PRINCIPLES FOR DESIGN AND TEACHING IN ONLINE AND BLENDED COURSE IN HIGHER EDUCATION

A mixed-methods study of course designs and teachers' and students' experiences

Daria Volosach

Master of Philosophy in Higher Education

University of Oslo

Faculty of Educational Sciences

March 2022

Abstract

Technological advancements influence significantly educational arenas, including higher education. The digitalization of higher education has resulted in various technology-rich learning environments and models. Furthermore, technology implementation by educational institutions has led to shifts from traditional campus-based learning to other hybrid models. Online blended courses are currently considered one of the most popular and applicable among European higher educational institutions. However, educational institutions and teachers still encounter challenges when designing and delivering such courses, which influence the effectiveness and quality of online teaching and learning. Research studies in higher education have been investigating this issue from both the perspective of teachers and learners. Some have introduced frameworks and principles for evaluating the design of online courses that result in the most effective online learning. However, none of the existing research addressed the design principles these blended courses adhere to, or explored how teachers designed and students experienced these designs.

The current study generates an understanding of coherence between three principles of online blended course design, teaching activities, and students' learning experiences. It does so by examining the designs of two natural science and engineering online courses at a Norwegian institution, and examines the relationship between the design and subsequent teaching/learning from both the perspective of the teacher and student.

This study employed mixed-method research, followed a deductive approach and implemented a systematic literature search of data on online teaching in higher education. It employed a conceptual framework that elaborates on online course design principles founded on constructivist and social learning theories, namely, the principles of *flexibility, interaction, and facilitation of the learning process*. Empirical data about course design was collected through course documents (course web-page, course plans), data about teaching online activities through qualitative semi-structured interviews and students' experiences through a survey (N=31). Documents and interview data were examined through thematic analysis, while the survey data was analyzed by applying descriptive statistics.

The findings show that *the principles of flexibility* and *interaction* are fully integrated into examined online courses. However, the requirements of the effectiveness of interaction between the students and teacher have not necessarily been met due to the low technological literacy of the teachers and their ineffective allocation of time during online teaching activities (lectures, seminars, guidance hours). The principle of *facilitation of the learning process* is also

constructed in the investigated online courses. The element of *learning organization* and *assessment* is fully reflected in the online courses, while the requirements of prompt and personalized delivery of the feedback element have not been addressed due to the large integration of the automatic feedback, and the little consideration of the learner's needs during feedback with the teacher. Online learners experienced positively the flexibility of the course design because it allowed them to allocate time and place for online learning. However, the learners experienced difficulties in online interaction with the teachers, including communication as well as receiving feedback from the teachers. Additionally, the teachers experienced challenges in organizing effective online communication for hard-skills disciplines, as well as facilitating learners' needs. The study suggested that such difficulties are mainly caused by the insufficient appropriate institutional support at two levels. Essentially, the findings indicate the need to provide technologically advanced infrastructure for online course delivery, and that teachers must be supported in developing their digital competence.

This study contributes empirical knowledge to the field of higher education by exploring the problem of effective online course design and teachers' and students' experience with teaching and learning in such courses. The study articulates implications for pedagogical practices and institutional requirements for higher education institutions, paving the way for more effective delivery and quality of online blended courses.

Acknowledgments

This Master's Thesis was the final part of my journey to the greatest dream in life - to be a graduate of one of the best European research universities. Hence, I would like to express my sincerest appreciation to the people who supported me during the toughest, but most meaningful path for me.

First of all, I would like to acknowledge my supervisor Crina Damsa for her support and guidance in cultivating knowledge of being a scholar. With your invaluable expertise and constructive feedback, I was able to successfully conduct this research.

Secondly, I would like to acknowledge NTNU and the Military Academy as well as participants of the study. I appreciate our collaboration, without teachers and students I would not be able to conduct this valuable for Higher Education research.

I would like to acknowledge my family, especially my sister Ekaterina Volosach. You have been a great example of a fearless and most beautiful woman who shared her wisdom of being patient and strong on the way to my dream. Спасибо тебе, моя дорогая сестра. Ты для меня пример и вдохновение.

I want to acknowledge my friends for their support, especially Stanislava Podustova, who was boosting my mood with her outstanding energy and Anna Vasilenkova, who cheered me up whenever I needed it. My dear Stanislava and Anna, having you as my best friends helped me to make my dream come true. Despite the distance, you are always with me. Я благодарна, что у меня есть такие подруги, спасибо вам девочки.

Last but not least, I want to acknowledge Kirill Vankov who actively supported me from the very beginning of my journey till the present day. Your experience and careful guidance helped me to make valuable steps in my life. Ты мой друг, моя опора и мой ментор. Спасибо тебе, мой муж!

Table of contents

Introduction

1.1. Background of the study

The rapid growth of technology and its strong, broad integration within everyday society life results in the formation of "digital societies" (Yates & Rice, 2020). Such phenomena consequently affect the educational arena, including the field of higher education.

Nowadays, almost all higher educational institutions actively implement different models of technology-rich learning environments. A blended model is viewed as popular and applicable among European higher educational institutions (Gaebel et al., 2021). Despite the high popularity of this model, teachers and educational institutions still have challenges with its delivery, that is, teaching according to the developed course design. This often impacts the effectiveness and quality of online teaching and learning. The main reason is that the nature of the blended model is based on a combination of traditional face-to-face instructional activities that are supported by digital solutions. While the teaching methods and principles for designing traditional courses are well examined and integrated into a campus-based environment, they are not always suitable for application in an online learning environment.

Technological advancement in higher education has also resulted in the formation of various *technology-rich learning environments and models* which incorporate a combination of synchronous (face-to-face) and asynchronous (online) teaching and learning settings (Figure 1). For example, in *"campus models"* digital technologies were applied to a campus-based setting, which happens at the same time and place; in *"blended model 1"* the technologies used for the purpose of organizing only online meetings for students at the same time, but from different places; in "*blended model 2*" the learners had a combination of physical and online meetings at the program; and finally the "online models" designed as purely net-based with an opportunity for students to work, collaborate and communicate asynchronously (Fossland, 2015). Consequently, the aforementioned models began to rapidly develop and become massively integrated into higher educational institutions, while shifting from traditional campus-based learning.

The technological integration in education has not only influenced the fulfillment of its primary processes, but as a consequence, modified the nature of learning (Säljö, 2010; Gleason, 2018; Minina, 2020). Therefore, researchers and teachers in the higher education context are exploring the principles of designing online courses as well as investigating methods for online teaching which would facilitate effective online learning experiences.

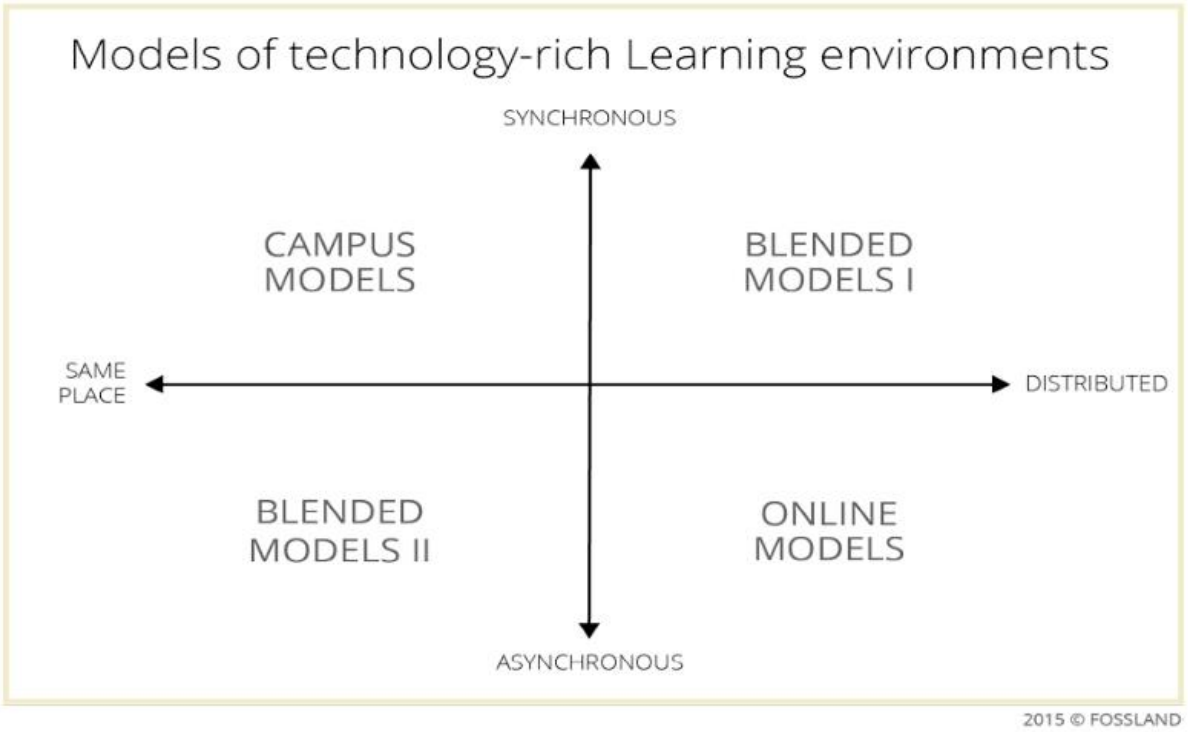


Figure 1. *Models of technology-rich learning environments (*"Digitale Læringsformer i høyere utdanning", by Fossland, 2015, *Oslo: Universitetsforlaget*)

1.2. Background of the problem

The integration of the online component of the blended courses is suggested as the most challenging process for educational institutions and teachers (Rasheed et al., 2020). Moreover, studies show that the main issues and difficulties are connected to the appropriate design of the course, including teaching activities, and appropriate estimation of the learners' needs within the course (Graham et al., 2013; Er et al., 2015; Medina, 2018; Kung-Teck et al., 2020).

Currently, a significant number of the studies suggest frameworks and principles for designing courses that would lead to its effective delivery in the online learning environment. For instance, a systematic review by Boelens et al. (2017) examined the problem of blended learning design and identified four key principles. The first principle was incorporating desirable **flexibility** for students in terms of *time* (study when they want), *place* (study whenever they want), *path* and *pace* (study what they want and how they want). The second principle contained characteristics of **stimulating interaction** between students and teachers. The third principle reflected teachers' activities that would **facilitate students' learning process**. And the last principle was to **foster an effective and motivating learning climate**, where students could feel accepted, valued, and safe during the learning process. In 2020, Robinson et al.'s study also suggested four principles for designing the online and blended

courses: *modeling, dialog, practice, and confirmation*. The study also highlights that aforementioned above principles should be integrated in the course by taking into consideration the learner's needs and feelings. Besides, there was an attempt among the researchers to transfer principles for designing traditional face-to-face courses and implement them into the design of the online courses (Crews & Wilkinson, 2015; Al-Furaih, 2017; Benton, 2019; Munna & Shaikh, 2020). However, the focus of the studies is primarily on the students' perspective, while the teaching activities which facilitated the integration of the principles are not explored. Despite the various conceptual frameworks and principles for designing the courses, there is still a lack of empirical evidence on how such principles are applied by the teachers or integrated by educational institutions.

Using digital solutions in the teaching activities results in the modification of teaching methodology and strategies at higher educational institutions. For instance, Graham conducted a number of empirical studies on quality enhancement of teaching methods in the blended courses (Graham et al., 2018; Graham, 2021; Lim & Graham, 2021). These studies identified that *student evaluation, administrative evaluation, peer evaluation* and *self-evaluation and metrics evaluation* of the online teaching activities led to its effectiveness. Such constant multi-perspective evaluation facilitates the teachers to identify the issues and solve them in a short period of time (Thomas & Graham, 2019). In addition, some studies show that a student-centered approach in online teaching helped the teachers to create effective learning experiences. For instance, the scaffolding teaching practices facilitated collaborative learning and helped the teachers to meet the learners' needs in the online environment (Hsiao et al., 2017). Besides, the aspect of communication and interaction between the teacher and the students plays a vital role in online education. The study identified that students do not assess an email as an effective form of communication (Sadeghi, 2019), while various digital platforms, such as chats and forums, facilitate more efficient interaction in the online learning environment (Habibi et al., 2018; Venkatesh et al., 2020). In addition, the importance of the technological literacy of the teachers has also been investigated. Some studies highlight that technology competencies influence the pedagogical competencies of the teachers as well as affect the quality of how blended courses are delivered (Pilgrim et al., 2018; Rasheed et al., 2020). Needless to say, the aforementioned studies significantly contributed to the investigation of online teaching practices in higher education. However, none of them have explored the design of the course, or how such teaching strategies and activities were envisioned and elaborated in combination with students' envisioned learning outcomes.

