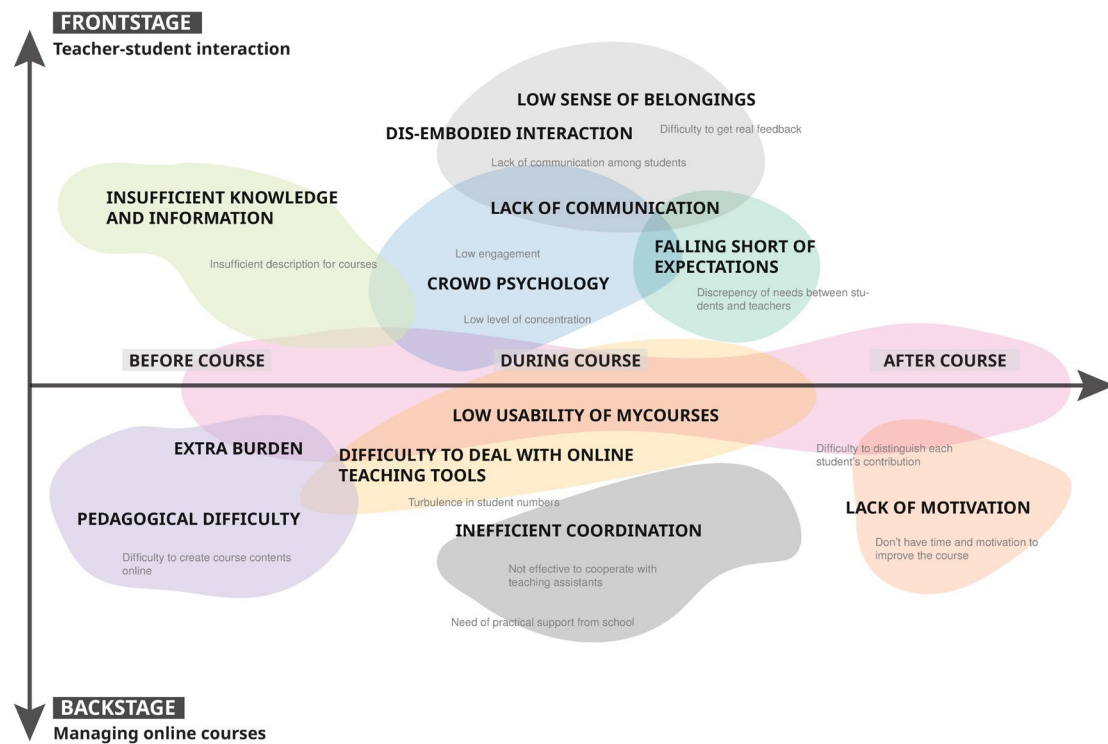
3.4. Ideation and Validation

On the basis of issues revealed by data analysis in Chapter 3.3, design directions and approaches were ideated to address the challenges, considering their practicality and reality. And a persona technique was utilised to define a target user who will primarily use the design. Finally, prototypes for new concepts were designed based on the persona profile, thus validated via a focus group.

3.4.1 Directions

Having considered realistic and feasible aspects surrounding the project, I decided to focus on improving the workflows of MyCourses that help teachers efficiently work with a smooth process of operating and actively interact with students. The key design directions were divided into two strategies: problem-based design strategy and opportunity-based design strategy. The problem-based design strategy focuses on addressing the existing difficulties in MyCourses while the opportunity-based design strategy focuses on creating new ideas that can solve the challenges.

- *Problem-based design strategy*

Improvements to the problems in MyCourses were considered as a design strategy. I discovered existing difficulties that needed to be further developed such as usability issues, thus solutions for the problems were ideated.

- *Opportunity-based design strategy*

This strategy was meant to create new opportunities and ideas that did not exist in MyCourses, but would be nice if they were added. This approach proceeded through concept ideation methods based on the research data.
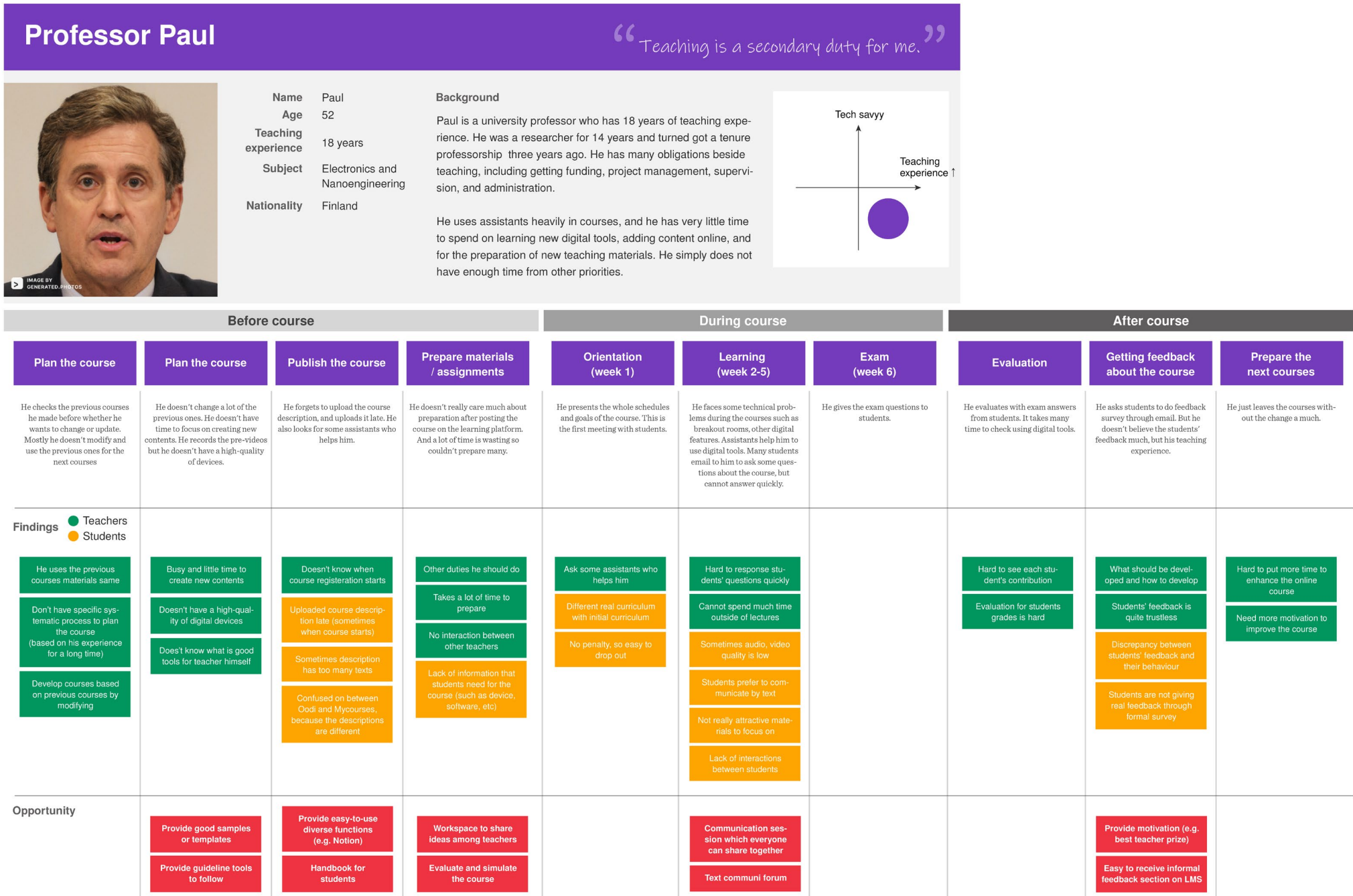
3.4.2 Persona

A Persona is a fictional character that represents a certain type of user and it helps researchers focus decisions by adding a layer of real-world consideration to the conversation (Pruitt & Grudin, 2003). The persona technique has been widely used in the design field ever since Alan Cooper coined it first in his successful book, *"The Inmates are Running the Asylum"* in 1999. Understanding the foundations of the technique, I created four different fictional characters of teachers considering the collected data and research. In particular, these personas represented teachers from the School of Electrical Engineering at Aalto University. The personas were categorised by the level of their digital literacy and teaching experience. Each persona is briefly described in the following paragraph.

The first persona is Sanna, who is an experienced teacher. She has been working for more than 5 years with her firm pedagogy. She is interested in learning new technologies to digitally transform their courses. Paul is the second persona, who is a professor with different duties. For example, he conducts research, projects, thesis advice as well as submits funding plans. Teaching is not her primary job. The third persona is lecturer Mikko is a teaching beginner and just started to work at the university. He is a young tech savvy and early adopter, and he is passionate about establishing his own pedagogy with different teaching experiences. The last persona is Ilona. She is an innovator. She is eager to experiment with various methods and tools to apply them into her courses and she puts a lot of effort into communicating with student to step closer to them.

Consequently, Professor Paul was selected as the key target persona for the project. In comparison to other personas who could relatively adapt to the online learning environment, this persona had more pressing needs to overcome challenges. The detailed profile of Professor Paul is described as shown in *Figure 4*.

Figure 4. Professor Paul's profile

Professor Paul

> " Teaching is a secondary duty for me. "

Name	Paul
Age	52
Teaching experience	18 years
Subject	Electronics and Nanoengineering
Nationality	Finland

Background

Paul is a university professor who has 18 years of teaching experience. He was a researcher for 14 years and turned got a tenure professorship three years ago. He has many obligations beside teaching, including getting funding, project management, supervision, and administration.

He uses assistants heavily in courses, and he has very little time to spend on learning new digital tools, adding content online, and for the preparation of new teaching materials. He simply does not have enough time from other priorities.

(Chart axes: Tech savvy / Teaching experience ↑)

Before course				During course			After course		
Plan the course	**Plan the course**	**Publish the course**	**Prepare materials / assignments**	**Orientation (week 1)**	**Learning (week 2-5)**	**Exam (week 6)**	**Evaluation**	**Getting feedback about the course**	**Prepare the next courses**
He checks the previous courses he made before whether he wants to change or update. Mostly he doesn't modify and use the previous ones for the next courses	He doesn't change a lot of the previous ones. He doesn't have time to focus on creating new contents. He records the pre-videos but he doesn't have a high-quality of devices.	He forgets to upload the course description, and uploads it late. He also looks for some assistants who helps him.	He doesn't really care much about preparation after posting the course on the learning platform. And a lot of time is wasting so couldn't prepare many.	He presents the whole schedules and goals of the course. This is the first meeting with students.	He faces some technical problems during the courses such as breakout rooms, other digital features. Assistants help him to use digital tools. Many students email to him to ask some questions about the course, but cannot answer quickly.	He gives the exam questions to students.	He evaluates with exam answers from students. It takes many time to check using digital tools.	He asks students to do feedback survey through email. But he doesn't believe the students' feedback much, but his teaching experience.	He just leaves the courses without the change a much.

Findings ● Teachers ● Students

Plan the course	Plan the course	Publish the course	Prepare materials / assignments	Orientation	Learning	Exam	Evaluation	Getting feedback about the course	Prepare the next courses
He uses the previous courses materials same	Busy and little time to create new contents	Doesn't know when course registeration starts	Other duties he should do	Ask some assistants who helps him	Hard to response students' questions quickly		Hard to see each student's contribution	What should be developed and how to develop	Hard to put more time to enhance the online course
Don't have specific systematic process to plan the course (based on his experience for a long time)	Doesn't have a high-quality of digital devices	Uploaded course description late (sometimes when course starts)	Takes a lot of time to prepare	Different real curriculum with initial curriculum	Cannot spend much time outside of lectures		Evaluation for students grades is hard	Students' feedback is quite trustless	Need more motivation to improve the course
Develop courses based on previous courses by modifying	Does't know what is good tools for teacher himself	Sometimes description has too many texts	No interaction between other teachers	No penalty, so easy to drop out	Sometimes audio, video quality is low			Discrepancy between students' feedback and their behaviour	
		Confused on between Oodi and Mycourses, because the descriptions are different	Lack of information that students need for the course (such as device, software, etc)		Students prefer to communicate by text			Students are not giving real feedback through formal survey	
					Not really attractive materials to focus on				
					Lack of interactions between students				

Opportunity

Plan the course	Plan the course	Publish the course	Prepare materials / assignments	Orientation	Learning	Exam	Evaluation	Getting feedback about the course	Prepare the next courses
	Provide good samples or templates	Provide easy-to-use diverse functions (e.g. Notion)	Workspace to share ideas among teachers		Communication session which everyone can share together				Provide motivation (e.g. best teacher prize)
	Provide guideline tools to follow	Handbook for students	Evaluate and simulate the course		Text communi forum				Easy to receive informal feedback section on LMS

3.4.3. Benchmarking

Based on Paul's profile, new ideas were generated by using brainstorming and benchmarking relevant cases. For example, Notion was primarily used as a benchmark. Notion is a software which helps users manage notes, content, tasks and others for greater efficiency and productivity. The software also provides a workspace where users can collaborate with others simultaneously. Notion is gaining popularity among users and was ranked as the best industry leader according to the G2 reviews in 2021. Notion is similar to LMS in that both are open-source service software and workspaces to interact and collaborate. Hence, this software could be a suitable benchmarking example of how LMS could be improved. *Image 2* shows the Notion's basic page with flexible features.