Research in higher education has also explored the experiences of online learners. Studies show that online learning is positively experienced by students (Wanner & Palmer, 2015). For instance, research studies have identified that students prefer online courses with blended modes of instruction more than traditional campus-based courses (Owston et al., 2013; Klimova et al., 2017). However, some studies have also identified negative experiences and difficulties which students faced during online learning. For example, some students' challenges are connected with self-regulation, such as procrastination and lack of proper time-management skills (Zacharis, 2015; Broadbent, 2017; Sun et al., 2017; AlJarrah et al., 2018). In addition, some difficulties referred to the technological illiteracy and competencies among the students, which directly influenced the effective delivery of the online course (Chen et al., 2016; Prasad et al., 2018). However, while the aforementioned empirical findings contributed to understanding the problem of online learning in higher education, few research studies explored the designs, teaching activities and strategies that facilitated learners' experiences in blended contexts.

1.3. Problem statement

Design of online courses

Despite a large amount of existing research addressing the problem of online course design in Higher Education, none of it has examined designing effective online courses through a framework that include considered essential elements: 1) online course design principles, 2) teaching activities that would facilitate the integration of design principles, and 3) learners' and teachers' experiences within the online course design.

To address this knowledge gap, the present study addresses, therefore, the complex problem of designing online courses which lead to effective online learning in higher education. The study aims to generate an understanding of **coherence between course design principles, teaching activities, and students' learning experiences** in the context of two natural science and engineering online courses with blended and online models (see Figure 2).

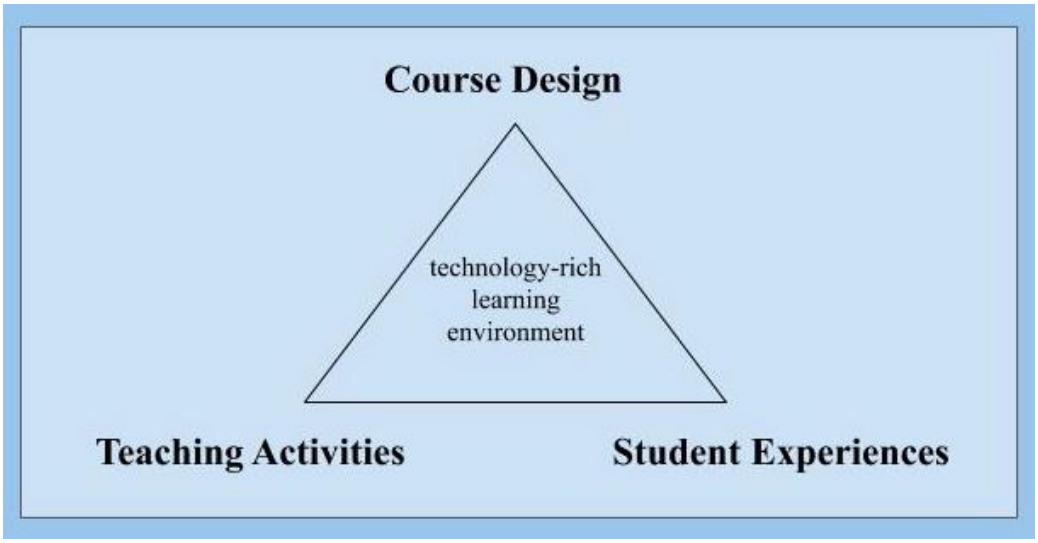


Figure 2. *Illustration of the knowledge gap in online higher education*

1.4. Research questions

The current study will answer the following research questions:

1. How do **course design** and **teaching activities** address design principles and requirements for online blended learning?

   1.1 In which ways is the flexibility principle materialized in the course design elements and teaching activities?

   1.2 In which way is the interaction principle realized through the online teaching activities?

   1.3 In which ways is the principle of facilitation attained through teaching activities and the organization of the course?

2. How are the online **course design and teaching activities experienced** by students and teachers in relation to flexibility, interaction and facilitation?

These research questions will be addressed by employing a mixed-method research approach. I have developed a conceptual framework that is based on the combination of the empirical findings obtained from research studies in the online higher education area. The conceptual framework consists of the online course design principles that are based on the constructivist and social learning theories.

In Chapter 1, I introduce a problem in online course design and teaching in Higher Education that is caused by technological advancement and its integration at all levels. Further, I present a review on highly relevant studies in the field of higher education in the thematic specification of course design, teaching, and learning in online and blended learning environments (Chapter 2). In Chapter 3, I present and explain the theories used as a basis for

the Theoretical framework of the present study. Besides, I elaborate on and explain the Conceptual Framework for the present study (Chapter 4). In Chapter 5, I explain the research design, approach, and methods of the present study, where I also include the data collection instruments and data analysis approach. In Chapter 6, I present the main findings in accordance with each design principle and with an analysis of how the principle is reflected in the course design and delivery of teaching. Where each of these aspects is explored and presented from teachers' and students' perspectives, and based on the analysis of the course documents. Further, I answer two research questions introduced at the beginning of this thesis as well as suggest implications for practice, future research and discuss the limitations of the study (Chapter 7). And I finalize the present Master Thesis with the conclusion (Chapter 8) by introducing final thought on design principles and teaching in the online and blended courses in Higher Education.

2. Literature review

The present section presents the literature on the highly relevant studies in the field of higher education. The section is divided into sub-sections according to the thematic specification. It presents a review of literature about: course design in Higher Education, in the context of the online and blended models (sub-section 2.1.), conceptual frameworks of the course design (sub-section 2.2.), online teaching and learning (sub-section 2.3.) and the challenges experienced by the teachers and students within online courses (sub-section 2.4.).

To review the research literature relevant for the current study, a systematic search strategy and strings as well as a snowball search strategy were implemented (Fink, 2019). All databases with open access from the UiO student account, as well as Oria and Google scholar, were used as main sources for identifying relevant literature for the present study.

2.1. Course design in Higher Education: online and blended models

In 2009, Coate's study introduced three important elements that should be taken into consideration while designing the course for higher education, namely level or degree of higher education, subject and discipline matter, and finally, the mode of instruction (blended, online, face-to-face). Thus, the study suggests that course design for undergraduates differs from postgraduate courses because professors who develop the curriculum for postgraduates tend to have more freedom in designing rather than those that develop for undergraduates. The main reason and explanation for this is that the introductory and undergraduate courses contain the "core" knowledge and disciple fundamentals that should be fixed and framed in the curriculum.

The report on the study "Quality of Norwegian Higher Education: Pathways, Practices, and Performances" highlights the importance of design and its coherent integration within teaching and learning activities. Accordingly, the following characteristics denote the quality of educational practices at course level: course design that allows students to employ conceptual knowledge in new contexts and makes learning explicit through the performance and/or the construction of products; the presence of alignment and internal coherence in a course (learning activities, outcomes, assessment); productive relations between curriculum elements in a course design; activities that link students to their wider perspective disciplinary or professional knowledge culture; a balance between the underlying curriculum logic, the course elements, teaching and learning activities, assessment (Damşa et al., 2015)

In 2019, Barrier et al. addressed and determined the challenges in designing courses for higher education. Thus, the first challenge was implementing the element of socialization in the course, which defines the extent of assimilation of knowledge and skills via interaction

between students. The second challenge was also connected with the sociological aspect but from a deductive perspective. And the final challenge was the influence of "external actors" on the process of constructing the course. The interaction and collaboration between higher education institutions and different companies and private accreditation agencies could regulate in which way pedagogical approaches, theoretical and practical knowledge would be established in the course (Barrier et al, 2019).

A number of empirical studies suggest to design online courses by applying principles from designing campus-based courses (Martyn, 2005; Al-Furaih, 2017; Benton, 2019; Munna & Shaikh, 2020). Thus, in 2014, Karoğlu et al. applied *Seven principles for constructing the course for undergraduates* that were first introduced by Chickering and Gamson in 1987. The study suggests that integration of the mentioned principles would lead to the effective delivery of the online course and significantly enhance the students' motivation. However, the focus of the study is primarily on the students' perspective, while the course design and integration of the principles were not explored.

The design aspect of the online course and the quality of teaching and learners' are interconnected. For instance, an empirical study by Roberts (2015), represents the factors that affect the design process with a philosophical orientation on curriculum. It was found that *a discipline-based orientation* focuses on students' induction into discipline; *Professional and academic orientation* aims to prepare students for future learning and professional work experiences. The purpose of *personal relevance orientation* is to guide students with regards to self-understanding and personal growth. *Social relevance and reform orientation* of the curriculum aims to develop students' understanding of the social world with its issues as well as with a view to social reform. And finally, *systems design orientation* targets designing an effective system for learning.

In 2016, empirical research conducted by Jaggars and Xu contributed to the quality assessment of the online course design**.** In the present study, researchers developed a rubric for online course design assessment and further applied it in 23 online courses in 2 colleges. It was found that neither the well-organized course with detailed objectives nor technological elements that were constructed in the course influenced the student's performance in terms of grades. But the frequency and quality of interaction and communication with the teacher that was organized in the course encouraged students to commit to the course and as a consequence directly resulted in higher student performance. Later, Baldwin & Ching, (2017) introduced a *checklist* for evaluation of the online course design that was based on the previously existing

assessment instruments. Further, the teachers' perception of the developed tool was examined through the survey, where 63% of the participants were satisfied with the checklist application and 21% introduced the change in the process of the online course design. However, the student's experiences within the new design were not examined.

Besides, a number of studies in the field of higher education have explored the design of online courses from a care-centered perspective (Cleveland-Innes & Campbell, 2012; Robinson et al., 2017; Chng, 2019. Namely, the studies have shown that the feelings and emotional presence of both learners and teachers are the necessary components of the creation of an effective online learning environment. The term **emotional presence** means the following: "the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry, as they relate to and interact with the learning technology, course content, students, and the instructor" (Cleveland-Innes & Campbell, 2012, p. 283).

Furthermore, the empirical study conducted by Robinson et al., (2017), suggests that it is possible to create an effective online learning environment based on the care-centered model, but if this model would be integrated not only into the teacher's level but also into the course design level, the question to consider is which elements would support the establishment of online care climate for learners?

The blended learning or mode of instruction is considered as a part of the online learning environment, because it is based on the principles of a combination of face-to-face and online instructional activities in order to support and encourage learning (Boelens et al., 2017). The number of studies that explore the blended mode of instructions from different perspectives are also increasing. The systematic literature review conducted by Zhang and Zhu (2017**)** reflects key research categories in the blended learning studies, such as design, strategy, factors, evaluation, methodology, and the review. Later on, the design aspect of the blended course would be evaluated as the most frequently researched model of learning in the online course arena (Ashraf et al., 2021).

In 2010, Köse introduced a model for blended learning that consists of a face-to-face environment and an online learning process that is supported by Web 2.0 technologies. The mentioned model was applied to the mathematics course, with the fixed sequence of activities per subject, namely the face-to-face lectures organized with online personal and classroom activities, where examination happens only after completing two or three subjects of the course. As a result, the explained model fostered an effective environment from learning and

pedagogical perspectives are suggested to be implemented in course design for higher educational institutions.

The research conducted by Gedik, (2013) suggests that a course in blended learning should be designed in the following principle: 50% of online components and 50% of face-to-face components. However, the online components in the present study include learning materials (reading resources, links) and online discussion (forums, chats), while the face-to-face components refer to the learning activities such as traditional lectures, group work and discussions, seminars. In addition, the results of the research showed the four interconnected factors that influence the design of a blended learning environment: *context, the pedagogical framework, instructor competency*, and *technical issues* that both teachers and students faced.

2.2. Literature review on the course design conceptual frameworks

The question of designing the courses was addressed in the research paper of Goodyear (2005), which outlined the novel and patterns-based approach to course design in the context of networked learning. Networked learning is understood and defined as an interaction between technological tools and people that could be applied to different modes of instruction such as campus-based, hybrid or online learning. Goodyear elaborated on what he calls the *problem space* of educational design, where the complexity problem is described through all the parts of the design such as organizational context, the pedagogical framework, educational setting, and learning outcomes. Organizational context influences the design and management of the educational setting and integration process, which through a pedagogical framework feeds into the design and management of educational settings. Later in 2015, Goodyear made a further contribution to the problem in designing teaching activities in different educational environments. For instance, interactive forms of activities (real-time, synchronous activities), pre-active forms (planning, design), and post-active forms (reflection, evaluation, assessment). To organize a successful design of teaching activities, three main components should be taken into consideration: learning activities, supportive physical and digital environments and the social organization and division of labor. However, he found that the key challenge of its implementation is not sufficient capacity of design at institutions among all staff including lecturers, professional staff, and managers.