Image 2. Notion page
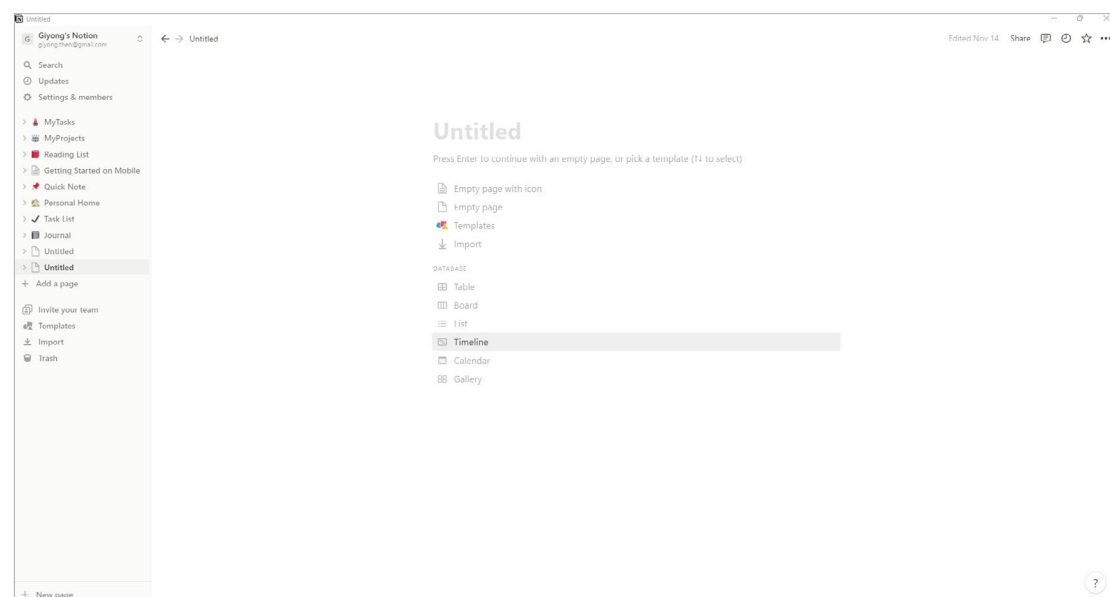
3.4.4. Prototyping

A workflow of MyCourses was designed by adopting teaching processes that are about how teachers run their online courses. The workflow included visual wireframes and user interfaces according to the persona's journey. Considering the teaching process, the workflow was created with low-fidelity prototypes because the purpose of prototyping was to validate the ideas.

3.4.5 Focus group

A focus group is a participatory group interview method that brings people together to engage in discussion simultaneously under the guidance of a facilitator for the purpose of collecting relevant information (Kumar, 1987). It is suitable for a study to receive sufficiently detailed opinions on a certain topic in a short period of time (Bertrand et al., 1992). Therefore, the focus group technique was chosen to validate the generated concepts and prototypes and to discuss the future directions. Moreover, the focus group has a great advantage, in that participants could help each other to incline towards and reflect upon perspectives of their daily life that are usually taken for granted (Côté-Arsenault & Morrison-Beedy, 1999). Due to the pandemic issue, the focus group was conducted within an online setting, and five teachers were invited to the discussion as shown in the *Table 5*.

Table 5. Focus group participants

Name	Academic field	Position	Experience
Participant 1	Electronics and Nanoengineering	Lecturer	>10
Participant 2	Electronics and Nanoengineering	Lecturer	>10
Participant 3	Electronics and Nanoengineering	Associate professor	7
Participant 4	Electronics and Nanoengineering	Teacher	2
Participant 5	Electronics and Nanoengineering	Lecturer	>10

Participants were given a pre-material as an online handout for efficient discussion during the focus group. The handout included relevant information for the discussion such as the time schedule, agendas, short descriptions of prototypes, and instructions on Miro board, as shown in *Appendix C*. Participants were asked to read the material in advance and add comments with the post-it feature on Miro board if they had time. This way could help them avoid anxiety from processing and generating large amounts of information at once during the focus group. The handout was generated as a PDF format in a visual manner with six pages and also made to be clearly and enjoyably read in about 15 minutes.

During the focus group, we discussed new ideas by viewing the prototypes together. Participants were encouraged to speak out and leave their comments on the Miro board at the same time, as shown in *Image 3*. Even after the focus group, they were allowed to put additional feedback on the board so that they could have more time to take a look into the prototypes.

After the focus group, I reviewed the comments left on the Miro board and transcribed the video recordings to discover the meaningful insights. Participants' responses to

Image 3. Workshop during focus group
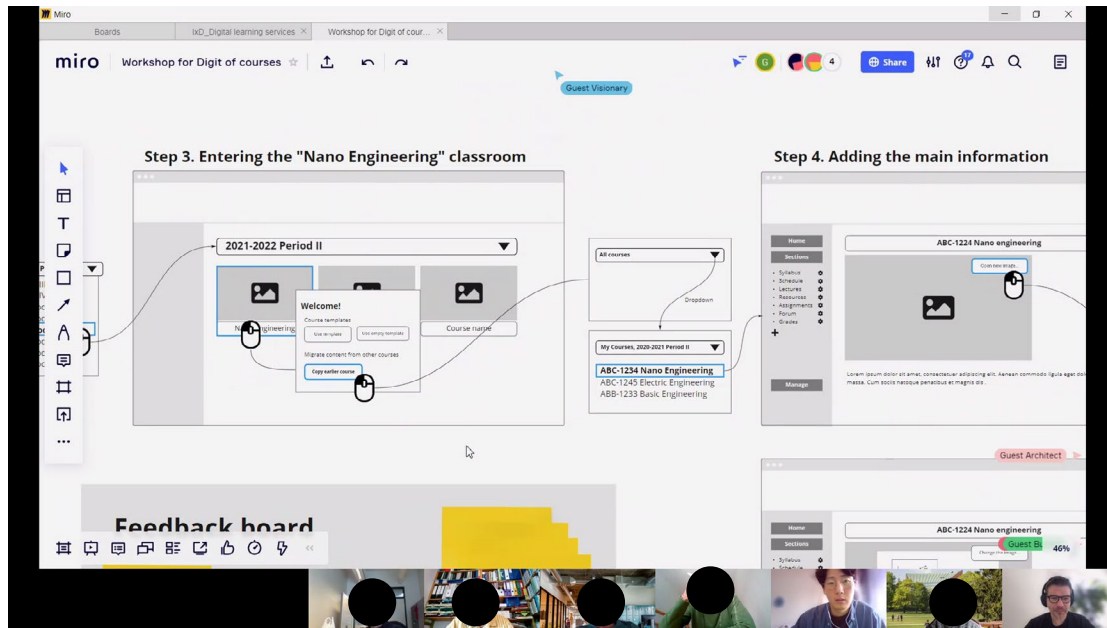
the improved interfaces and prototypes were generally positive, and they agreed that MyCourses should continue to evolve. The next part demonstrates the key takeaways from the research.

04
RESULTS

The research investigated the challenges in an online learning environment at higher education institutions during the COVID-19 pandemic, and thus created workflows of MyCourses with user interfaces that could help teachers improve work efficiency and asynchronous interactions with students.

This chapter consists of two sections. The first section demonstrates the findings that were derived via data analysis using the affinity diagram based on interviews and observations. In the next section, the suggested workflows of MyCourses are illustrated along with the feedback from the focus group.

4.1   Unmet needs between teachers and students

The ultimate purpose of the research was to discover what challenges they faced and the real needs of teachers and students. Thus, this section shows the findings from the research. I compared the challenges that teachers and students encountered and clustered them according to the results. Therefore, the findings were illustrated by eight and five themes respectively in the following paragraphs, and *Table 6* shows a summary of the findings.

Table 6. Findings

Actor	no.	Theme
Teachers	1	Insufficient knowledge and information
	2	Difficulty to deal with online teaching tools
	3	Dis-embodied interaction
	4	Inefficient coordination
	5	Extra burden
	6	Low usability of MyCourses
	7	Pedagogical difficulty
	8	Lack of motivation
Students	9	Distraction and fatigue
	10	Crowd psychology
	11	Low sense of belonging
	12	Falling short of expectations
	13	Lack of communication

4.1.1 Teachers

- *Insufficient knowledge and information*

University teachers had little experience on remote teaching before the pandemic. They struggled to find suitable approaches for online courses without sufficient online pedagogical knowledge and information. They tried to search online resources and asked other colleagues to gain the relevant information which can be used for their courses. Despite their efforts to address the difficulties, learning new methods took more time than they thought. They also run monthly meetings for sharing experiences with peer teachers, but the meetings were yet to be organised productively.

"Doing things together is somehow we should enhance the online setting and I don't know tools and whether we don't know how to use tools. There are lots of activities in MyCourses."

– Teacher (No.1)

"There is also some meeting organised by department, but those are larger meeting so not as a productive way to discuss practicalities on courses. I think it's also very important to discuss with other teachers a little bit of synchronising between courses.

– Teacher (No.1)

"We have monthly coffee time with teachers, we share ideas and experiences, but I think It's hard to discuss with a lot of people in a given time actively and efficiently."

– Teacher (No.2)

"There are many types of assignments that I haven't used. I didn't notice that they are even available in fact, and it would be nice to try new things."

- Teacher (No. 4)

- *Difficulty to deal with online teaching tools*

Teachers had little experience on using digital tools for online courses other than basic tools such as PowerPoint, Word, and Excel. Teachers were concerned that it would be the worst-case scenario, if the course contents used in the traditional classroom were transferred online in a form of merely copying and pasting. It was also a hassle to purchase and practice high-performance devices including a microphone, speaker, light, and tablet for real-time lectures and video recording. They should have bought these gadgets with their personal budget, since the university could not afford to buy all the products for each teacher. Despite the difficulties of handling these devices, many teachers were passionate about learning new tools and methods to further develop their online courses. Simultaneously, they admitted that there were some teachers who were not. Furthermore, faculty members argued that they have limited time to invest more effort into learning for generating new contents, because teaching is not their primary duty but also various tasks such as studying their fields, writing articles, applying for funding, and advising their students.

"What I learned is the worst idea in this situation is to copy directly contact work to remote work. My idea is they have to be designed so that they take the advantage of remote environments according to the technology. How to utilise the given technology for the remote course is the main key. Giving examples is a great way. Some teachers don't want to learn new tech."

– Teacher (No.4)

"The list of things to be updated is significantly longer due to this remote mode. In an ideal world, I would want to have done it before the course starts, but in the real world, I will always have almost done things and prepared materials for next year. I'm a little bit ahead but not that much."

– Teacher (No.1)

"I'm learning video editing on my own, there are some experts at Aalto for editing, but in fact, it takes time to practice new technologies."

– Teacher (No.2)

Some teachers are tech-savvy using various tech tools, but some are not. ... They also need to consider tool licenses."

– Teacher (No.7)

"The problem of the whole learning design process is the tiny minority of FITtech teachers who ever have time to enter this process. They just tend to open up their courses and face problems. This FITech process is kind of heavy and time-consuming for them."

– Teacher (No.7)

- *Dis-embodied interaction*

Since physical interactions do not occur in the online environment, teachers strived to recognise students' reactions and responses synchronously and asynchronously. However, many students who turned on their camera did not give questions regarding the lecture. It led teachers to get frustrated to distinguish whether students were listening or not. In particular, as the electrical engineering school required laboratory exercises, it was demanding to shift from the traditional way to the online or hybrid mode.

The same thing happened in the asynchronous learning environment. Despite the fact that students were encouraged to participate in discussions outside of real-time lectures, MyCourses remained silent. Some teachers ultimately shifted to other platforms such as Discord and Slack, which students are more accustomed to using, as alternatives.

Moreover, it was complicated to track how much time students spent for studying aside from the real-time lectures. As teachers could not see each student's personal contribution, for example, in the case of group works, it was demanding to grade fairly.

It resulted in confusion, as to whether or not they needed to rethink their assessment criteria and methods for grading.

"No one, of course, has a camera on, it is okay, but anything very few questions in the chat. I really don't know how many of them actually are listening, and doing some-thing else while joining the online session."

– Teacher (No.1)

"Compared with the previous teaching methods, writing and texting are the potential way to communicate with students. We or teaching assistants can respond to students immediately using Telegram group chat and they can discuss with multiple people simultaneously."

– Teacher (No.3)

"We are struggling to figure out some working exercise concept online; it has worked pretty good in a classroom setting in reasonable size hall/room(capacity 20-40), and then teaching assistants who work in to help students. So implementing similar online is a somehow more difficult. ... Really difficult to know that this works, and how many actually participate in."

– Teacher (No.1)

"In Spring, the thing was that during this course online, the only feedback I got was quite negative like 'this topic was difficult, the deadline was too tight, like that' and then the course feedback was quite opposite, saying like 'this course was quite well-organised and difficult level was okay.'"

– Teacher (No.5)

"Students are not active in the discussion forum. They don't ask sadly. ... I have no clue that what is the students' point of view about my course."

– Teacher (No.2)

"For some exercises and group works, it's difficult to see what are they doing and distinguish each contribution without looking at it in person."

– Teacher (No.2)

"Just to discuss with students informally is better (to get real feedback). Formal feed-back is usually reflecting how successful have been in the course. So based on how success their course, the feedback results are different."

– Teacher (No.4)

- *Inefficient coordination*

The guidelines and instructions about online courses that the school provided were too general for teachers to implement them into their practices. Teachers demanded more practical aid from the school and more efficient ways for working together to create bigger synergies. Therefore, teachers were required to interact with the school more frequently to request their needs.

Depending on the course plan, faculty members typically have their own teaching assistants who support with technical and communicational sides. However, sometimes teaching assistants did not feel that they are working effectively because

of a lack of clear guidelines for their role in the online environment. They were unsure as to how and what to contribute to the success of the course beyond basic tasks such as responding to students' inquiries and checking their attendance. For teaching assistants to support teachers productively, a clear division of duties and a cooperative system seemed to be required.

"There was no practically helpful support and guideline for planning courses from the organisation."

– Teacher (No.1)

"I would say teachers need support like hands-on guiding in practice."

– Teacher (No.8)

"I worked as a teaching assistant. I organised Zoom exercise once a week and there were five or six other assistants. But we didn't know how to divide the roles."

– Student (No.4)

- *Extra burden*

Teachers encountered a lot of workloads in comparison with the pre-COVID pandemic, which sometimes resulted in them feeling overwhelmed. For example, they had to learn how to use new devices and software to create online materials and use them in lectures. They had to respond the student's inquiries with online means and they also had many online meetings. In particular, teachers who have additional duties, such as research and thesis advising, had little time to learn and execute unfamiliar jobs due to a lack of preparation.

"We developed learning process for FITech teachers, but it turned out for many of them to extra workload and not well-fitting to them. So we want to make it easy for them to adopt online courses for learners."

– Teacher (No.7)

"Too many things to be considered to complete every single course. As a result, there is a high percentage of drop-out in online courses but teachers don't consider much about drop-out, but planning."

– Teacher (No.5)

"Typically, teachers do research, not even researchers, they organise research, help their graduate students. Those are their primary jobs. Teaching is somehow on top of that."

– Teacher (No.8)

- *Low usability of MyCourses*

Using MyCourses was the toughest challenge for teachers. They argued that MyCourses was not interactive or easy-to-use. For instance, some features were

so elusive, that sometimes teachers did not realise that the features were available. Moreover, they should have clicked multiple times for accessing a certain page and repeated the same actions. These obstacles prevented teachers from organising their online courses efficiently and productively.

"Mycourses is not very interactive. We have only 2hours a week for online interaction on Zoom, but very few students ask questions outside the lectures. ... In the final feed-back, many students said that there was not many support from the teacher even though their participation in activities was low. The big discrepancy between students feedback and their behaviour. Very disappointed that students do not join the sessions teachers organised. I don't know why. I haven't gotten good comments from students at the moment."

– Teacher (No.4)

"Copying existing courses – much clumsier – you click something 5-6 times to find what you want to do, and it's important user interface point of view."

– Teacher (No.2)

- *Pedagogical difficulty*

Teachers encountered pedagogical challenges in the online learning environment that could not be addressed by previous ways. For instance, they questioned whether it was ethical to request students to turn on their cameras during online lectures. Therefore, teachers recognised that new pedagogies for online courses are required for using digital tools, but they struggled to adopt and implement new methods that had not yet been codified.

"It can underestimate teacher's professionalism if you force them to follow some crappy modules. Because they might have better ideas, they might have better modules somewhere."

– Teacher (No.8)

"Maybe I should use some better tools, but I have to say it's not very systematically. Because I think I am somehow an experienced teacher so I can just do it."

– Teacher (No.4)

"Unfortunately, students' comments are such that hard to follow. One student suggests "more" but the other one say "less". So, I don't change my course very much. I have pedagogic mind that do not follow students."

– Teacher (No.4)

"I reduced exams but increased the number of exercises to encourage students to be more active in the online environment, but I'm still trying to invent the way of exercises with new digital tools."

– Teacher (No.2)

- *Lack of motivation*

Teaching is not the only task for teachers, rather they have various duties such as doing research, guiding graduate students, and applying for funding. As a result, they

cannot spend a lot of time to making the appropriate changes and developing their courses further. Even if time allows for teachers to do so, they should sometimes be motivated to work on the improvements.

"Half of teachers are not really interested in learning pedagogy, like you never see them in any meetings and they will do as little as they are just forced for developing new ways of teaching. They have their own ways, but some still follow 80's, 90's style. … It takes time to develop their thinking, and like somehow it's quite old-fashion thinking. It's like you have lectures, you have some exercises, and that's it."

– Teacher (No.7)

"But young professors or teachers design their courses well and validate their courses for their career, like portfolio. They actually give more effort to that."

– Teacher (No.8)

"They lack their motivation spending enormous time to make system and process. There's a limit to learn new tools, if you spend one week for learning a tool and use it for one course and one year, and Aalto decides 'we are not gonna use this tool any-more'. It's not worth learning that, really."

– Teacher (No.8)

4.1.2 Students

• *Distraction and fatigue*

Students got bored easily and struggled to keep focusing while sitting at their desks for hours. The environment where they studied had more aspects to distract their attention than the one that the classroom had. Students were also influenced by the teacher's tone of voice, atmosphere, mood, and way of teaching during online lectures which were closely connected with students' motivation. And technical issues built up students' fatigue, emotional stress, and tiredness. For example, low audio and video quality during a real-time online lecture caused students to lose their concentration and they ended up turning off their camera. Moreover, they tended to be distracted by text-heavy and unreadable course contents in MyCourses.

"It's hard to focus on the lecture with a monotone for 3 hours online."

– Student (No. 3)

"I'm tired of the low audio quality. I couldn't handle my concentration, you know, I hope it's like, as similar quality as Youtube."

– Student (No.5)

"I lost my focus on the lecture so I had to replay a video(recording) quite frequently after that."

– Student (No.1)

"It's somehow boring to watch around 30mintues to 1-hour of videos. It's hard for me to focus."

– Student (No.4)

- *Crowd psychology*

Student engagement and participation in their learning process and social activities are of paramount importance. However, many students were mute, keeping their cameras off during the lecture and preferred to communicate by text in the chat box. Students also, tended to follow the behaviour and thoughts of others, although they explained privacy, environmental and personal situations as reasons. In particular, first-year students tended to be shyer and less active than high-year students who had already gotten to know each other. These phenomena also emerged in MyCourses.

"I joined a Zoom lecture but I was alone out of 100 and so embarrassed. The lecture was cancelled at the end."

– Student (No.1)

"Others don't participate in the online lectures so I was thinking that should I join?"

– Student (No.6)

"I was only participant in the online Zoom, it's kind of in a few weeks and the teacher was giving up like okay, you are the only one here even though there's hundreds of other students. But I'm only one in that on Zoom. There's sometimes like one person and then that person drop out pretty soon. So the teacher kind of like frustrated. It's kind of unfortune really."

– Student (No.2)

- *Low sense of belonging*

A lack of physical interaction brought about the isolation that students felt due to a low sense of belonging. Not only teacher-student interaction but also student-student interaction was missing. In comparison with online colleges, students expected to be a part of the university community and to participate in social activities with other students. However, students had less chances to form a sort of community which ended up with low engagement in the online learning environment.

"Some courses have really good models but the others, it's kind of totally lack of inter-action. They can ensure that the students are somehow engaged to the topic or like have to follow the course because probably some people don't really like to even follow up the paces. Maybe a little bit more effort from the teachers and the teacher teams"

– Student (No.2)

"We used Telegram for chat, and I like this to communicate with teachers and people rather than MyCourses. I don't know, I just feel like this is more convenient."

– Student (No.3)

> "I got quite a lot of support from other classmates like we normally contact each other when there's a problem that we don't understand. And then if there are more issues then we contact to tutors."
>
> – Student (No.2)

> "I will have short video lectures and one live session each week and try to have some of easy to participate. Because it seems really hard to get people are unfamiliar with each other to discuss in online setting."
>
> – Teacher (No.1)

- *Falling short of expectations*

When students explored MyCourses to register for courses during the enrolment period, they sometimes encountered unready course pages which did not publish all the course content yet. Some teachers explained that they did not know when the actual student registration begins, so the course page could not be prepared in time. Nevertheless, the insufficient information on the course page led students to be indecisive about registering for the course, resulting in confusion. Once the course fell short of what students were expecting from the MyCourses page, they ended up dropping out even after the course started. Moreover, students mentioned that some course descriptions were not clear enough for them to fully understand, so they got frustrated when they recognised that the course is not suitable for their level and interest.

> "It was difficult to follow the learning level which was higher than what was written in the course plan. If the plan is short when choosing a course, I doubt it somehow. I think detailed and systematic course plans are more reliable and helpful to understand the course. It's annoying if it's too long though."
>
> – Student (No.1)

> "Sometimes the course description on MyCourses is uploaded when the course just begins. And I used to drop out once I realised that the curriculum is not what I was thinking."
>
> – Student (No.3)

> "I expected coding and group work, but it was more of reading and writing. I took the course for two or three weeks, but I quit because I felt it wasn't right."
>
> – Student (No.4)

> "Some courses, in MyCourses, do not have information, or not detailed. I tried to see the previous works of the course in MyCourses, but I couldn't see the page because I didn't have permission."
>
> – Student (No.6)

> "There's no penalty for drop-out, so people around me often stop taking courses. Sometimes I take courses and drop them out even after it ends depending on my grades."
>
> – Student (No.4)

> "My strategy is like registering courses as many as possible, not too many, and see through their first view and read the introduction, and decide which courses I will continue. I think it could be good support for students to kind of like including more about their curriculum of the courses on MyCourses, they would know a little bit more about the course content itself."
>
> – Student (No.2)

- *Lack of communication*

Students did not know how to communicate with teachers and other students during the online courses. They found that people were not active during real-time lectures. Moreover, there was little communication in MyCourses. Students rarely left their comments on a discussion forum, unless they were by force. Students explained the low accessibility and usability of MyCourses as the reason. Moreover, students often got confused by using different external software depending on courses, such as A+, Teams, and Slack for informal communication. Some said a certain standard integrated platform is needed to lose the confusion.

"Well, we rarely used MyCourses. We had a group chat through Telegram or Slack, also including teaching assistants. They responded to our questions quickly."

– Student (No.4)

"I sometimes get confused because I use a lot of software such as A+, TIM and Piazza. Yeah, it's just depending on the courses. I don't know why we don't use MyCourses. It's a little inconvenient."