A meaningful contribution in developing a framework for hybrid courses was made by Wong, (2008). He suggested a *5i design framework* for online courses that could be implemented at all graduate levels for higher educational institutions. This framework has the

following characteristics such as: ***i****nitiative,* ***i****nteraction,* ***i****ndependence,* ***i****ncentive and* ***i****mprovement.* According to the study, there is a problem in enhancing students' motivation to participate not only in a traditional classroom but in an online classroom as well. Thus the hybrid course should include elements that would initiate students to active participation in the learning process. Besides, while designing hybrid courses, it is necessary to ensure opportunities for interaction among and between students and teachers, especially in an online environment. As well as activities' interaction between online and face-to-face classrooms. Additionally, the present research highlights that hybrid courses should be designed in a way that provides the ability for students to study independently in both modes, where they could understand their progress and assess their improvement in the learning process.

In 2014, Karoğlu et al.'s study made an interesting investigation into exploring design principles for blended learning. *Seven principles for constructing the course for undergraduates* that were first introduced by Chickering & Gamson in 1987 were underlined as a basis and were transferred to an online environment. The first three principles: *student-faculty contact, cooperation and active learning* could be arranged in both face-to-face and online environments, via emails and learning platforms and further ICT tools, while *the prompt feedback* should be organized only online, in order to provide comments and feedback as fast as possible. *Time on task* principle implies that as technology use and availability of learning resources tend to extend the learning time beyond the classroom hours that further would enhance students' learning motivation. *Communicating high expectations* principles reflects the discussion about course outcomes and students' expectations that happen in a face-to-face environment. And finally, *respect for diverse talents* and *ways of learning* principles should be included in blended learning in a way that students have an opportunity to decide the time on fulfilling the tasks and methods that would be applied according to their own preferences. The present research suggests that mentioned principles could be effectively transferred and integrated in online learning while enhancing students' motivation and performance results.

Robinson and colleagues (2020) conducted an empirical study of a care-centered model in the context of designing online courses for higher education. The present model contains Nodding's framework (2012) that is based on the ethics of care theory and has four main principles: *modeling, dialog, practice, and confirmation*. Thus, the *modeling principle* explains that the teacher should act and behave in certain ways that make students feel cared for as well as being sensitive to the learners' needs while designing and delivering an online course. In addition, the necessity for synchronous interaction at the beginning of the online course was

highlighted, indicating that the teacher should take responsibility for establishing a connection between the students and teacher, creating a polite climate and encouraging learners (by tone of the voice). The *dialog principle* includes personal and group communication that is timely and organized. It is also correlated with the *confirmation principle,* where the feedback should be personalized and has a qualitative/quantitative character. The *practice principle* shows first of readiness and competencies of teaching online. And secondly, how teachers should support each other in sharing their experiences of designing and delivering care models in an online course. The study suggests that all these principles could be applied not only in the online teaching perspective but also in online course design. And as a result, the findings of the study demonstrate that the online course with the present model had a climate of care and led towards more inclusive learning experiences where the learner's needs were met.

2.3. Online teaching and learning

While exploring the course's methods, principles and elements of online and blended learning, it is necessary to present the perspectives of those who are an essential part of the educational process, namely teachers and students, because their experiences within online education are fundamentals that should be taken into consideration while designing the course in higher education.

There is a significant amount of studies that have examined and explored the students' perception of blended learning which have demonstrated a result of students' positive experience and high level of satisfaction in the blended learning courses rather than studying in fully online or fully face-to-face classrooms (Martyn, 2005; Lim, Morris & Kupritz, 2007; Castle & McGuire, 2010; Smyth, Houghton, Cooney & Casey, 2012; Owston, York & Murtha, 2013). In addition, the case study conducted by Klimova et al, (2017) represents an advantage of blended learning in the context of students' academic achievements. It was also mentioned students' satisfaction in the blended model is an opportunity to study independently and flexible in terms of time and place due to the online component of the model, as well as communicate, discuss and actively participate in the face-to-face classroom activities.

However, the empirical findings of Prifti (2020) research show that the influence and connection of the self-efficacy learning component on the students' motivation in the Management Course that was designed in the hybrid traditions. However, none of the course design elements or teaching activities were presented in the study, which led to the difficulty of the results' generalization. In 2020, Venkatesh and colleagues examined students'

experiences and satisfaction with online medical education. It was determined that the organization of the very first meeting in the face-to-face environment and the interactive online tools contributed to the overall student satisfaction. However, participants of the study noted the decreased level of efficient communication between each other or even sometimes the lack of opportunity to ask spontaneous questions concerning the course content to the teacher online.

In 2008, So and Brush examined students' perception of collaborative learning, social presence and overall satisfaction of a blended-learning environment and determined three factors that influenced it. *Course structure, emotional bonding* (between students and teacher, among students) and *communication medium* critically affected students' perception of satisfaction, collaborative learning and social presence. As a result, the more students were emotionally connected, engaged in collaborative learning, the better social presence in a blended course they had. And consequently, students with a high perception of social presence were more satisfied with the course.

Wanner and Palmer's (2015) study shows how teachers and students perceived flexible learning and assessment in a flipped course at a university. The findings reflect that students had a positive flipped classroom experience with a high level of engagement. Moreover, they highly valued a flexible aspect of assessment, which let them decide assessments' methods, criteria, timing, and weighting. As a result, learners preferred a blended mode of instruction to a fully online course. Additionally, the investigation of the teachers' perspective demonstrated that a student-centered or personalized learning approach in a flipped classroom entails not only creating a learning environment to meet the student's educational needs but mainly providing a personalized assessment and feedback to each student. Here were also discovered main challenges for teachers, namely, the lack of time and institutional support.

Regan and colleagues (2012) examined teachers' experiences in the different online learning environments, including the blended mode of instruction from the emotional perspective. In the present study, negative emotions were noticed the most in comparison with positive ones, such as feeling restricted, stressed, devalued, validated, and rejuvenated. Further, a strategy for managing the negative emotions was suggested in the study, however without factors that could influence the growth of positive emotions. Unfortunately, the empirical findings of the study could not be generalized due to the limited sample size.

Contemporary and relevant research about how teachers experienced online teaching in the forced COVID-19 conditions in Norway was conducted by Damsa and colleagues (2021).

It was found that even though a transition to an online environment was unexpected, most academic teachers have quickly embraced online teaching, where not only the pre-recorded lecturing, but also the various forms of interactive learning were used, including *live* streaming, discussions and break-out groups. Most academics relied on themselves in order to manage the transition, however, some respondents addressed their issues to colleagues, pedagogical center, IT as well as supported each other through Facebook groups and participated in live tutorials. According to the research, teaching methods were changed significantly, but not to a large extent; only 35% of respondents. Main challenges in rapid transition and online teaching were underlined, such as technological challenges and pedagogical insecurity, digital overload and psychological health issues and the lack of direct contact and feedback communication with students and colleagues.

In 2019, Anthony and colleagues explored the influence of blended learning on teaching effectiveness in Higher Educational Institutions. The findings of the study suggest that course delivery, performance, motivation, and evaluation elements of the blended course have a negative impact on the academic staff's effectiveness. On the other hand, the proper design of teaching strategies, technological integration and course would enhance the teachers' effectiveness. However, the present research has not examined the level of the technological competency and literacy of the teachers that have a direct influence on the organization and quality of the educational process in an online environment. For instance, Boumadan et al.'s (2020) empirical study has outlined the factors that determine the value of online education, including *the content* of the course, *technology* that was applied, *and pedagogy or* pedagogical methods that the teachers used. Additionally, techno-pedagogical training was highlighted as a necessary component for effective online course delivery. However, it was further pointed out in the study Castle and McGuire, (2010) as a factor that provides a proper alignment between online course goals & content and learning activities.

2.4. Challenges

Despite the positive perception and the advantages of online learning among students and teachers, both perspectives have been experiencing challenges during the delivery of the blended course. The literature review conducted by Rasheed and colleagues (2020) reflects that a number of studies in higher education were focusing on the challenges that are connected with the online component of the blended course. For instance, the technological illiteracy of both students and teachers was highlighted as the most common challenge that directly

influences course delivery, knowledge acquisition and communication in online learning. However, in 2016, Brown referred to the students' technological illiteracy as one of the teachers' challenges to online course delivery. Further, Pilgrim and colleagues (2018) explored the influence of technology competencies on the pedagogical competencies of the teachers. The findings outline several barriers that were related to the course structure, relevance, and content as well as obstacles in managing time and stress, and technological accessibility.

A number of studies were investigating the student's self-regulation challenges from a variety of perspectives. AlJarrah et al. (2018) study explores self-regulation issues in the form of procrastination during blended learning that further results in stress and deterioration of the students' performance. The findings demonstrated that the students with "low performance" and "medium-performance" tended to access the course materials and lectures on the last day as well as had problems with assignment delivery in a timely fashion. However, there weren't any conclusive suggestions for the teachers or learners to interfere and influence the procrastination process. Nevertheless, earlier, in Zacharis' (2015) study, a model for teachers in order to predict poor students' performance was introduced. This model entails the analysis of tracking data by the teachers and could be installed in the Learning Management System. However, it could be difficult to apply to the course with a significant number of students.

Further, Broadbent (2017) compared the self-regulation strategies of online and blended learning environments. Based on the questionnaire results completed by 466 students it was shown that the poor time-management skills, online-help seeking strategies, and improper utilization of the online peer learning strategies were outlined as main challenges in online and blended learning courses. The mentioned students' challenges could be explained due to the flexibility component, high level of self-control, and a great sense of transactional distance that take place in blended learning (Boelens et al, 2017).

Sadeghi (2019) showed challenges in online learning from a communicative perspective, where students found it difficult to interact with the teachers through the email. Due to the situations, where the learners could not receive a response on the email from the teacher in time. Or in a situation, where the answer to the question does not require much time and could be simply asked during the online activities, however, the teacher preferred to substitute such interaction by emailing. Besides, a study conducted by Bakhtiar et al. (2018) shows the influence of students' emotions on the interactive and engagement activities within online learning. As a result, negative emotions that occurred during communications could be an obstacle for effective engagement and interaction among the students.

3. Theoretical framework

The present study implements a combination of the principles from the following empirical studies as a lens for data analysis: Baran (2011), Boelens et al. (2017) and Martin et al. (2019). Thus, it is necessary to explain that each principle of mentioned studies builds on a particular theory. Therefore, this section aims to present and explain the theories used as a basis for the theoretical framework of the present study. The scientific importance of the mentioned studies and explanation of how they are integrated into the Conceptual framework will be described and elaborated in Chapter 4.

3.1. Constructivist learning theory in the online course design principle

Boelens' (2017) principle of the flexibility and facilitation of the learning process to assist in creating a learning environment implies students are primarily responsible for their own learning. For instance, students can choose time and place of study as well as control the path and pace of their learning. Baran's (2011) study also underlines that the flexibility principle is reflecting the idea of creating a student-centric learning environment, where the teachers are ready to adapt the course structure and teaching activities in accordance with the students' needs. In addition, this research study highlights the importance of the relationship between students and teachers, where the teacher has a role as a facilitator or mentor with a respectful attitude towards students' expression of opinion.

Consequently, the mentioned ideas originate from the constructivism learning theory. Such a theory reflects the learning environment, where teachers no longer take a central place in the educational process. In addition, the teacher creates an environment, where he/she accepts and values the learners' opinions, and gives them the opportunity to control their own learning as well as strategies, activities and content of the course. The teacher facilitates the learning process, while simultaneously should be ready to introduce the necessary changes in order to unleash students' talents (Paily, 2013). Two main representatives of the constructivist theory are Jean Piaget in the context of cognitive constructivism and Lev Vygotsky in the area of social constructivism. The main differences between social and cognitive constructivism are that, according to cognitive constructivism, the learning process is shown and based on the individuals' schema (knowledge), while in social constructivism the knowledge of the individuals is based on the socio-cultural interaction between the individuals (Chuang, 2021).