– Student (No.1)

"Some tutors are very dedicated to the support a lot for helping others but sometimes we get a response late. … it's a lot difficult to communicate or to talk with them because we are working from home and everybody is literally working in a different time zone for example depends on your sleeping hour and where you are."

– Student (No.2)

4.1.3 Three gaps

The above findings indicated that there were "unmet needs" between teachers and students. "Unmet needs", in this thesis, refer to gaps between teacher and student expectations, and they were classified into three categories: Communication gap, Digital literacy gap, and Perception gap. The gaps widened due to the absence of physical communication, the different digital experiences and skills, and the different perspectives on online learning. Therefore, it was apparent that more the aspects of the three gaps are addressed, the more it satisfies the needs of both teachers and students as a result.

- *Communication gap*

Creating a relationship is the vital foundation for establishing a good atmosphere for student engagement and active participation. In an online environment without embodied interactions, however, such a relationship could not be formed despite the advantages of not being limited by time and place. Furthermore, the lack of

experience and knowledge about online communication using digital tools deepened the communicational gap. That eventually caused limited communication between teachers and students in both synchronous and asynchronous learning environment, resulting a low sense of belonging and low participation.

- *Digital literacy gap*

It is obvious that different age groups had different experiences and skills. Young students, who have grown up with modern devices, are digital natives and more digitally literate than older teachers. Also, they were rather aware of digital-age trends and learn new ones quickly when compared to teachers. Once the COVID pandemic began, the digital literacy gap clearly came to light. Moreover, the advantages of technologies were not being fully capitalised, falling short of students' expectations as Conde et al. (2014) stated.

- *Perception gap*

Teachers and students experienced the same online courses with different perspectives. As student expectations were evolving, it was difficult to distinguish student's likes and dislikes and took measures for compensation in a short time. It seemed there was a discrepancy between teachers and students. For example, some students were less willing to participate in the online discussion, but eventually some said that they did not get enough support from teachers. They did not know what each other wanted or what they thought. Teachers struggled to comprehend why students were disengaged from the course, while students struggled to comprehend why teachers were unable to interact with them.

4.2 Design Proposals and Validity

4.2.1 Design challenges

The above findings imply that the unmet needs between teachers and students should be met to increase the quality of online learning services. It was expected, considering the realistic and feasible aspects surrounding the project, that improving the workflows of MyCourses might reduce these gaps with practical assistance effectively. Particularly, the key directions for this project were to help teachers work efficiently reducing their workloads and to improve asynchronous interactions with students in the learning environment. Hence, the improved workflows of MyCourses can play a role in bridging the unmet needs and support them with a smooth process of operating and teaching courses.

Referring to Notion as an example of benchmarking used in the ideation process of the project, which was explained in Chapter 3.4.3, I identified four features that should be addressed to improve the workflows of MyCourses for teachers, which are as follows: Efficiency, Flexibility, Compatibility, and Learnability. These features are closely related to usability, which is a quality attribute that cares about how easily a user interacts with a product or service. The usability level of MyCourses should be improved systematically. Ultimately, teachers can run courses efficiently with flexibility through the LMS that is compatible with other platforms, and they can utilise the LMS effectively with easy-to-learn features.

- *Efficiency*

The results showed that the current MyCourses had yet to support teachers' work efficiency in all respects, that was, the reduction of time spent on repetitive tasks. Teachers should have utilised the benefits of digital technologies in MyCourses fully. Ultimately, it was evident that practical support was required to make teacher's work simple, effective, and productive.

For Notion, templates are one of the key features that have made them successful. Notion provides a gallery with different template pages for each theme (e.g. Design, Education, Marketing, and Personal). Templates are built and shared by a community of customers, and these templates can be viewed and selected to meet other users' needs. On the other hand, despite MyCourses now offering some template-like services, they are not practically utilised due to lacking variation.

- *Flexibility*

There were claims that the current MyCourses needs to function more flexibly, so teachers can modify default features with autonomy. Notion, for example, uses a block model so users can build content with the singular pieces of blocks inside the Notion editor. Users can pick any block types and properties, and then arrange them with simple operations to design pages without coding skills. Moreover, they can create the desired pages through easy-to-use functions (e.g. drag-and-drop) with a clean interface. Considering the Notion's strategy, therefore, it was apparent that MyCourses could provide a flexible interface for teachers to build course pages and manage resources freely, so that it helps teachers adopt their pedagogy plans to MyCourses.

- *Compatibility*

Using multiple software at the same time caused anxiety to teachers and students. For instance, Aalto University has MyCourses as their LMS, and Sisu. The two platforms exchange data synchronously with each other such as the information of students

who registered for a course. However, sometimes students spotted de-synchronised information due to technical problems, causing confusion. Teachers also struggled with being able to synchronise information flexibly and taking time to update it with repetitive actions.

Furthermore, on the technical side, third-party software were not compatible with the MyCourses system. Sometimes the link for the software could not be opened directly through MyCourses. Students should have entered the link by copy-pasting the long link text, which also made the course page messy. On the other hand, Notion has great integrations by collaborating with partners. External software that connects with Notion can be easily embedded on the Notion page, so that users can use Notion as an all-in-one software that connects with all other platforms. Hence, MyCourses should be able to embed external platforms easily.

- *Learnability*

Notion has a consistent user interface with simple icons and patterns that users are familiar with. For MyCourses, learnability is essential because many features must be utilised to reflect the teacher's pedagogical approaches. For instance, Notion provides a simple preview for each feature, so that users can grasp how it works quickly. As such, MyCourses can adopt tutorial services in different formats such as videos, embedded trainings, or training services that can help teachers learn features easily.

Furthermore, some features were elusive in a way that teachers actually knew and used relatively few functions compared to the available ones in MyCourses. Advanced search features may be comprehensively beneficial to discover course content quickly, in case the contents are excessive and elusive.

4.2.2 Design and assessment

Considering the design challenges with four features, a workflow of the web-based MyCourses was created as a low-fidelity prototype based on the teaching process. Also, considering the course cycle, the workflow is iterative.

Consequently, the improved workflow of MyCourses consists of three stages: 1) Before the course; 2) During the course; 3) After the course as shown in the *Figure 5*. Each stage with new user interfaces is explained alongside the journey of Professor Paul, who is the Persona which was described in Chapter 3.4.2, in the following paragraphs.

Figure 5. The improved workflow of MyCourses

MyCourses
Learning Management System (LMS)

1st discusison
Before the course

Step 01. Starting MyCourses
Step 02. Finding the Period II (2021-22)
Step 03. Entering the "Nano Engineering" classroom
Step 04. Adding the main information
Step 05. Editing the contents of the Syllabus
Step 06. Adding course schedules and timetables
Step 07. Adding the lecture content
Step 08. Creating assignments
Step 09. Adding previous course reviews
Step 10. Grading the level of course digitalisation

2nd discusison
During the course

Step 01. Preparing the course in advance
Step 02. Giving a greeting and reminder
Step 03. Starting the course
Step 04. Answering the questions

3rd discusison
After the course

Step 01. Grading exams
Step 02. Getting course feedback

Improved workflow with user interfaces

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- **Before the course**

Step 01. Starting MyCourses

Professor Paul has been assigned a "Nano engineering" course in the next semester, following the academic curriculum of the programme that was planned last year. As the course was conducted in the last spring, he plans to use the existing course data on MyCourses that was used previously. Therefore, Paul accesses to MyCourses and clicks the "Log in" button, which is easy-to-find. He ends up logging in MyCourses by filling out his school account.

Image 4. Step 01
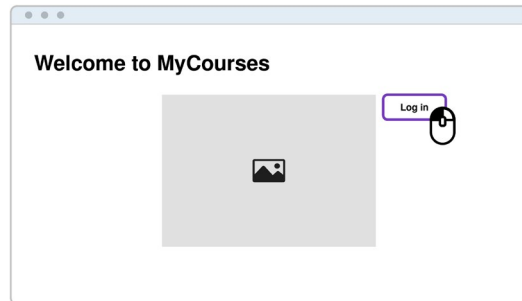
Step 02. Finding the Period II (2021-22)

Paul enters to the dashboard page and checks all his courses. To create the new course page, he clicks "All my courses" button and select "Period II (2021-22)" from a drop-down menu.

Image 5. Step 02
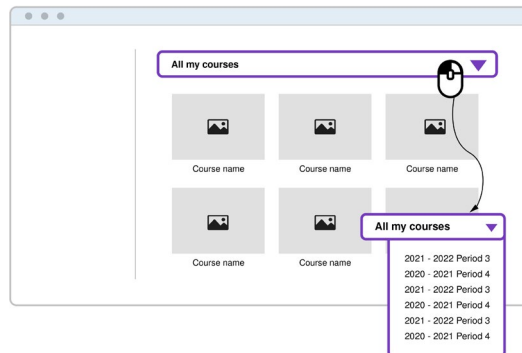
Step 03. Entering the "Nano Engineering" classroom

Once the courses for Period II (2021-22) are shown on the page, Paul clicks the "Nano Engineering" course, which was automatically synchronised from Sisu. Since he ran the course last year, he selects "Copy earlier course" to use content from the previous course of 2020 as a template.

Image 6. Step 03
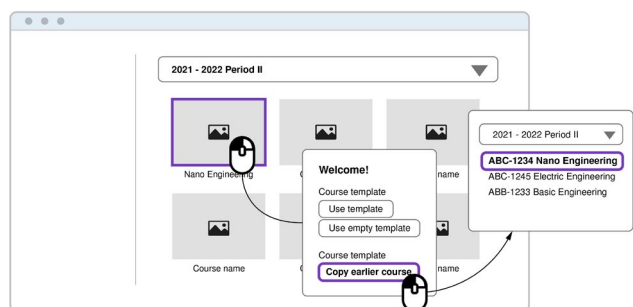
Step 04. Adding the main information

Paul now enters the course page for "Nano Engineering" course. The course page is already with previous data as a default. He plans to add a course description and appearance. First, he wants to change the "Main image" on the landing page. He clicks "Open new image" and select an image he likes (Also images can come from the free open-source services). Once he clicks "Ok", then the image is applied on the template. Also, he edits the text to fill in a greeting and description of the course.

Image 7. Step 04
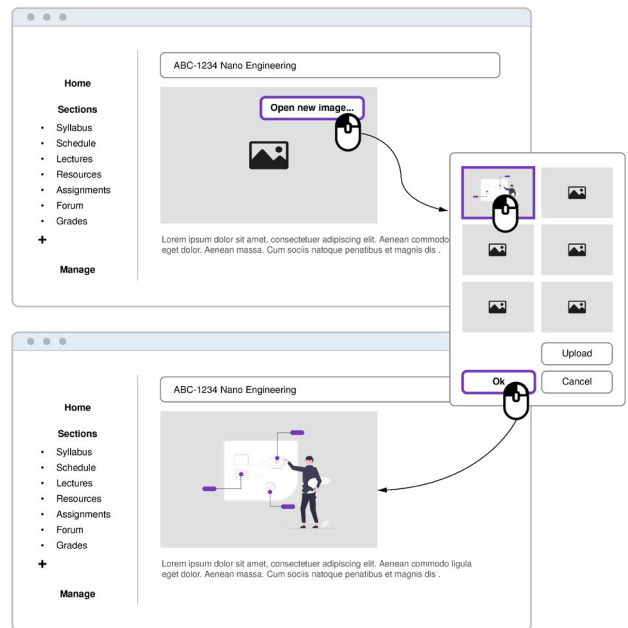
Step 05. Editing the contents of the Syllabus

Now, Paul wants to update the syllabus information on the course page. He accesses the "Syllabus" page on the navigation bar. Since the syllabus data is automatically copied from Sisu, he just checks if the information is correct or not. He has something to change in the syllabus, so he clicks the "Edit..." button. He starts filling out the text boxes to make it easier for students to understand better. First, he clicks the plus button to insert images and watches the preview of the feature by hovering his mouse cursor to understand what it is. Once he is ready, he clicks the "Save" button then the information is now updated.
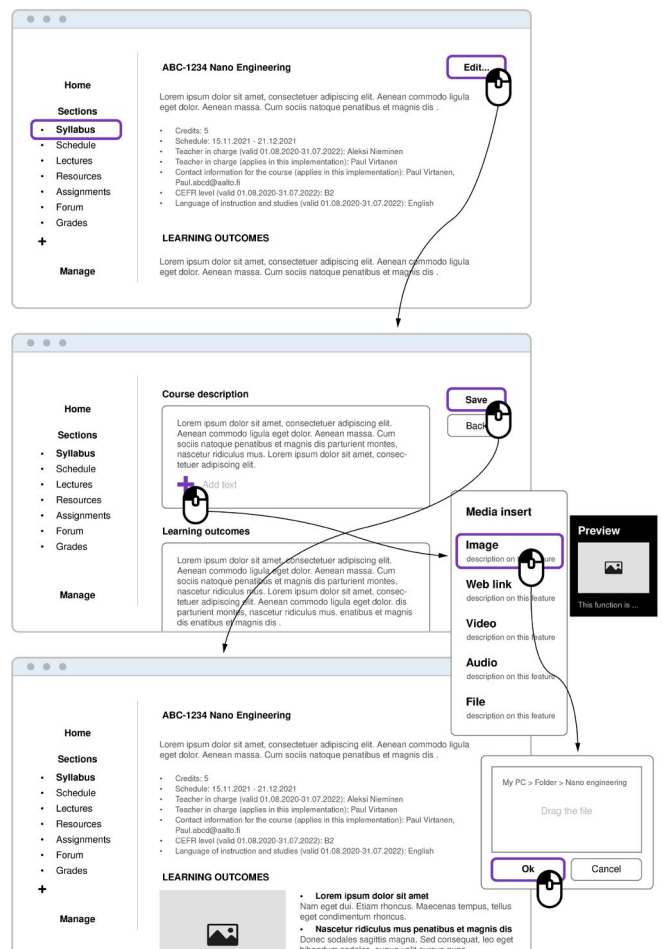
"The good point is that after choosing a template, then it is easier to add stuff smoothly into the course pages with the guide process."