3.2. Social learning theory in the online course design principle

Boelens et al (2017) in the framework of the effective principles of online course design included a principle of interaction, where the teachers need to foster and facilitate communication during the online learning experience. Martin et al's (2019) study also highlights the necessity of building effective communication not only between teacher and student but also in the student's engagement. According to the study, such engagement could be implemented in the online course through the various forms of interaction, for instance, participation in the discussion forum as well as in the different forms of formative assessment, such as quizzes, term projects. Furthermore, the aforementioned empirical studies underline a social learning theory, which explores the idea of emphasizing social relationships, where each individual could gain, develop and exchange knowledge through observation and interaction with other individuals (Akers & Jensen, 2017).

The social learning theory claims that the learning process occurs internally in each individual, but the nature and content are shaped by the interaction with the society. Social learning is building on the individual level, group level, organization level, and society level; a change in the process of how knowledge, and what type of knowledge, is exchanged (von Schönfeld et al., 2020).

The idea of the social learning theory correlates with ideas represented by Lev Vygotsky in the social constructivist theory. The major theme of Vygotsky's framework is that social interaction plays a fundamental role in the development of cognition (Illeris, 2018). Vygotsky believed that *learning* occurs in two stages. Firstly, it happens through interaction with others and then integrated into the individual's mental structure. And secondly, the learning takes place in the "Zone of Proximal Development" (ZPD). This "zone" is the area of exploration for which the student is cognitively prepared but requires help and social interaction to fully develop new knowledge and skills. In addition to that, the teacher provides the learner with "scaffolding" to support the student's evolving understanding of knowledge domains or development of skills. Therefore, collaborative learning, discourse, modeling, and scaffolding are identified as strategies and practices for supporting and facilitating student learning (Illeris, 2018).

4. A Conceptual framework for analyzing blended learning

This section presents findings related to the principles for the online course design in higher education, and an elaboration of the principles that form the basis of the conceptual framework of this study.

In 2017, a systematic literature review by Boelens and colleagues on the problem of blended learning design reflected four key principles. The first principle is incorporating desirable 1) **flexibility** for students in terms of *time* (study when they want), *place* (study whenever they want), *path* and *pace* (study what they want and how they want). The second is 2) **stimulating interaction**, because communication between students and teachers becomes challenging in blended-learning, in terms of time and space flexibility. The third principle is 3) **facilitating students' learning process**. The blended-learning environment pre-supposes self-regulation skills, time management, and skills in technological use, however, some students may not possess it and there is a need for teachers to implement activities that would support and facilitate the learning process. And the last principle is to 4) **foster an effective and motivating learning climate**, where students could feel accepted, valued, and safe during the learning process. The findings this systematic literature review show that few studies offer students the opportunity to control the blended-learning realization. Introductory face-to-face meetings stimulate social interaction while monitoring learners' progress and personalization is mostly organized through online instructional activities. However, such instructional activities that foster an effective learning climate were not estimated or highlighted in the studies.

Martin et al (2019) introduced a framework for online course design based on the literature review and the following experience of teachers in Higher Educational institutions. According to the study, the teachers in Higher Education should take into consideration that the effective online course includes three main interconnected elements: *design, assessment & evaluation, and facilitation*. As for the design elements of the framework, teachers should apply a systematic approach to designing online courses, in order to structure the course within its goals and description, organize the syllabus before the course would be transferred to the online environment. Further, it is necessary to apply the backwards design approach in order to plan and organize the teaching activities that would meet the course objectives. This approach has a precise role, namely to create the alignment of the syllabus, learning activities, learning outcomes, technologies that would be applied within the course. In addition, the course should be organized by modules, weeks, or units. Assessment and evaluation are

recommended to be authentic and traditional which would include the variety in terms of format: assignments, quizzes, projects, and time: weekly, where the feedback from the teacher should be provided in a timely fashion. The framework also highlights the element of facilitation of the learner, which implies consideration of the learner's needs by applying a student-centric approach as well as enhanced communication that could be also reached through the formative assessment, for instance, discussion posts on the online learning system.

Baran (2011) highlighted the need for the transformation of the teacher's role, and practices in the online environment with the following creation of the distinctive pedagogy for online learning. Thus, it was found that the teachers revisited their approaches not only to evaluating teaching activities but also towards designing an online course, where the balance between planning and structuring of the online course in advance is playing a huge role. Due to the fact that the detailed and very-structured course plan does not allow to introduce the necessary and sometimes unpredictable changes, the design of online courses should have a "flexibility" component. In addition, teachers should constantly conduct a course evaluation and take into consideration that the design of online courses requires more time investment due to the introduction of the technologies at all levels, including the process of organization of educational activities in the online environment as well as uploading the necessary educational materials. Furthermore, teachers should enhance teacher-student relationships in order to know the students' interests, improve the level of communication and interaction and strengthen the students' online learning guidance. According to the study, all the mentioned above actions should trace the successful online teaching in higher education institutions.

Currently, there is no unified theory for exploring the online course design in Higher Education which also includes the teachers' and students' perspectives (Ashraf et al., 2021). I created a specific framework that would address the complex research problem and answer the research questions in the present study, by combining the significant principles and elements of the frameworks mentioned above. However, it is necessary to highlight that the study conducted by Boelens et al. (2017) was used as a preliminary basis for the development of the analytical lenses for the present study. This study addresses the problems of course design for blended learning and suggests the key principles that should be implemented in the design. In addition, it explains the way how the principles could be achieved, namely through the teaching activities.

The conceptual framework for online course design builds on the principles of flexibility, interaction, facilitation of the learning process, and effective climate (see Figure 3).

The flexibility principle was constructed on the combination of the flexibility principles from Boelens et al (2017) and Baran (2011) frameworks. Thus, the flexibility principle refers not only to the students' perspective that allows students to maneuver the time, place, path, and pace of the course, but also to the teacher's perspective in terms of building the structure of the course that allows it to adapt and introduce any changes. **The interaction principle** was mainly built on the stimulation interaction principle by Boelens, but also includes the elements from Martin et al., (2019) and Baran (2011) frameworks. As a result, the interaction principle additionally includes two perspectives: first, **the interaction between students and students**, which could be reached through the engagement activities; second, t**he interaction between teacher and students** that is happening through the various forms of communications, for instance through the emails and meetings. **The principle of the facilitation of the learning process** was based on Boelens and colleagues (2017) but was modified by including the elements from Martin et al.'s (2019) framework. Thus, the facilitation of the learning process principle consists of three main components: **learning organization component** refers to providing assistance and guidance to students in order to help them to place their learning in the online environment; **assessment component** allows the teacher to evaluate students' knowledge and monitor the students' progress in an online environment, periodically and with a variety of forms & methods, for instance, quizzes, assignments, and projects; **feedback component** should be personalized and conducted in a timely fashion.

The developed conceptual framework was used as a lens for analysis of the investigated online course designs, teaching activities, official course documents as well as evaluate teachers' experiences and the students' experience within the courses.

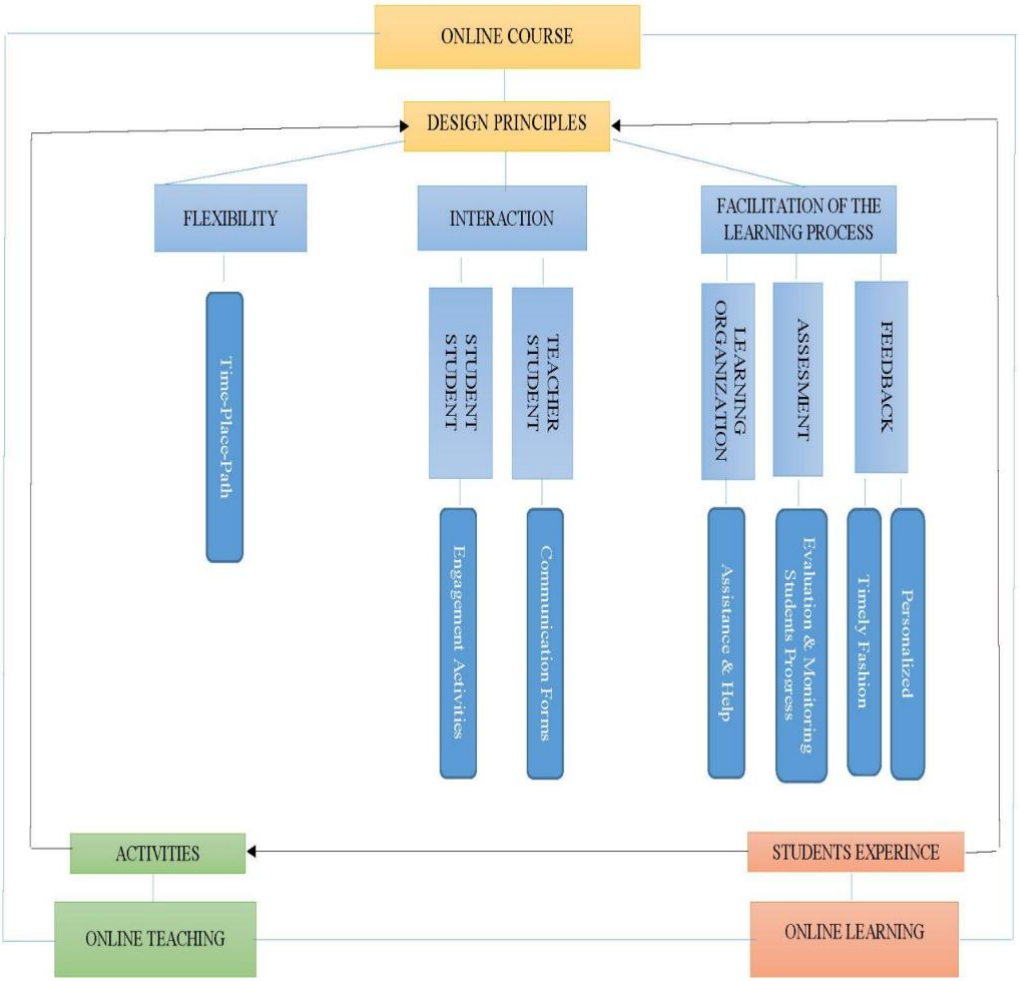


Figure 3. *Conceptual framework*

5. Methods

The section first introduces and explains the research design, approach and methods of the present study (sub-section 5.1.). It also presents the structure of data collections instruments and illustrates the way how they were employed in the research (sub-section 5.2.). Sub-section 5.3. explains the empirical context and introduce the samples for the research. In sub-section 5.4. presents a detailed description of the data analysis approach, which was conducted in three phases: *1. interview analysis; 2. survey analysis; 3. document analysis*. In sub-section 5.5. describes the actions which ensuring quality and rigor. The last sub-section 5.6. contains information about ethical considerations and demonstrates the validity of each data collection tools that were used in the present study.

5.1. Research design and methods

This research study used a deductive approach. The main reason to select the deductive approach lies in the ability to begin research with problem formation and theory, then consistently move to the observations and findings (Wolfer & Jacoby, 2007). Consequently, first of all, I explored the existing knowledge of online course design principles, frameworks, and learning theories in higher education; secondly, identified the problem and raised the research questions; thirdly, I moved to the data collection and analysis.

The present research employed a case study design because the observation phase was placed in the context of the particular higher education institution with a focus on precise online courses. Correspondingly, this design method "entails the detailed exploration of a specific case, which could be a community, organization, or person" (Bryman, 2016, p. 40). As a result, the present case-study design was embedded in the Norwegian University of Science and Technology (Norges Teknisk-Naturvitenskapelige Universitet, NTNU). There are several reasons for the exploration of research problems, particularly in the aforementioned Norwegian Higher Educational Institution. First of all, NTNU is the largest higher educational institution in Norway that primarily focuses on technology and science. In addition, it has been providing online courses, in a variety of Bachelor and Masters degree programs, including Engineering, Medicine, Architecture, and Natural Science. Moreover, NTNU has been collaborating with other educational institutions by distributing access to the online courses of the programs. For instance, students from Norwegian Military Academy have a similar online course in Mechanics that is completely designed, organized, delivered, and evaluated by NTNU teachers. Also, it is necessary to mention that courses that were introduced in the online environment

have different models, including “online model”, “blended model 1” and “blended model 2” which indicates and highlights the spectrum of a variety of online courses in Norwegian University of Science and Technology (NTNU, n.d.).

The present case study includes exploratory methodology because there is a need to generate a proper understanding of how the online course was designed, which elements it included in order to provide effective learning and how the online course was delivered based on the experiences of the teacher and students within this course. Thus, the descriptive methodology corresponds to the research aim and design of the present study (Gerring, 2017).

In addition, a mixed-methods data collection was chosen. The research problem of the present study was identified as a complex problem because it requires an investigation of three main aspects such as online course design principles, teachers’ activities, and students’ experiences within the online course design. Consequently, the present study needed a combination of qualitative research methods in order to explore the online teaching activities in accordance with design principles and quantitative methods in order to examine students’ experiences within the online course design. The combination of the obtained findings from the different perspectives results in triangulation that only could be conducted in the traditions of mixed-method research (Creswell, 2014). Besides, the integration of the mixed-method approach and triangulation of the findings provide advantages for the researcher, namely an in-depth and broad understanding of the investigated phenomena in higher education as well as enhancing the validity of the study (Watkins & Gioia, 2015).

The detailed description of how triangulation was conducted would be further described in the data analysis approach (sub-section 5.4). The collection of qualitative data was the main and preceding quantitative data-collection approach (Bryman, 2016). For this reason, the qualitative approach emphasizes words and text intending to understand the social phenomena as well as place the researcher closely to investigate the phenomena, rather than distantly. Furthermore, it “provides a detailed account of what goes on in the setting being investigated” (Bryman, 2016, p.394).

5.2. Data collection instruments

Several data collection instruments that were developed for the present study are described in the following sub-section.

A semi-structured interview was developed based on qualitative traditions (Ann, 2017). The interview was used to collect data about online teaching, the design and delivery of online

courses, assessment & evaluation, teaching activities, climate as well as online teaching challenges and benefits. The interview guide can be found in the Appendices section of the present study. It is necessary to clarify that the data that was gathered from the mentioned qualitative interview was characterized as primary data. The reason for placing the interview with teachers in the central position of data collection is because the organization of the educational process and effective course design and its delivery in the online learning environment to a greater extent depends on the teacher's actions.

The semi-structured interview contains 6 parts and 22 questions. In the part *"Background information"* the teachers were asked about their experiences as teachers in the higher education institution and pedagogical practices in online teaching. Questions concerning teachers' responsibilities in the online learning environment were placed in the part *"Responsibilities and instructions"*. The part *"Online course design"* contains questions concerning the development of online courses, including the structure and design components. In the part "*Assessment, evaluation & facilitation*" teachers were asked about how they organized the assessment, monitored students' progress within the online course as well as which tools were used for facilitation mentioned teaching activities. More questions concerning online teaching activities in the online course were placed in the part *"Teaching activities online"*. The last part of the interview "Benefits & challenges" was aimed to identify advantages of teaching online as well as challenges that emerged during the online course delivery. Each part of the interview was developed in alignment with principles that were identified in the Conceptual Framework of the present study, namely *flexibility* (time, place, path); *interaction* (teacher-student communication; students engagement), *facilitation of the learning proces*s (learning organization, assessment, feedback).

Moreover, the structure of the interview consists of questions that were used previously in the data collection instruments of studies examined for the Conceptual Framework. Further information of the validity of the tool would be described in section 5.5. It was decided to conduct the interview in the online environment by using the Zoom platform for online communication for the following reasons, first of all due to the 170 km physical distance difference between myself (researcher) and participants; secondly, current restrictions and recommendation of keeping a distance that was introduced by the Norwegian government due to the Covid-19 pandemic; finally, the use of an online platform allowed me to conduct the interview in accordance with the availability of the teachers. Besides, it is necessary to explain

that the teachers participating in the study are referred to in the Findings section in the following way: “Teacher 1”, “Teacher 2” or, and “(T1), (T2)”.

A quantitative survey for students was developed as a second tool for the data collection in the present study (Saris & Gallhofer, 2014). The survey instrument aimed to collect the data from the students in order to describe their perspective and experience within the online course and teaching within it. It was designed in accordance with the theoretical framework and the interview instrument for the proper alignment between the variables in interviews with teachers and the variables in the students’ survey. The mentioned instrument consists of the 5 parts of quantitative questions and one part that include only two qualitative questions and consequently could be characterized as a mixed type of survey (Creswell & Creswell, 2018).

The first part of the survey contains two sections: “Background information” (Bakgrunnsinformasjon) and “Digital competencies & experiences with online learning” (Digital kompetanse og erfaring med online læring). This part aimed to gather general information concerning the participants. In the second part “Students experiences with online course design” (Studentenes erfaringer med online kursdesign) students were asked about their experiences with the online course design and its elements & components. The third part “Online learning activities & teaching” (Nettbaserte læringsaktiviteter og undervisning) was developed in order to get the students’ opinion concerning the learning and teaching activities that were organized in the online course. In the fourth part “Communication & collaboration” (Kommunikasjon og samhandling) were placed questions on how students experienced communication with the teacher and collaboration activities with the classmates during online learning. The last part “Online learning benefits & challenges" (Nettbaserte læringsfordeler og -utfordringer) aimed to gather information on what students considered and experienced as benefits as well as challenges of online learning (in the context of the investigated online courses). It is necessary to explain that participants of the survey would be referred to the Results section in the following way: “Student (number)” or, (S number), for instance, “Student (25)” or, and “(S25)”.

The survey was initially developed in English, but was additionally translated with the help of a professional linguist to Norwegian. The results retrieved from the open-ended question were translated into English. Further information about the actions that were taken for enhancing the validity of the data collection instrument is described in section 5.5. The students’ survey was placed on the Nettskjema platform developed by the University Information Technology Center at the University of Oslo. The reason to choose this platform

is its design, which allows to conduct online surveys in accordance with the Norwegian Privacy requirements and easily export the data for further analysis.

The document review was also included as a method for data gathering in the present research (Bryman, 2016). It was conducted in qualitative traditions that allowed me to obtain the data for the online course itself including an official description of the course, course goals, course plan, and structure, which is necessary for investigating effective online course design principles. The documents were mainly collected digitally through the official web page of the higher educational institution as well as directly from the teachers of the courses that were taken as a sample for the present study. The analysis of curriculum and course plans together with semi-structured interviews and surveys would shed light not only on the coherence between the course design and teaching activities.

5.3. Participants and sample

Empirical Context

Natural science and engineering programs are run by **NTNU: Norges teknisk-naturvitenskapelige universitet.** The mentioned programs have "Mathematical Method 1" and "Mechanic" courses that are taught in the face-to-face & online learning environment and also introduced in the **Norwegian Military Academy** but only in the online environment. The mentioned courses use two models, *blended model 2* and *online model* in both higher educational institutions**.** Teachers, students, and course documents of the "Mathematical Method 1" and "Mechanic" online courses are expected as part of a population of the present research.

For analyzing the teachers perspective: teachers of the "Mathematical Method 1" course and teachers of the "Mechanics" course that have been teaching in an online environment in the 2020-2021 academic year have been chosen respectfully as a study sample.

For analyzing the students perspective: second and third-year students from "Mathematical Method 1" and "Mechanics" online courses of the engineering and natural science programs have been chosen as a study sample.

For analyzing course documents: a purposive sampling method has been selected to collect documents and course plans of two "Mathematical Method 1" and "Mechanics" online courses including course plan pedagogiskopplegg, where could be included course goals, teaching, and learning activities, tasks, and assignments, forms of assessment, feedback; official web-page of the descriptive information of the courses.

5.4. Data analysis approach

An analysis of the obtained data was conducted in the three phases: 1. interview analysis; 2. survey analysis; 3. documents analysis. Each of the phases would be further described in details.

1. Interview analysis

First of all, I transcribed the interviews with the teachers, where the personal information of the teachers was coded. Then, the interview scripts were uploaded to the Nvivo 12 program. Further, I used Nvivo 12 program as a tool for conducting a thematic analysis of the transcribed interviews (Barbour, 2013). The thematic analysis method allowed to perform the data analysis according to the conceptual framework developed for the present study. Further, the main themes were explored: "flexibility," "interaction with the students," "students' engagement," "facilitation of the learning process". Then, the mentioned themes were coded in the "nodes" and "sub-nodes" in the Nvivo 12 program, where the nodes mean "a collection of references about a specific theme, place, person or other areas of interest" (Bryman, 2016, p.596). The following nodes were used in the analysis: "flexibility" with sub-nodes: "flexibility of the course structure," "flexibility in terms of time," "flexibility in terms of place," "flexibility in terms of the path,"; "interaction with students" with sub-nodes: "interaction with the students online," " face-to-face interaction with students"; "students' engagement" with sub-nodes: "online engagement activities," "on-campus engagement activities"; "facilitation of the learning process" with sub-nodes: "learning organization," "assessment," and "feedback". A detailed description and scheme of the coding will be attached in the Appendices section of the present study.

2. Survey analysis

As a first step, I carefully retrieved the data from the Nettskjema program according to NSD regulations. Then, the data set was uploaded to the SPSS program that is suitable for analyzing the quantitative type of data (Bryman, 2016). As the following step, I identified the variables from the data set that were aligned with the course design principles, which were constructed in the conceptual framework of the present study, such as "flexibility," "interaction with the teacher," "students' engagement," "learning organization," "assessment," "feedback." Then, the answers from the participants (N=31) "completely agree" and "partly agree" were aggregated in the answer "agree." As well as, the answers "completely disagree" and "partly disagree" were united in the answer "disagree." Further, I used a descriptive statistical method for analysis because it allowed me to describe and summarize the data without making any predictions (Agresti, 2017). Besides, cross-tabulation analysis was also included in the study

for identifying and summarizing the relationship between the variables (Salkind, 2021). A detailed description and scheme of the coding will be attached in the Appendices section of the present study.

3. Document analysis

In order to conduct a document analysis, I collected the following type of data: official web pages of the investigated online courses (on the institutional website), screenshots from the learning management system, online course plans, pensum, examples of the exercises that were used in the online learning. Only official web pages had open access, whereas other documents were provided directly by the teachers (interview participants) of the investigated online courses. The content analysis of the documents was conducted in the qualitative traditions (Bryman, 2016). Necessary to add that none of the software was used by the researcher for conducting the document analysis. Thus, the analysis was done mssanually, where I identified themes in the documents such as "online course description," "online course structure," "flexibility," "teacher-student communication," "students' engagement activities," "learning organization," "assessment," "feedback." The mentioned themes correspond to the online course design principles of the conceptual framework of the present study. A detailed description and scheme of the coding will be attached in the Appendices section of the present study.

5.5. Ensuring quality and rigor

As it was previously mentioned, the present study was conducted by applying the mixed research method, due to the opportunity for triangulation of the findings (Creswell, 2014). I triangulated findings in accordance with the conceptual framework that includes three main principles: flexibility, interaction, and facilitation of the learning process. The steps of triangulation would be further explained in accordance with each research question separately:

In order to answer research question 1: *"How do the course design and teaching activities address principles and requirements for blended learning?",* including sub-question 1.1 "*In which ways are the flexibility principle materialized in the course design elements and teaching activities?"* I compared the variables that were aligned with the flexibility principle from the teachers' interview data set with the variables that were aligned with the flexibility principle from the students' survey data set, and compared with the variables that were aligned with flexibility principle from the online course documents.

For answering sub-question 1.2 *"In which way is the interaction principle realized through the online teaching activities?",* I compared the variables that were aligned with the interaction principle from the interview data set with the variables that were aligned with the interaction principle from the survey data set, and compared with the variables that were aligned with the interaction principle from the online course documents.

For answering sub-question 1.3 "*In which ways are the principle of facilitation attained through teaching activities and organization of the course?"* I compared the variables that were aligned with the facilitation of the learning process principle from the interview data set with the variables that were aligned with facilitation of the learning process principle from the survey data set, and compared with the variables that were aligned with facilitation of the learning process principle from the online course documents.

In order to answer research question 2. *"How are the online course design and teaching activities experienced by students and teachers in relation to the principles of flexibility, interaction and facilitation?"*, I compared the variables that were aligned with the flexibility, interaction and facilitation principles from the teachers' interview data set with the variables that were aligned with the flexibility, interaction and facilitation principles from the students' survey data set.

5.6. Ethics and validity of the study

Ethical considerations

For the present study I took into consideration the ethical aspect of conducting the study. Thus, I read in detail the Guidelines for Research Ethics in the Social Sciences provided by The Norwegian National Research Ethics Committees. The Guidelines are considered valuable and important for conducting the research in the context of the Norwegian system. In addition, it consists of four sets of norms that reflect the internal ethics (self-regulation and the research community) and external ethics (relationship between the research and society - NESH, 2019).