- Participant (No. 5)

Image 8. Step 05

Step 06. Adding course schedules and timetables

Paul wants to add information on the Week 1 lecture in the schedule, so he clicks the "Schedule" section on the navigation bar. As the academic schedule is automatically synchronised with Sisu, three courses that he will run during the next semester are already shown on his calendar. He clicks the "Edit…" button and week number and time. Now, he edits the name and description of the course in the text boxes, and thus he saves the information.

"The idea of the clearly visible calendar is nice.
Somehow it would be great to have it better
integrated. Sometimes I forget to change
the MyCourses calendar and students get
confused."

- Participant (No. 4)

"Synchronisation is the key point. New
scheduling tool is needed by synchronising in
both ways, which is easy to change for us."

- Participant (No. 1)

Image 9. Step 06
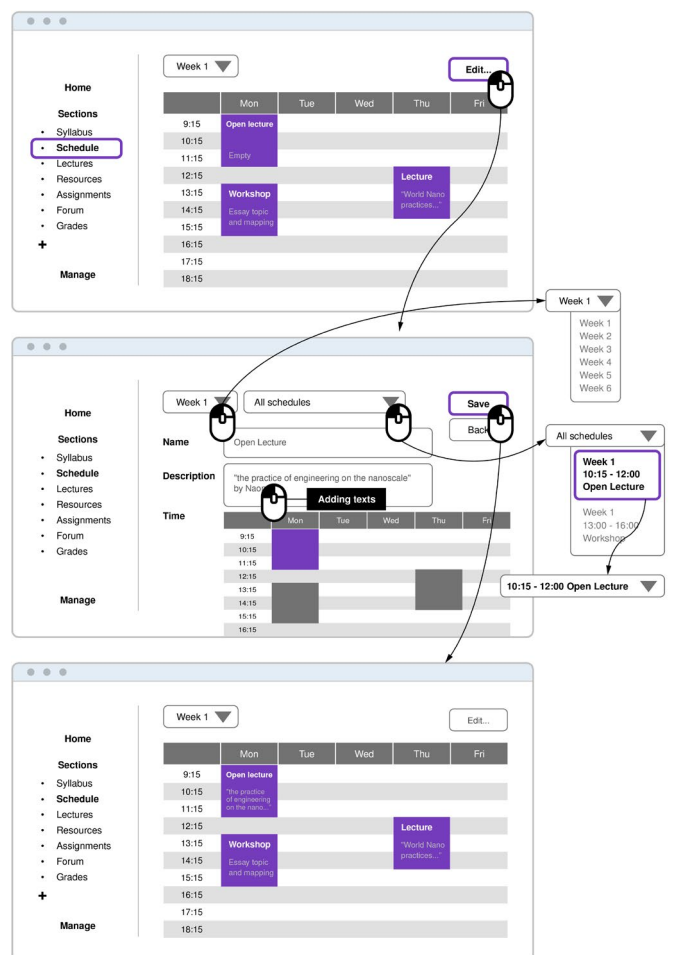
Step 07. Adding the lecture content

Now Paul needs to add chapters for six weeks that are standard defaults.

He tries to change the "Main image" of each chapter, so he clicks the "Open new image" for the Week 1 page and saves after selecting an image. When he enters to the Week 1 page, a template page is shown. He clicks "Edit..." to add the Week 1 lecture content. He fills out the boxes by adding a video and text and eventually saves the information in the end.

"Instead of lectures/materials/assignment, it can be useful to structure the course in different topics or lecture weeks, so that each topic or module or whatever contains lectures, materials and assignment."

- Participant (No. 3)

"I like the idea that there is a full period in a single view of the lectures page."

- Participant (No. 2)

Image 10. Step 07
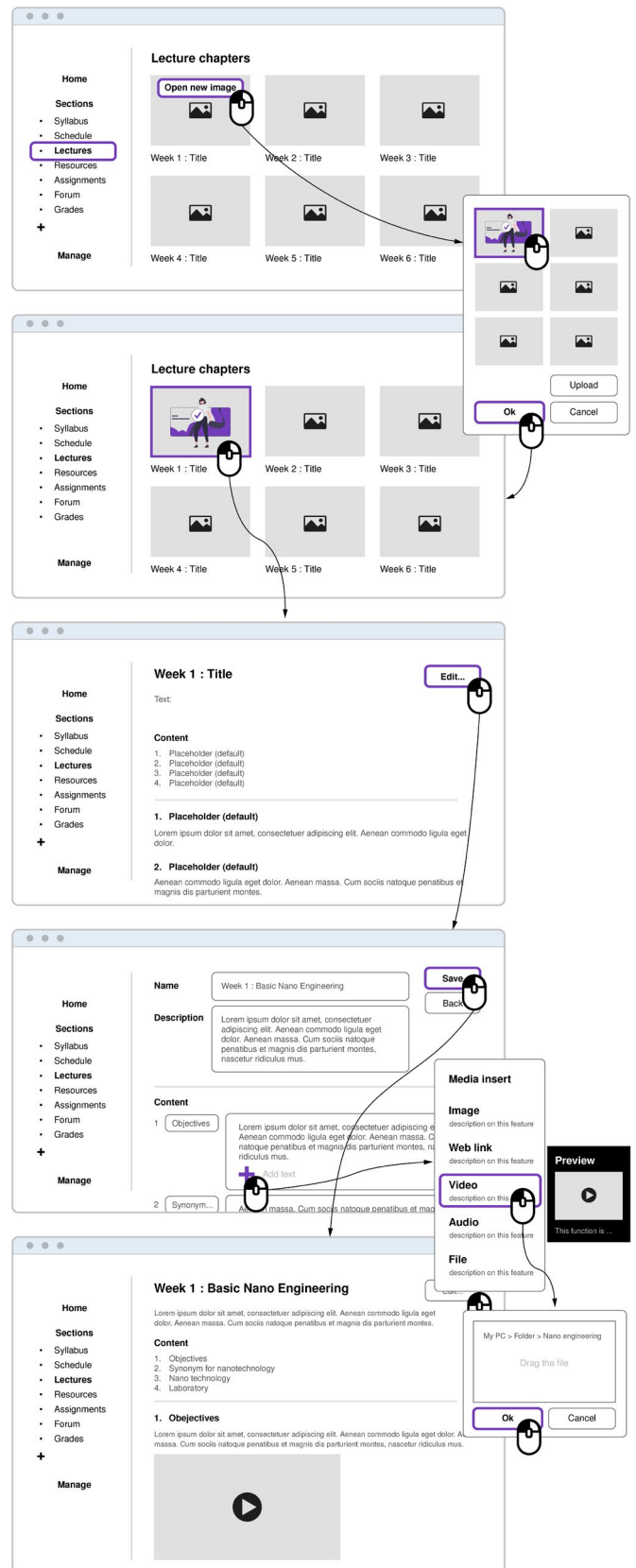
Step 08. Creating assignments

Paul enters to the "Assignments" section through the left navigation bar. He clicks the "New assignment" button and fills in the "General" data with an inserted file. Next, he adds the "Grading", "Availability", and "Release" data and clicks the "next" and "save" button in the end.

> "It has one level of navigation, but actually, if you have more materials, it would be sometimes handed into two levels of navigation. Each session becomes really long so topic-based navigation would be very helpful."
>
> - Participant (No. 1)

> "There're a lot of other assignments that do not fit into submission or online text format. These are also needed."
>
> - Participant (No. 1)

Image 11. Step 08
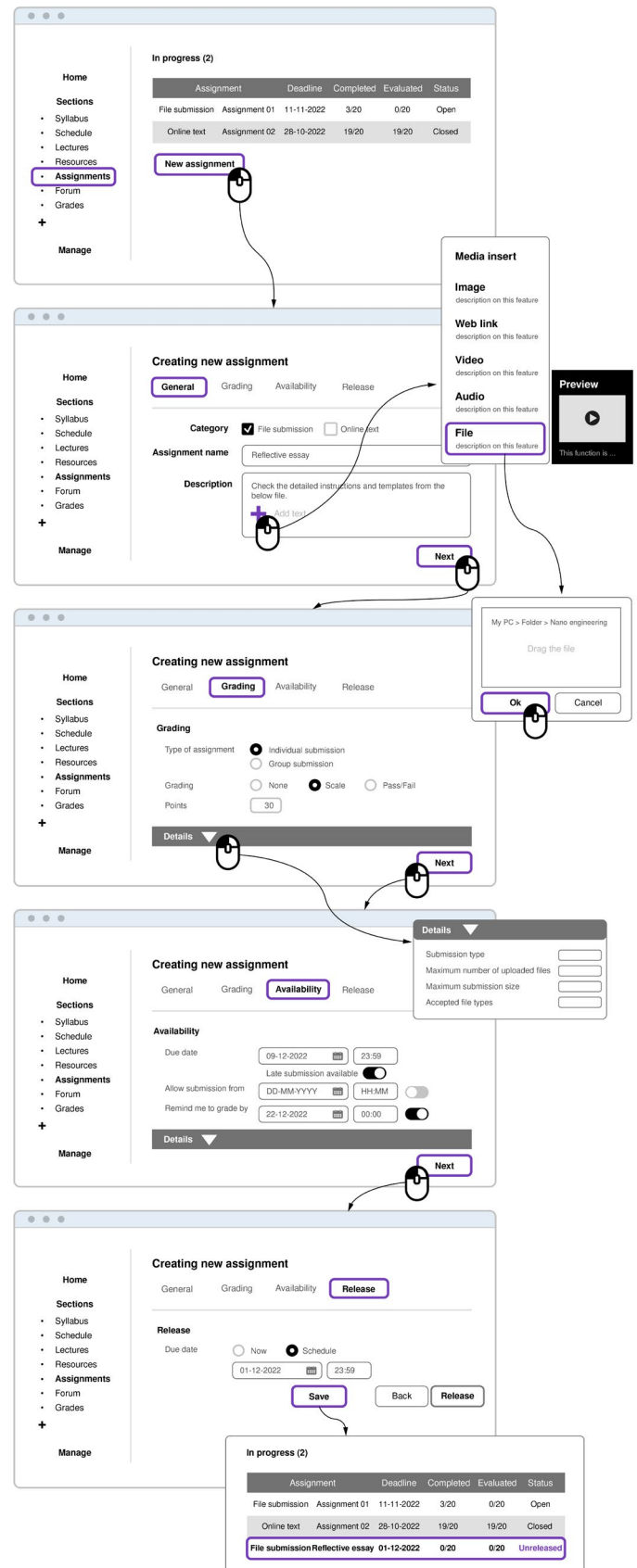
Step 09. Adding previous course reviews

Paul now wants to publish student reviews of the previous course. He creates a new section on the navigation bar, and clicks the "Review" button and drags and drops it under the "Lecture" section. Reviews can be anonymous depending on the student's decision in advance.