Moreover, the four key principles of ethics that were identified by Diener and Gradall (1978) were also applied. Despite the fact that the mentioned principles were summarized in 1978, it is still presented as a key method for evaluating ethical consideration in contemporary books for conducting social research (Bryman, 2016). The first principle not to *harm participants* was implemented in the present research, where the researcher tried to minimize the disturbance of the interview participants, by negotiating a suitable date for the interview. Besides, conducting the interviews there was used a structure that assisted the research asking

about particular things connected with the study, avoiding personal questions, non-related to the topic.

As for the second principle *of informed consent,* I provided the participants of the study with informed consent before any type of data collection process began. The informal consent was sent electronically and would be enclosed in the Appendix part of the paper.

The third principle, *an invasion of privacy,* was also taken into consideration. Thus, the identity, notes, and documents of the interview participants as well as survey participants were maintained confidentially and were coded immediately.

The last, fourth principle where I excluded the *involvement of deception* by representing the results of the present study as they are in order to pursue the truth in the examined research problem.

Validity of the data collection tools:

Interview

Data collection through semi-structured interviews were approved and conducted with NSD (Norwegian center for research data) regulations of data collection. Besides, the developed tools are based on the tools of previously conducted studies that were examining a problem of the blended course design in higher education. The interviews were anonymous and transcribed, where the identity of the teachers was coded. It is necessary to mention that the data collection instrument was first tested with the teachers from my own educational institutions. A information letter as well as consent form were provided to the teachers. The interview guide and questions are included in the Appendix for transparency.

Survey

The survey was approved and conducted in accordance to NSD regulations of data collection. Besides, the developed survey instrument were based on validated instruments that examined a problem of the blended course design in higher education. Furthermore, the survey instrument was initially developed in English, translated into the Norwegian language by a Norwegian native speaker, then tested with the voluntary students from my educational institutions. And finally, the developed students survey was launched in the secure platform Nettskjema that is approved by NSD.

Documents

The documents that were used in the document analysis were provided directly by teachers of the examined online courses. In addition, the documents were saved in accordance with NSD regulations. The researcher removed any personal data that was mentioned in the documents.

6. Findings

The main findings in this chapter. The section features information about the description and type of the blended course. The main findings are presented using a structure that follows the presentation of each design principle, with analysis of how that principle is reflected in the course design and delivery of teaching. Each of these aspects is examined and presented from the teachers' and students' perspectives, and based on the analysis of the course documents.

6.1. Description of the investigated online courses

6.1.1. Representation of the courses by the educational institution

On the official website of the NTNU university are introduced web pages of each course, that contains the information of the courses. It could be seen from Figure 4 and Figure 5, the web pages of the courses were designed in the same style and both could be presented in the Norwegian and English languages. The codes of the courses and the name of the course were introduced as the very first information. Thus the Mathematical Method 1 course was coded as "IMAG1001", while Mechanics had "MEKG1001" code. Each course page was divided into three main sections, such as "About", "Timetable", "Examination".

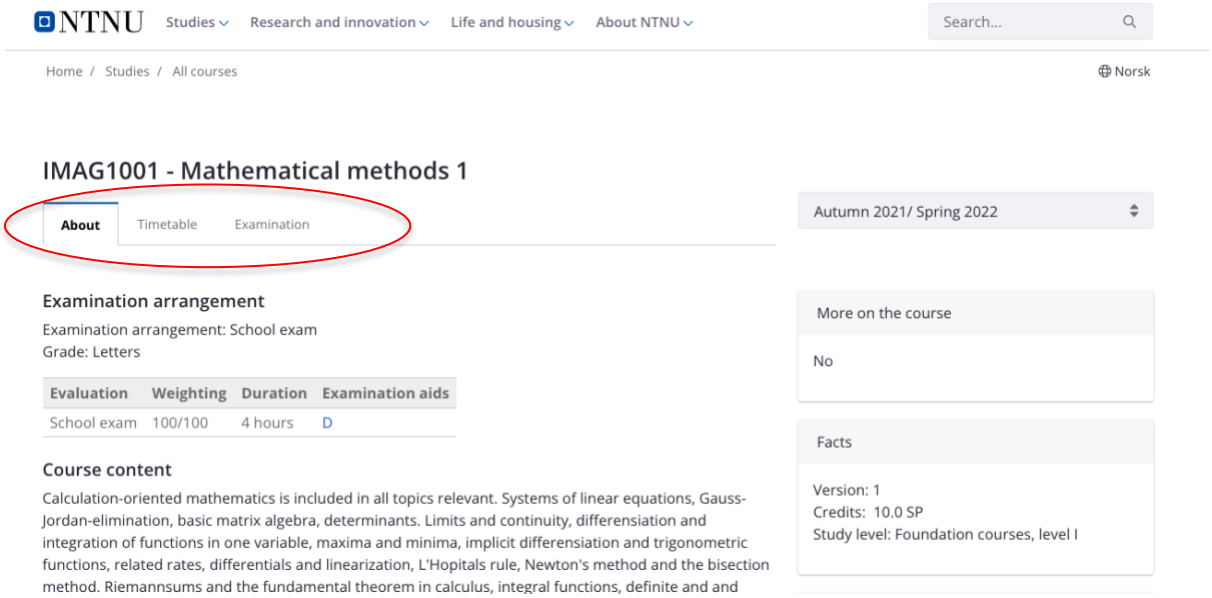


Figure 4. *Screenshot of the Mathematical methods 1 course web-page* (https://www.ntnu.edu/studies/courses/IMAG1001)

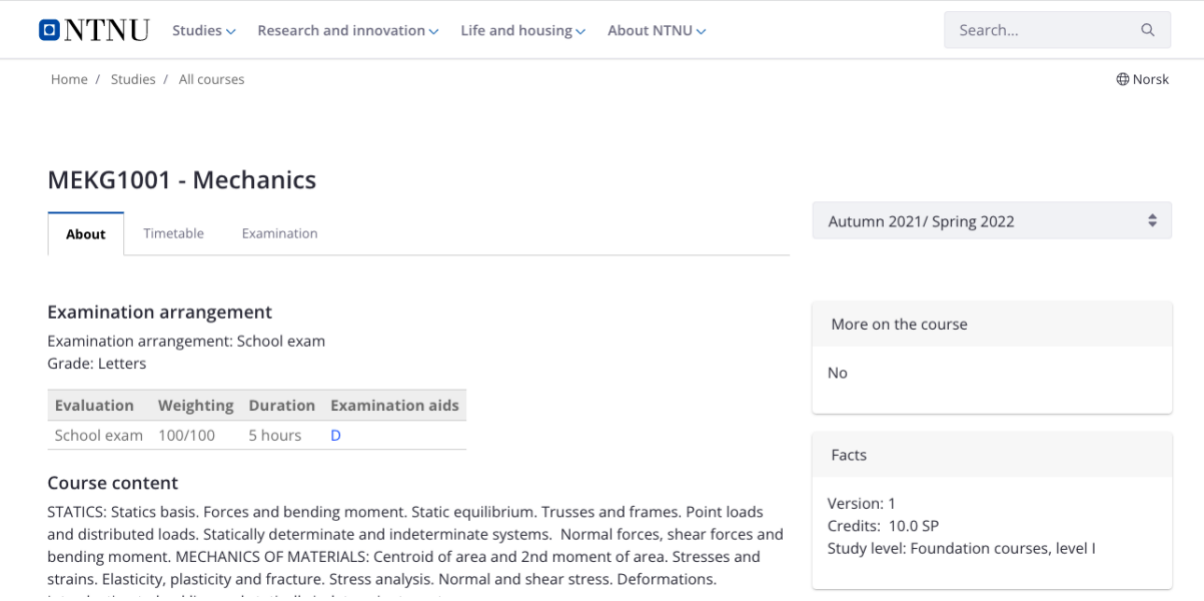


Figure 5. *Screenshot of Mechanics course webpage* (https://www.ntnu.no/studier/emner/MEKG1001)

Section "About"

The section "About" contained course information about "examination arrangement", "course content", "learning outcome", "learning methods and activities", "compulsory assignments" and "further evaluation". Thus, "examination arrangement" described the form of the assessment, grade system, duration of the exam as a type of aid that was allowed to be used during the examination. Both courses had "exam" as a final assessment, as well as "D type of the examination aid", where "no printed or hand-written support material is allowed. A specific basic calculator is allowed". However, the duration of the exam had a difference of one hour, where MEKG1001 had 5 hours exam duration (see Figure 5), while the IMAG1001 was one hour shorter (see Figure 4).

Note also "Course content" and "Learning outcome", which provided detailed information about the main themes that would be taught in the course as well as what skill, knowledge and general competence would the student or "candidate" obtain after completing the courses. It also introduced a section that had information about "Learning Methods and Activities".

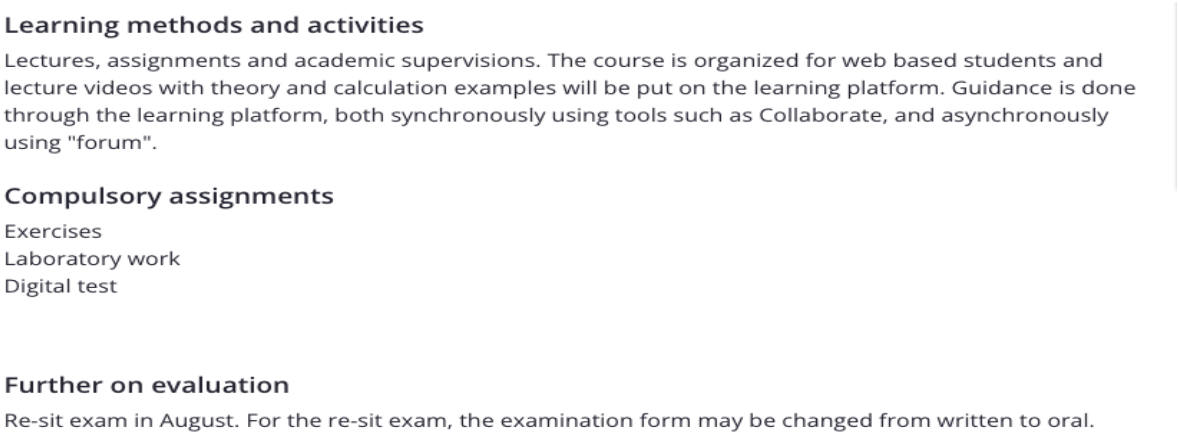


Figure 6. *Screenshot of "Learning methods", "Compulsory assignments" and "Further evaluation" of the Mechanics course web-page* (https://www.ntnu.edu/studies/courses/MEKG1001)

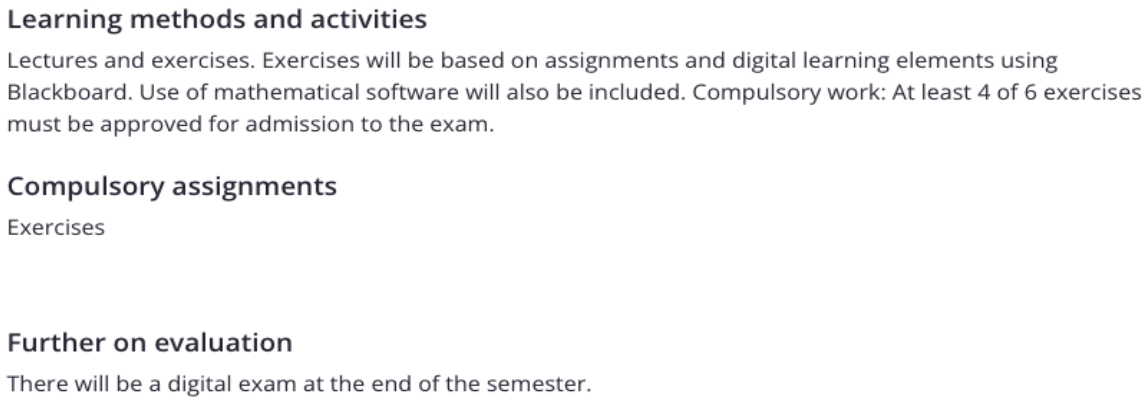


Figure 7. *Screenshot of "Learning methods", "Compulsory assignments" and "Further evaluation" of the Mathematical methods 1course web-page* (https://www.ntnu.edu/studies/courses/IMAG1001)

In the "Learning Methods and Activities," section of the Mechanics course was mentioned that teaching and learning were organized in the "learning platform" both "synchronously" and "asynchronously" and included "lectures, assignments and academic supervision", theoretical "lecture videos", practical "calculation examples ", and "guidance" with a help of "Collaborate" and "forum" digital tools (see Figure 6). According to the description of the "Learning Methods and Activities" of the IMAG1001 course, it included the following teaching and learning activities such as "lectures" "exercises that are based on the assignments", "the use of mathematical software" and "compulsory work" (see Figure 7).

As for the "Compulsory assignments" section of the IMAG1001 course, it stated only one form of assignment, namely "exercises", while in the course description of the MEKG1001

were mentioned “exercises”, ”laboratory work” and “digital test”. The section on “Further evaluation” also varied in the courses. Thus, in the Mechanics course was mentioned the “Re-sit exam”, that might be changed “from the written to oral” form of examination. Whilst in the Mathematical Method 1 course was described as “digital exam at the end of the semester”.

Section “Timetable”

The information about the timetable of the lectures and seminars was not available under the sections “Timetable” of both courses (see Figure 8 and Figure 9). It was explained that “it may lack” and advised, “to contact the department responsible for the course”. However, the information about the timetable could be found if the user presses the link “Detailed information” that was located in the left-down corner. Then the link referred the user to the online calendar *“Timeplan”*, which reflected the “day”, “time” and “place” of “lectures”, “seminars” during the semester.

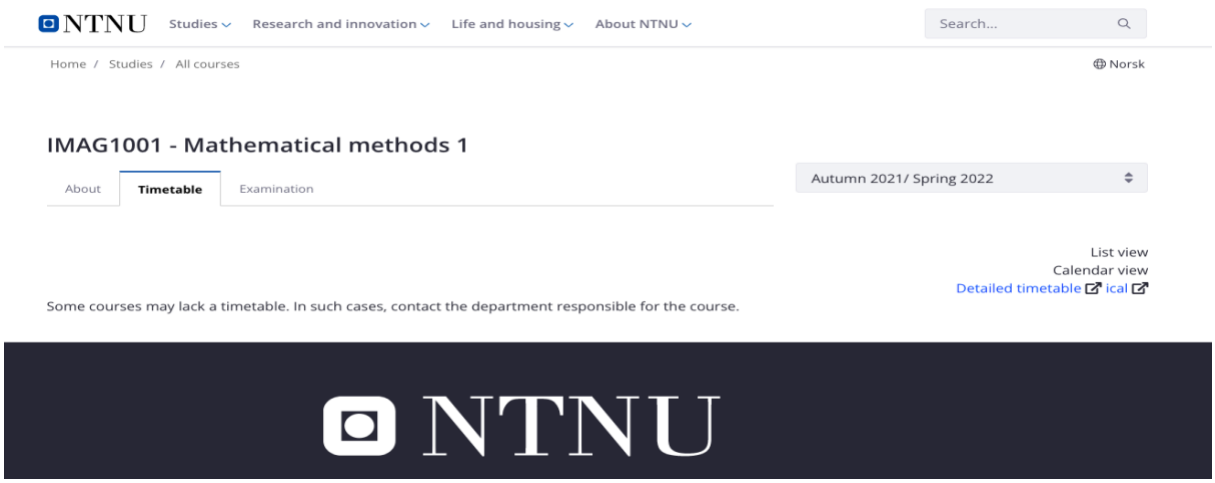


Figure 8. *Screenshot of “Timetable” of the Mathematical methods 1course web-page* (https://www.ntnu.edu/studies/courses/IMAG1001)

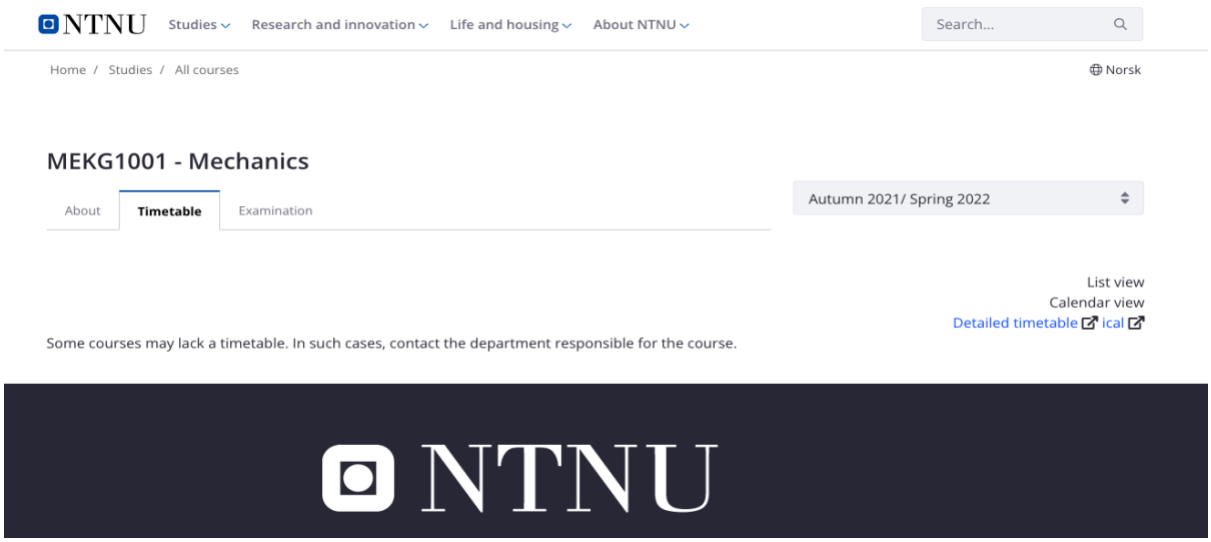


Figure 9. *Screenshot of "Timetable" of the Mechanics course web-page* **(**https://www.ntnu.edu/studies/courses/MEKG1001)

6.1.2. Characteristics of the blended structure in the course plans

The course plan of the MEKG 1001 consists of three aligned columns: "Time" (Tid), "Topic" (Tema), and "Videos" (Videoer) (see Figure 10). The time column contains information about the date when the learning was organized and reflects the time period of each module of the course. The total number of course modules is 14. The topic column has information about which themes would be explained and touched during the module. And the last, third column has names of the videos and "indicates which videos should be watched in the time set aside for lectures". The duration of the course was mentioned in terms of weeks, namely "31 weeks". Thus, during the "34 week" (uke 34) were introduced information about the subject "informasjon om emnet" and started the first module of the course the basics of statistics, "Statikkens grunnlag". In addition, there were five videos that were prepared for this module: Information about the subject "Emneinfo", Use of Numbas "Bruk av Numbas", Concepts and background "Begreper og bakgrunn", Force vectors "Kraftvektorer", Free body diagram (force diagram) "Fritt-legeme-diagram". All these videos should be watched by students during the mentioned period, namely from "17.8 till 21.8".

Tid	Tema	Videoer
Uke 34 (17.8-21.8)	Informasjon om emnet og 1. Statikkens grunnlag	«Emneinfo» «Bruk av Numbas» «Begreper og bakgrunn» «Kraftvektorer» «Fritt-legeme-diagram»
Uke 35 (24.8-28.8)	1. Statikkens grunnlag	«Moment» «Eksempel: Skive» «Eksempel: Kubein» «Kraftresultanter» «Eksempel: Resultant I» «Eksempel: Resultant II»

Figure 10. *Illustration of the course plan of the MEKG 1001 (part 1)*

Uke 17 (26.4-30.4)	13. Knekning	«Introduksjon» «Eksempel: Utledning av knekklast for fritt opplagt søyle» «Knekklast for forskjellige randbetingelser» «Eksempel: Knekning av linjal» «Eksempel: Ramme»
Uke 18 (3.5-7.5)	13. Knekning 14. Oppsummering og repetisjon	«Eksempel: Estimat av knekklast» «Eksempel: Avstivning» «Oppsummering og repetisjon»
Uke 18 - Ukeslutt	Frist oblig nr. 12 – Knekning og torsjon	
EKSAMENSPERIODE		
Uke 23 (Mandag 7.6)	Eksamen	

Figure 11. *Illustration of the course plan of the MEKG 1001 (part 2)*

In addition, in the course plan were written the dates of the “Mandatory Assignments” in the amount of the “12 tasks”. They were placed after each second week and highlighted with a blue color. Besides, “Exam period” was also mentioned twice in the course plan and underlined in the plan with a red color. The particular date of the exam is stated once, at the end of the course (see Figure 11).

The course reading plan of the IMAG 1001 consists of 4 aligned columns: “Chapter” (Kap.), “Name” (Navn), “Page” (Sider), and “Comments” (Kommentar). It could be seen from the Figure 12, the first column describes the number of chapters the were included in the modules, while the second column refers to the name “navn” of the topic that should be read. The column Pages “Sider” gives a view of the number of pages that every topic contains. And the last column was used for the teacher to write in any notes or comments for students. Thus, the first chapter is called “Unear Equations in Linear Algebra” and was written in the book

"from 2 till 57 pages". There were no comments made by the teacher. According to the reading plan of the course, IMAG 1001 was structured in "11 modules".

Kap.	Navn	Sider	Kommentar
1	**Linear Equations in Linear Algebra**	**2 - 57**	
1.1	Systems of linear equations	2-12	
1.2	Row reduction and echelon form	12-24	
1.3	Vector equations	24-35	Ikke pensum
1.4	The matrix equation Ax=b	35-43	
1.5	Solution sets of linear systems	43-50	
1.6	Applications of linear systems	50-56	

Figure 12. *Course reading plan of the IMAG 1001*

6.1.3. Type of online course through the teachers perspective

The two courses were described by both teachers as a blended type of online courses that had online and face-to-face activities. The proportion and combination of the activities were described by both teachers as: "it is like 60 % digital and 40% physical activities" (Teacher 1) and "60% online and 40% will be on campus" (Teacher 2). However, it was highlighted the influence of the Corona Pandemic restrictions on the organization of face-to-face activities in the course:

> "Now all the physical guidance is transferred to the digital environment" (T1), "Now all the assignments are digital, but we are not a hundred percent sure. It will not be in the future" (T2).

In addition, each of the teachers implemented a different type of teaching method in the online environment, where one had "teaching with pre-recorded videos" (T1), another did "teaching online only synchronously, in live streaming mode" (T2). Both teachers (T1&T2) described the exam admission requirements for students, which includes the fulfillment and delivery of the mandatory assignments. According to the interview with teachers, the number and type of assignments vary from each course. Thus, a course with pre-recorded teaching had "12 mandatory assignments" (T1), while the course with synchronous teaching had "8 mandatory assignments" (T2).

It was found that the teachers (T1 & T2) used a Blackboard learning system as a platform to place the course in the online environment, "we use Blackboard, it is a hub for everything"(T1), "it is a platform, where you can store different resources" (T2). In addition, two different online tools were used for organizing the learning and teaching activities. Thus, "Zoom" and "Teams meetings" facilitated not only "lectures" (T2) "digital guidance"(T1 &T2), but also the interaction activities and evaluation.

6.2 The principle of flexibility in the online course design

6.2.1. The course structure through the teachers perspective

The course teachers, Teacher 1 (T1) and Teacher 2 (T2) described the course as allowing for a redesign and introducing changes. For instance, T1 decided to introduce the changes in the structure of the course in order to "make it better and clearer". He/she commented:

> To make it a clear structure so that it's not jumping back and forth. It's like, get this video about that topic and it's nothing more, nothing less, uh, and try to imagine what could be the questions that arise… I realized that videos are hearing like it's kind of unclear (T1).

As a result, the course structure was modified, by including in each module more short videos, where each of them addressed a particular topic or precise questions. The long videos with mixed topics were excluded from the course. He/she also highlighted that redesigning the course structure was happening due to the adaptation of the unpredictable circumstances in the context of the Covid-19 pandemic,

> We had pre-recorded videos and we had physical guidance hours for, uh, for campus students. Uh, and so that in November or something, we had to switch everything to digital. So also the guidance was digital (T1).
>
> "you experienced problems with it and then considered redesigning it" (T2).

However, it was found that the content of the course could not be changed due to the peculiarity of the subject. Here is her/his explanation:

> Because the course content or such a course is very fixed, uh, in the sense that this is courses and its curriculum was mainly developed in 1800, most of the curriculum. So it's like old stuff, classical stuff, which is taught in all universities around the world. It's like the fundamentals of mechanics. Everyone should know, every mechanical or civil engineer must know these are fundamental concepts (T1).