Image 12. Step 09
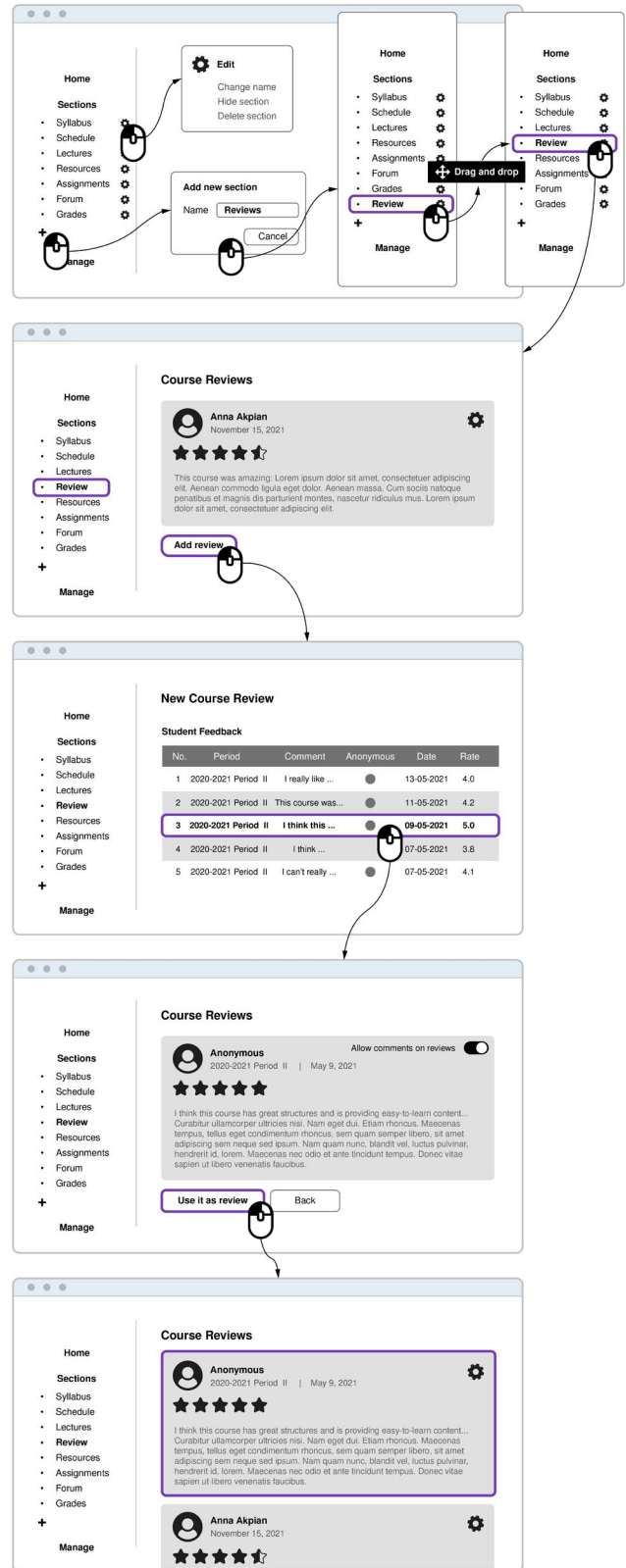
Step 10. Assessing the level of course digitalisation

Paul accesses the "Manage" section on the bottom left side of the page, and enters the "Self-evaluation" section. He ticks off items in the list, and submits the answer. Once the checklist result is shown, he checks and interprets the level of course digitalisation.

> "They look very suggestive, like technology-based, and should more reflect on how the course activities have supported learning"
>
> - Participant (No. 4)

Image 13. Step 10
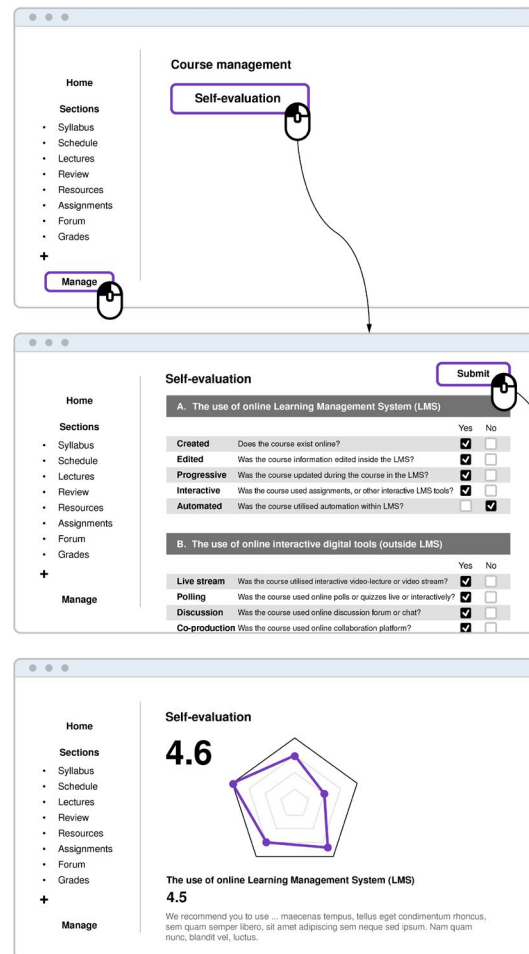
• **During the course**

Step 11. Preparing the course in advance

Paul is notified of the date via MyCourses when the students registration period starts, so that he can prepare all the course content on his course page to be published in the given time. Now he accesses the "Nano Engineering" course page to double-check the course information and appearance. Also, he adds a Zoom link on the landing page. He clicks the icon for "Settings" next to "Start with Zoom", and fills in the Zoom link.

Image 14. Step 11
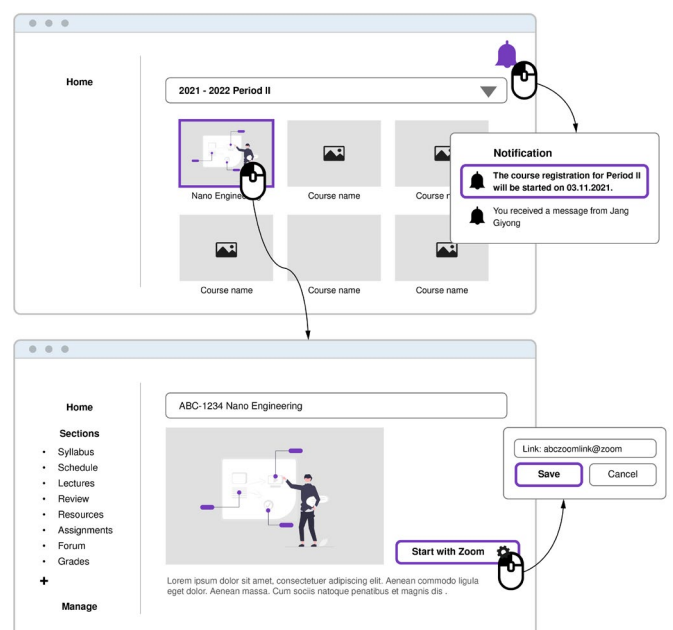
Step 12. Giving a greeting and reminder

Paul wants to give a greeting to students, so he starts posting a greeting announcement on MyCourses. He enters the "Forum" section on the navigation bar, and clicks the "Add" button to create a post. Once he fills in the title and description, he finishes by clicking the "Save" button. Afterwards, students receive the notification on MyCourses that there is a new announcement from the teacher.
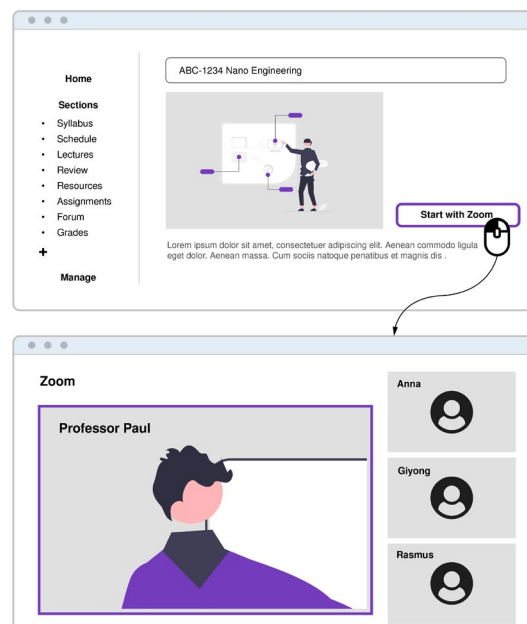
Image 15. Step 12
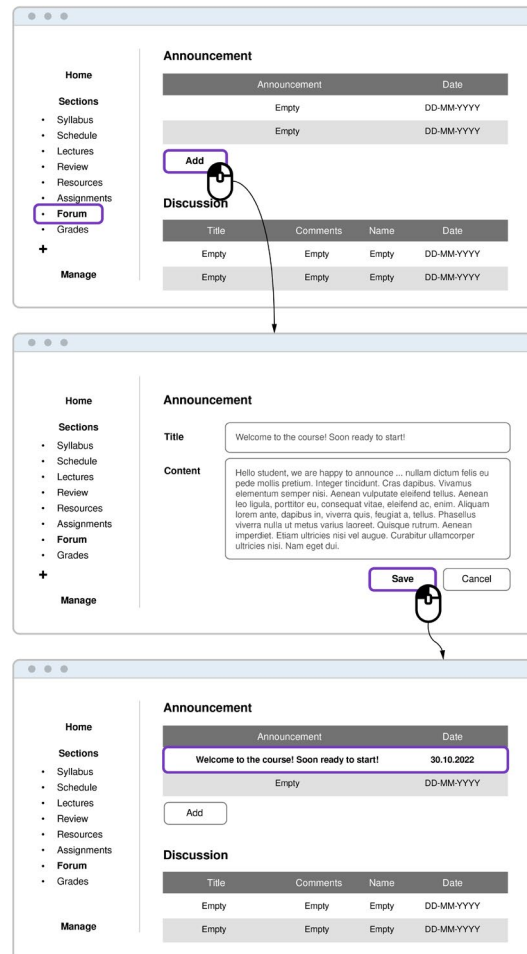
Step 13. Starting the course

When the first lecture starts in the first week, he enters the Zoom link directly by clicking the "Start with Zoom" button. He could also click the time slot on an integrated calendar in MyCourses so that he avoids confusion to find a proper link.

"I wish there's reliable and automatic creation of recurring Zoom sessions for each lecture that will (all) show up in MyCourses calendar and in my aalto.zoom.us account (and in my Office calendar)"

- Participant (No. 2)

Image 16. Step 13

Step 14. Answering the questions

When the course begins, students add some questions on the "Forum" section. Paul clicks the "Chat" activity button on the Forum section, and he checks the questions and answers with teaching assistants. He finds questions from a student that he can respond to. So, he sends a message directly to the student through his profile.

Image 17. Step 14

• **After the course**

Step 15. Grading exams

After the last lecture is done, Paul and his teaching assistants receive notifications when students submit their assignments and exams via MyCourses. He enters to the "Nano Engineering" course page, and the "Grades" section on the navigation bar. He clicks the "Exams" button in categories to check the submission status. And he selects the "Peer review" button and fills in the form to assign peer review, and he ends by clicking the "Save and publish" button.

Image 18. Step 15
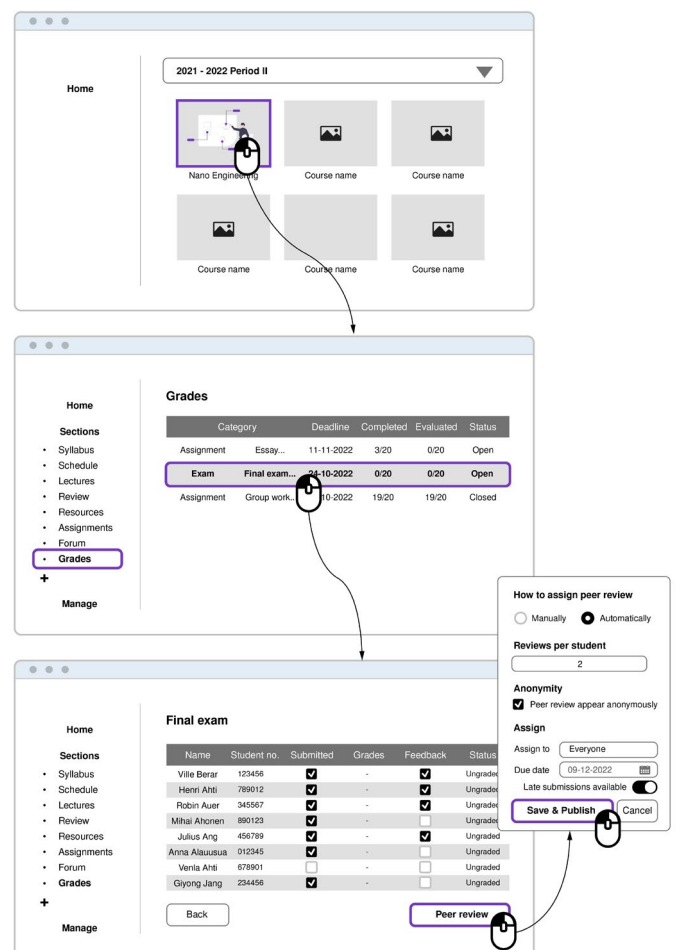
Step 16. Getting course feedback

Paul encourages students to do a feedback session in MyCourses directly by posting an announcement on the Forum. He enters the "Manage" section on the navigation bar to review the course feedback after he waits. He clicks the "Course feedback" button and checks the comments from students. The collected course feedback from students is used as reviews for the next course promotion.

"I think the teacher should have a chance to select which reviews are shown, like cherry-pick, because some reviews might have misleading, wrong or narrow-minded information about the course."

- Participant (No. 2)

"Visibility of any student comments on MyCourses must be up to the teacher, I guess, simply to protect the teacher's personal rights."

– Participant (No. 1)

"The feedback is usually multiple-choice, I just skip open-ended questions unless I have a big complaint. ... I'm just too lazy to give feedback."

- Student (No.4)

"I don't do feedback surveys unless I'm forced to do. It was like just click, click, click and it was done. I just don't know why I had to."

- Student (No.1)

"Well in general, I don't give normally feedback. Just something that I personally don't give feedback. But for example, some courses have extra point for feedback, so that's something that encouraged me to do. That's the only encouragement for me really."

- Student (No.2)

Image 19. Step 16
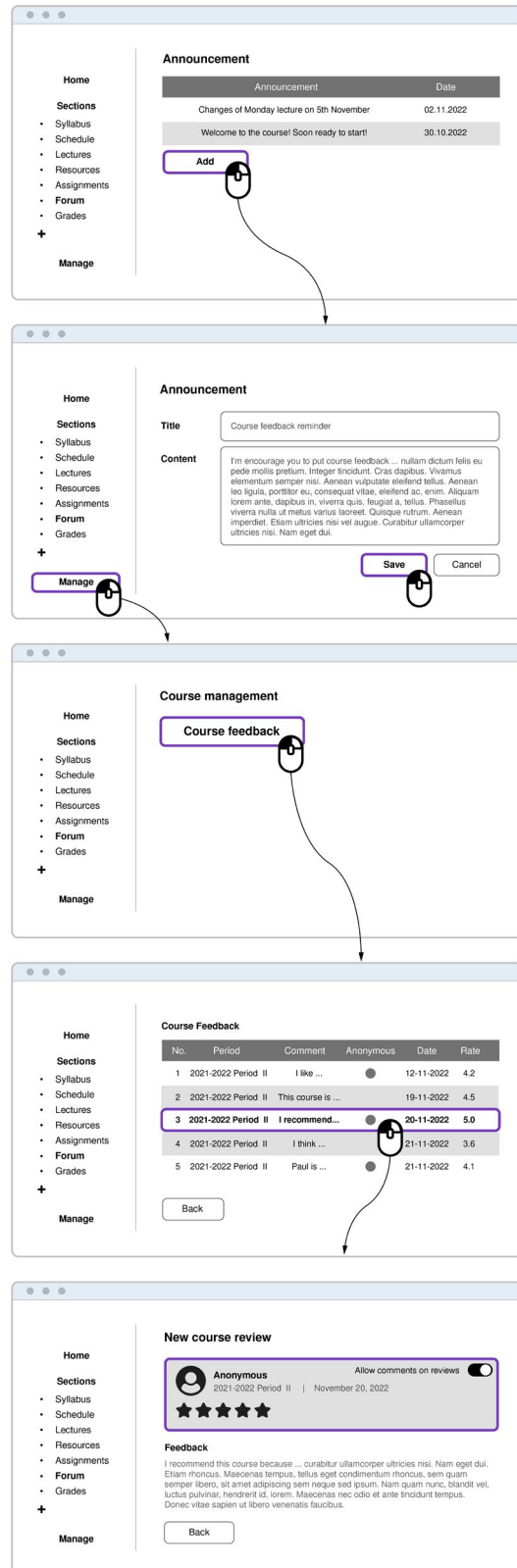
Once the semester completely ends, the university commends Professor Paul as the best teacher based on the student feedback. He is motivated to keep working on the improvement of his course for the next year.

05
CONCLUSION

5.1. Conclusion & Discussion

The learning and teaching practices of higher education have been changed since the COVID-19 pandemic began in 2020. University teachers had to run online courses that had never been done before. They encountered various difficulties when it comes to interacting with students in the online learning environment. Also, they struggled to incorporate new pedagogical knowledge and digital resources into their teaching practices. To improve the quality of education, it was important for teachers to have practical support at the school level, along with their own efforts. In particular, LMS could be used as a practical aid, but it has yet to support teachers comprehensively. Therefore, the thesis outlined a feasible vision of developing the LMS that could help teachers improve their teaching practices and adopt pedagogical approaches with thoughtful use of technology, and increasing interactions with students in the asynchronous learning environment. And it could be used to support the improvement of the LMS digitally mediated pedagogical workflows.

Chapter 5 responds to research questions by comparing the research data with academic findings from the literature review. The following sections illustrate the answers to each research question.

- **What were the challenges that teachers and students encountered in online courses during the COVID-19 pandemic?**

Through the interviews and observations, the research identified thirteen challenges that teachers and students faced in online courses during the COVID-19 pandemic. The challenges are grouped into eight and five themes for teachers and students respectively. Consequently, the research reveals three unmet needs between teachers and students that reflect the challenges.

- *Communication gap*

Embodied interaction was considered as a core aspect in higher education institutions. However, due to the lack of in-person interactions during the COVID-19 pandemic, teachers and students experienced communication difficulties. Teachers could not establish a relationship with students, resulting in social isolation, student fatigue, disengagement, boredom, and confusion (Ylirisku et al., 2021). Moreover, LMSs could not be efficiently utilised to support teacher-student interactions in the online learning environment.

- *Digital literacy gap*

Getting familiar with digital technologies was not easy for teachers in comparison with students, who were born as digital natives. It took longer for teachers to get accustomed to methods they had not used often in the past. Indeed, teachers were reluctant to learn how to use new digital tools and technologies (Alias & Zainuddin, 2005; Bennacer et al., 2021; Yueh & Hsu, 2008). Young students had been exposed to various digital technologies on a daily basis and they could compare the content that universities provided with other content from young platforms. Once students faced courses that were not digitised fully, then they often lost their motivation. Furthermore, when a lecture was delayed due to the unexpected technical difficulties such as low internet connection, it caused student distraction and fatigue.

- *Perception gap*

The different perspectives and expectations between teachers and students in online courses caused confusion on understanding each other. Teachers struggled with the application of their traditional pedagogies into the digital domain without sufficient knowledge and experience on online teaching. They needed to learn new ways for online teaching but it was extra burden to invest their time in the familiarisation process. Moreover, working with teaching assistants was not operated well to support teachers in an efficient way (Basri et al., 2021). Importantly, motivation was missing for teachers to keep improving their online courses. On the other hand, students struggled to maintain their motivation because teachers' online learning services fell short of their expectations, that they had had in the beginning. Also, they tended to avoid what others do not. For example, students did not open their camera when others also did not, while teachers did not understand the reasons why students were hiding. Furthermore, social activities among students were missing that were important in universities, resulting in them not feeling a sense of belonging.

- **What workflows of an LMS could help teachers improve work efficiency and asynchronous interactions with students?**

The research adopted a teaching process as a workflow of the LMS that could enhance a teacher's performance and interactions with students in an asynchronous learning environment. The teaching process refers to the overall journey of teachers that starts from understanding students, course structure and teaching, and finally reflections regarding the course. And the course's quality could be improved further as the process is iterative. Considering the teaching process, the workflow of the LMS could be divided into three phases: before the course, during the course, and after the

course. Each phase is explained by comparing the study result with what academics have found in the following paragraphs:

- *Before the course*

This phase is important for a course to be successful, as it is the preparation stage of the teaching process. Teachers must prepare their courses in an organised and creative way to ensure the high-quality of online learning services to students (Feldman & Zucker, 2002; Ragan, 1999). The more teachers have a concrete plan, the better their course is as corresponding to Feldman and Zucker (2002). Teachers can begin empathising what students want and define what subjects they would teach and who would be the target students. Also, they should consider various "e-tivities" and digital tools to be used in the LMS that can encourage students to be more active to engage in learning and to increase the level of interactions in the course (Greenland, 2011; Perveen, 2016). Eventually, they can test and develop their course with a self-assessment before the actual course begins. It is helpful to improve or refine the course as corresponding to the recent experience (Bennacer et al., 2021), which identified a self-assessment tool, which could improve a teacher's skills and activities on the LMS. Importantly, the self-assessment should be designed carefully so that it does not evaluate the teacher's pedagogy as there were some sceptical opinions from the focus group testing.

- *During the course*

Teachers begin their courses from this phase actively interacting with students. Starting from an orientation in the first week of a course, they meet and teach students in synchronous lectures via video conferencing tools such as Zoom and Teams. In the asynchronous learning environment, teachers should encourage students to discuss with other peers and reflect themselves through the LMS (Hsiao, 2012; Woo & Reeves, 2008), so that they can think over a topic with in-depth learning and critical thinking. Moreover, a sort of community needs to be formed during the course using discussion forums. And teachers are required to facilitate and foster the community for students to interact and collaborate (Elias, 2010; Gunn, 2001; Hiltz, 1998b)

- *After the course*

Finally, when the course is about to end, teachers should be able to get familiar with the different grading systems to give students' grades fairly. In the meanwhile, students leave course feedback, and thus teachers can update the course to be used for the next semester based on the students' comments. Students can be encouraged to put their feedback honestly with some rewards as motivation. Moreover, teachers should be motivated with different rewards or incentives to improve their pedagogy and teaching practices constantly (Wolcott, 2003). The teaching process is not over,

but it returns to the first phase and is repeated.

- **What user needs were discovered through exploration of an improved user-interface proposal?**

The proposed workflows were validated through the focus group to identify the teachers' needs for using the LMS. The proposal included prototypes with user interfaces that were improved based on the four features: efficiency, flexibility, compatibility, and learnability. The following sections use these four features as themes to illustrate the discovered needs of teachers.

- *Efficiency*

First, efficiency is considered as the key aspect to address the user needs. It was evident that LMS should be easy-to-use, user-friendly, and productive, reducing complicated and repetitive processes to improve the usability level. The research indicated that providing a template, a shared format used as a pre-set, can be a suitable solution to enable users to avoid time-consuming tasks and processes. It also enable teachers to design their course page in a creative and consistent way, and to overcome their anxiety about learning new technologies (Lee et al., 2006). Moreover, various template formats can be created depending on the teachers' demands. For example, teachers can simply select a preferred template for a course page including different sub-pages for grades, assignments, schedules, and resources. It can allow to build and save a page as default template and use it for the next courses. Hence, instead of creating course materials from scratch, it can enable teachers to create new pages and activities easily with an organised framework by duplicating and editing them.

Also, LMS interface needs to be clean and simplified by providing a series of accessible buttons and links (Elias, 2010). For instance, a shortcut feature helps teachers make usage steps simple. Clickable buttons with frequently used links can be commonly utilised as a shortcut to navigate users to a suitable page quickly. As a practical example, if teachers want to change the deadline of a course assignment, they should be able to locate the assignment page with a couple of clicks, rather than wander from place to place, and afterwards, they should be able to change the date with easy operational keys. Moreover, mnemonic keys as keyboard shortcuts (e.g. Ctrl+F = finding words or phrases) can increase the work process speed (Ramakrisnan et al., 2012).

- *Flexibility*

Flexibility is essential for teachers to ensure that they can adopt their teaching

practices and approaches in the online learning environment. With the benefits of the template feature for efficiency, LMS should ensure teacher autonomy and freedom to access different features freely instead of relying on a single rigid template or option. Therefore, LMS should provide a flexible interface for teachers to create, modify, manage content freely.

Furthermore, various features should be available to help teachers apply their teaching approaches to the LMS. For instance, teachers can create a button with a link on a course page, rather than merely add a hyperlink. Moreover, the flexibility needs to accompany user-friendly features. If teachers plan to make a course syllabus page, then they can start with its template and access the page in an editor mode. Afterwards, they can easily add and modify properties (e.g. text, pictures, and graphs) with simple operations depending on their needs.

- *Compatibility*

Universities have internal platforms for different purposes to be used for teachers and students. For example, Aalto University has MyCourses as their LMS, and Sisu for students to manage their study plans. These software in universities needed to be compatible with each other, for teachers and students to ensure that all the information on both software are synchronised. Furthermore, teachers may need to adopt complementary tools that can support their teaching apart from internal tools. As such, many teachers use various software which help them with technical support. Also, third-party assistive tools should be integrated into the LMS according to the universal instructional design principles (Elias, 2010). Since using different external software is essential for teachers to support their practices, it is important for them to receive information about new tools and select which one would be the most suitable depending on their preference.

- *Learnability*

Learnability is a critical factor for increasing usability when users start to use a new platform. This factor considers how easy it is for users to perform tasks the first time they encounter the interface. LMS should help teachers learn LMS features easily when they use a workspace with consistent familiar patterns, buttons, icons, or visuals that everyone knows rather than text-based options. A type of tutorial for better onboard experience can also be considered to increase learnability levels. Considering the digital literacy gap, teachers should be more supported than students by a service that they can understand easily and apply features into practice quickly. They should have a chance to get familiar with features before they meet students in their courses.

5.2 Impact of this Study

Whereas traditional universities emphasise on classroom teaching through synchronous approaches, modern universities and online colleges have chosen online teaching through asynchronous approaches. For this reason, researchers have tended to study synchronous and asynchronous learning separately by dividing them into classes. However, both synchronous and asynchronous learning occur throughout the entire course journey in universities. They should be complementary to each other in order to ensure the high quality of education. Hence, a study focusing on asynchronous learning in higher education should get more attention in the academic field. And there needs to be better case studies regarding the LMS development in higher education institutions. Ultimately, this research is expected to provoke discussion on how to improve online learning services through LMS.

Furthermore, since the thesis project was initiated to seek practical solutions to enhance online learning, it is anticipated that it will be considered to provide guidance for the research and development of Aalto's moodle-based LMS. The proposal's main impacts include the following aspects:

- The proposal can enable student-teacher interactions to be further improved so that teachers can ensure high quality education.
- It enables teachers to use LMS effectively and productively.
- It enables teachers to organise online courses efficiently.
- It enables teachers to encourage students to participate in courses actively in an asynchronous learning environment.

5.3 Limitation

The data was gathered through interviews with participants from the School of Electrical Engineering at Aalto University, which funded this thesis project. For that reason, the results may not be the representative of all the schools and departments. Furthermore, the thesis focused on the severe moment when the COVID-19 pandemic began in 2020 and 2021. Since the pandemic crisis is about to end, schools, teachers and students might have been accustomed to online teaching. Therefore, it may need support to reflect the new online teaching conditions that have changed as it transitions from the Pandemic to the Endemic.

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APPENDIX

A. Interview script: Teacher

Checklist before Interview (Teachers)
• Introduction with ethic consideration (build trust)
• Introduction on the purpose of interview and project
• Ask for story
• Ask for permission to record that will be only used for studies

Introduction (3min)

• Moi, I would like to explain what I am doing and what we are going to do today. This project is the study for developing new solutions for digital learning services at the Aalto University School of Electrical Engineering through applying a service design, user experience design approach.

• Today, to discover the real needs of teachers, I asked you to have interview and thank you for accepting this interview. Your engagement would be very helpful for this study.

• I prepared a couple of questions about workflow and process of your course, and issues you have faced so far during online courses.

General Questions (5min)

• Could you tell me a little about yourself?

• What do you teach, and for whom?

• How long have you worked as a teacher?

(Show the Miro boards)

In-dept Questions (20min)

• **Before course**

1.How have you organised your new course for online courses? (What is your own building process for courses online?)

2.Which process was the hardest for you? (e.g. time consuming)

3.How long it takes to be ready for course, and when starts?

4.How to create your course contents and activities?

5.How to decide which course is needed for students?

• **During course**

1.What kinds of teaching have you done? (Synchronous/asynchronous/ blended learning)

exercise/exam/materials/assignments

2.What devices do you have and use? (e.g. laptop, i-pad, tablet, etc)

3.What digital tools do you use, and why?

4.What could be difficulties during live class?

5.What are your daily tasks as a teacher?

• **After course**

1.Have you got any valuable feedback from students after course?

2.What happens for you after course?

• **Additional question**

1.What do you think should be changed the most?

2.How do you think digital education in the future will change and teachers will respond?

3.What is the most difficult part of online classes as a teacher?

Conclusion

• Thank you for your kindness today. It will be very helpful for this study.

• I would like to ask if I can take part in your new course at period 3 for only about 1 hour, and observe what's going on during courses between teachers and students in person. Only as long as you are willing to permit my participation.

B. Interview script: Student

Checklist before Interview (Students)
• Introduction with ethic consideration (build trust)
• Introduction on the purpose of interview and project
• Ask for story
• Ask for permission to record that will be only used for studies

Introduction (3min)

• Moi, this project is the study for developing novel solutions for digital learning services at the Aalto University School of Electrical Engineering through applying a service design, user experience design approach.

• Today, to discover the real needs of teachers, I asked you to have interview and thank you for accepting this interview. Your engagement would be very helpful for this project.

• I prepared a couple of questions about workflow and process of your course, and issues you have faced so far during online courses.

General Questions (5min)

• Could you tell me a little about yourself?

• How long have you studied at Aalto?

In-dept Questions (20min)

• **Before course**

1.What is the hardest part in deciding or searching courses?

2.What make you attract a course?

3.Do you read syllabus of courses, and what is the hardest part?

4.What kinds of information are needed for you?

• **During course**

5.What kinds of learning have you done? (Synchronous/asynchronous/ blended learning)

6.What devices do you have and use? (e.g. laptop, i-pad, tablet, etc)

7.What digital tools do you use, and why?

8.What could be difficulties during live class?

9.What are your daily tasks as a student?

10.Have you had experience about drop-out? And why?

• **After course**

11.Have you give feedback to the teacher of course?

12.Do you have something to expect for teachers after courses?

• **Additional question**

13.What do you think should be changed the most?

14.How do you think digital education in the future will change and teachers will respond?

15.What is the most difficult part of online classes as a student?

Conclusion

• Thank you for your kindness today. It will be very helpful for this study.

Handouts

Focus group workshop

Digitalisation of courses
through service design for teachers

- 13:00 - 15:00 (2 hours)
- Wednesday, 31st of March, 2021

Hello!

Overview

This focus group workshop is intended to **share and discuss created design proposals for the MyCourses interaction system** to develop the digital learning platform for teachers in ELEC at Aalto University. The design proposals have been developed through applying a service design, user experience design approach. We expect you to share your ideas and feedback on the current designs to be reflected in further studies.

Key workshop takeaways

1. Assess designs and share feedback with teachers
2. Discuss the implementation of design in terms of feasibility
3. How to develop the concepts for further studies
4. Identify potential opportutnities

Schedule

Time	Session
13:00 - 13:10	Introduction
13:10 - 14:00	1st discussion: Before the course
14:00 - 14:30	2nd discussion: During the course
14:30 - 14:50	3rd discussion: After the course
14:50 - 15:00	Closing

Before
the workshop

Instruction

1. Open the Miro board link
   Click here
2. Observe the designed interactions

If you have time:

3. Add comments (on the yellow post-its)

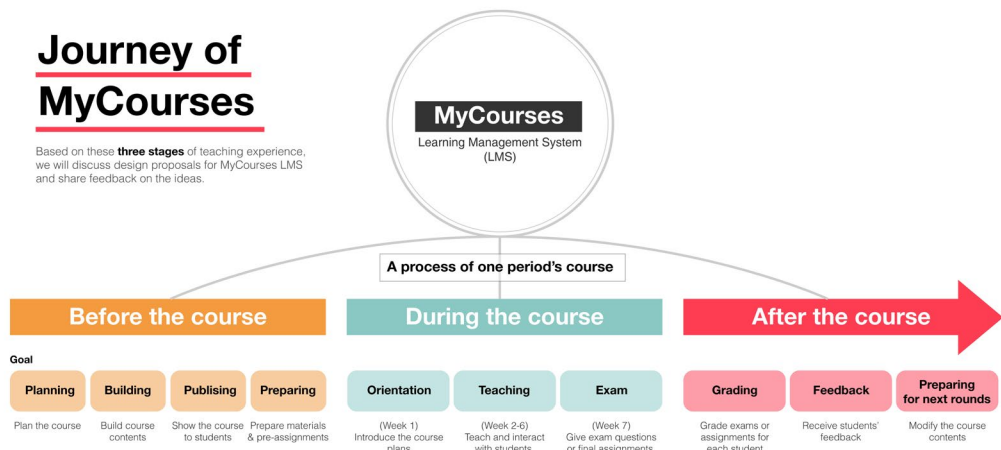* We will explain more detail during the workshop

How to use Miro board?

Designed interactions

Feedback board
Feedback board

write your ideas ...

I don't know if this is necessary or not...

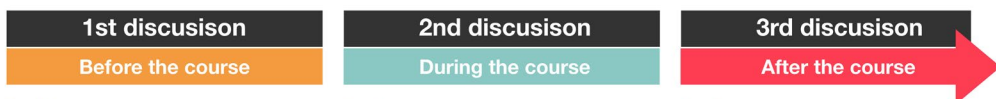**Write your feedback**

Other functions

Copy a sticky : Drag & Drop

Zoom out/in : Scrolling/pinching

Move : Space bar + left drag

Journey of
MyCourses

Based on these **three stages** of teaching experience, we will discuss design proposals for MyCourses LMS and share feedback on the ideas.
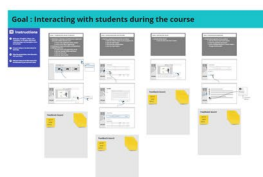
MyCourses
Learning Management System
(LMS)

A process of one period's course

Before the course	During the course	After the course

Goal

Planning	Building	Publising	Preparing	Orientation	Teaching	Exam	Grading	Feedback	Preparing for next rounds
Plan the course	Build course contents	Show the course to students	Prepare materials & pre-assignments	(Week 1) Introduce the course plans	(Week 2-6) Teach and interact with students	(Week 7) Give exam questions or final assignments	Grade exams or assignments for each student	Receive students' feedback	Modify the course contents

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Discussion Sessions

1st discussion	2nd discussion	3rd discussion
Before the course	During the course	After the course

1st discussion — Before the course
Step 01. Starting MyCourses
Step 02. Finding the Period II (2021-22)
Step 03. Entering the "Nano Engineering" classroom
Step 04. Adding the main information
Step 05. Editing the contents of the Syllabus
Step 06. Adding course schedules and timetables
Step 07. Adding the lecture content
Step 08. Creating assignments
Step 09. Adding previous course reviews
Step 10. Grading the level of course digitalisation

2nd discussion — During the course
Step 01. Preparing the course in advance
Step 02. Giving a greeting and reminder
Step 03. Starting the course
Step 04. Answering the questions

3rd discussion — After the course
Step 01. Grading exams
Step 02. Getting course feedback

Goal : Creating a new course called "Nano engineering" into MyCourses

Goal : Interacting with students during the course

Goal : Finishing the course

Thank you,

Contact
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