In addition, the process of introducing the changes or redesigning the online courses was mentioned by Teacher 2 (T2). In order to redesign the course, the teacher should discuss this question in the meeting where all teachers from the mathematical courses of all campuses of NTNU were gathered together. The final decision was made as a result of the mutual agreement:

> All the decisions, all the campus take parts equally. So there's some, but like we dispute, uh, or the choice almost equally for all the campus and all the lectures. So there's nothing, like really like you doing this, you're doing that. So we are teaching our classes, but like all decisions will be made together (T2).

Teacher 1 also commented and confirmed that the decisions on developing the online course structure were made together with the colleagues from the other campuses,

> So I teach one course here in X (name of the city), which has a similar curriculum to one in X (name of the city), to one in X (name of the city). And among us, we have discussed, uh, what should the order of section, should be on section 12 before 13 or vice versa (T1).

Besides, the time period and frequency of the meeting with the colleagues at the educational institution were not mentioned by the teachers during the interview.

6.2.2. Characteristics of flexibility through the teachers perspective

Time

The teachers demonstrated a different attitude towards the flexibility element in terms of time, in the context of the deadline submission of the assignments. According to their statements, both blended courses have a number of mandatory assignments, where each assignment has due dates and has to be delivered before the exam. Teacher 1 characterized him/herself as "very flexible" and further explained how he/she created a space for flexibility for the deadline of the assignments:

> For, uh, for the assignments, they have a due date, but they can do it whenever they want before the date. ..Uh, um, um, but for the mandatory assignments, they normally release the mandatory assignments, uh, before the end of, or the deadline for the prior one so that they are slightly overlapping, but then they can do it whenever they want in the timeframe before. But that's what I'm telling the students, but I'm also very flexible, uh, as long as they do all the assignments before the exam (T1).

Besides, Teacher 1 added another comment on how he/she organized a space for flexibility in terms of tasks delivery, "but if one student is not able to do it within the deadline, uh, I will not keep him, her from doing the exam as long as they do it before the summer and when the exam comes". (T1) In addition, it was explained that by introducing this type of flexibility, the teacher could effectively "arrange the pace" of the course. On the contrary, Teacher 2 described an opposite attitude towards the submission time of the mandatory assignments. Here is how she/ he commented:

> "They have several attempts for each assignment, but when the deadline is lost. They don't have the opportunity to take that one again. There is no, there is no, there is no retake after a deadline". (T2)

But, it was further explained that he/she was ready to support the students and make individual decisions on them. However, it was more in the context of "exception of the rule" rather than an option for students to choose.

Path

As it was previously mentioned, the teachers that participated in the interview had a different type of online teaching with pre-recorded and synchronous online approaches. The first teacher explained that the uploaded course videos for students were "on the demand", despite the fact that these videos "were necessary for understanding the material of the course content". Besides, Teacher 1 created and uploaded to the learning management system the additional assignments with the following answers and solutions for the mathematical problems that aimed to provide more practical space for the students to master new skills and knowledge:

> "Students have additional assignments as if they have time if they choose to if they want to, but they are not mandatory" (T1).

Moreover, there were no deadlines, criteria, nor norms for fulfilling the additional assignments, **so students could choose on their own which assignment to do and whether to deliver it or not during the course**. Teacher 2 mentioned, in relation to synchronous online lecturing, that the course contained "two and a half additional lectures", where students could choose whether to attend it or not. Besides, it was noticed that the requirements for students in terms of being admitted to the final exam were not strict. Thus, eight mandatory assignments were introduced, where students "have to at least, uh, pass a six out of eight... So we had different kinds, but all in all, there are eight assignments". Consequently, if the student delivered seven out of eight, he/she would still "have an opportunity to take the final exam" (T2). That requirement allowed students to choose whether to submit or not submit two mandatory assignments when the minimum number of them was delivered. Additionally, the teacher (T2) was recording the online lectures, while he/she was teaching synchronously:

> "I do record, uh, most all my lectures, but I don't usually just distribute them like, okay you can watch the videos. Students can ask for watching the videos, uh, but I don't usually like to dislocate watching it instead of being in class" (T2).

In the other words, the teacher created an additional video content of the lectures in order to meet the learner's needs, namely if the student wants to recreate the knowledge from the lecture or just wants to use it as a helpful resource for studying. Besides, **the video lecturing format was characterized by teachers as a "flexible and reusable digital resource" for students**.

Place

According to the interview, teachers (1),(2) explained that the courses were designed in the blended-mode of instruction traditions, where there were activities that were placed in the online environment and face-to-face environment. Thus, students from one course had "lectures online" (T2) with "tutoring or exercise classes on campus" (T2) and students from another course had "video pre-recorded lectures" (T1) and "guiding hours on campus" where "students sitting together and working together" (T1). None of the teachers mentioned any of the placement requirements for students during the online activities, while the place for face-to-face activities was defined as on the campus. However, both teachers highlighted the change of the placement of physical activities into the online environment due to the introduced restrictions of the Covid-19 pandemic:

> "In November we had to switch everything to digital. So also the guidance was digital..the reason for not having physical lectures was Corona" (T1),
> "Now all the assignments are digital, but we are not a hundred percent sure..It will not be in the future" (T2).

6.2.3. Flexibility principle through the students perspective

While representing the results on the flexibility component in the online course design from the students' perspective it is necessary to be conscious of its connectedness to the student's ability to take responsibility for his/her own learning. According to the survey results, **it was found that 80,6 % of the respondents confirmed that they have strong time-management skills when they study online**, while 12,9 % of the students disagreed with this statement and only 6,5% selected the answer "neither agree, nor disagree". In addition, **96% of the students agreed that the online course allowed them to take responsibility for their own learning**, and only 3,2% of the students chose the "neither agree, no disagree" with the statement (see Figure 13).

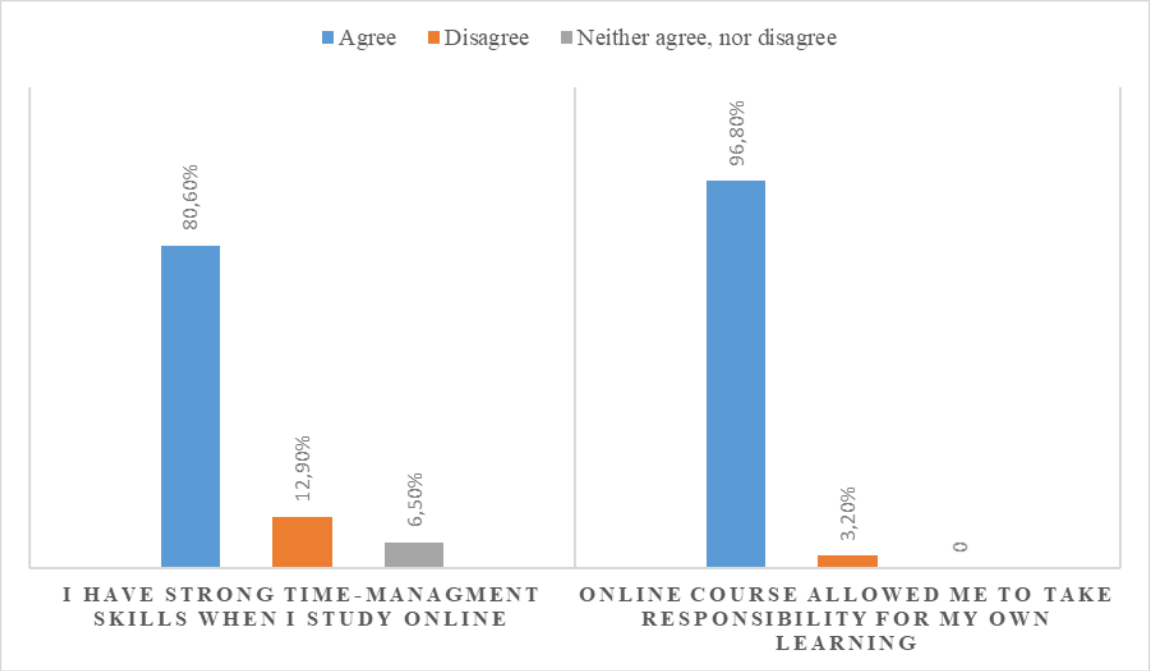


Figure 13. *Students self-evaluation in terms of responsibility and time-management skills*

On the one hand, it was found that among the students who agreed with the statement: "the online course allowed me to take responsibility for my own learning" there were 80% of students with strong time-management skills. In addition, 16,1% of the respondents in the open-ended question commented on the opportunity to be self-reliable and apply time-management skills as a benefit of the online course. Here is what the students wrote in the answers on the open-ended question:

> "You can have time management on your own" (S3).
> "The freedom to control and organize your own day" (S7).
> "Can plan everyday school life by myself" (S14).
> "Can plan lectures around my everyday life, not the other way around as with ordinary lectures" (S25).
> "You can control a lot yourself when learning so that it suits each individual best" (S27).

On the other hand, 12,9 % of the students found self-discipline and organization of the time on their own as a disadvantage of the online course:

> "Having the self-discipline to do and see everything. It is good that you can choose for yourself when you want to do things, but it can also present challenges if you are not structured enough" (S15).
> "Requires self-discipline" (S17).
> "Time planning (scheduling) around doing tasks and lectures" (S24).

Moreover**, around 90 % of the respondents agreed that the online course allowed them to choose a physical place to study as well as time for studying during online learning**, while less than 14% disagreed with both statements.

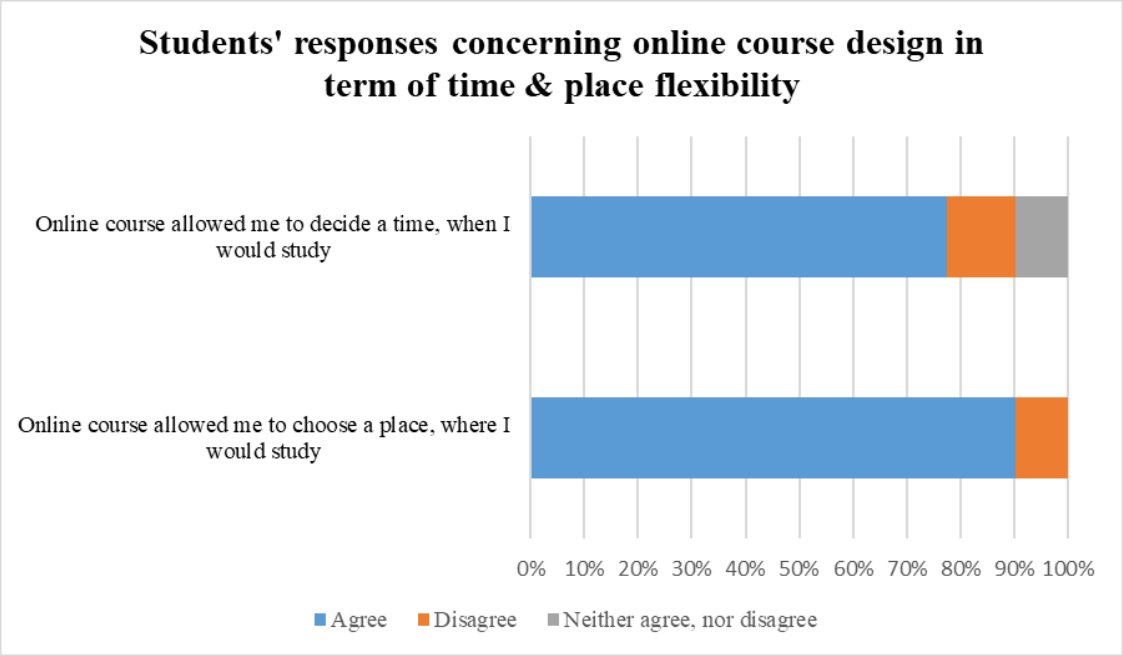


Figure 14. *Student responses on the online course design in terms of time and place*

It is necessary to add to the result section that students were asked about the benefits of the online course, in the open-ended question at the end of the survey. **93% of those surveyed highlighted flexibility as a benefit of the course in the open-ended question**. The flexibility was explained in different contexts. Thus, it was found that 9,7% of the respondents wrote that the main benefit of the course was "flexibility" (S12, S17, S21). However, other respondents provided a broader description of the online course advantages. Thus, there were students that outlined the opportunity to adjust and regulate the speed of the lectures' videos that were recorded by the teachers:

> "You can watch lectures at increased speed and strengthen your everyday life" (S6).
> "You can stop and rewind in lectures, it gives flexibility because you can watch it a little whenever you want" (S13).
> "You can take the video at a faster speed" (S20).
> "I can lose focus in class and miss out on information. If the lecture goes digital, I can rewind to retrieve this information" (S23).
> "You can play recordings again and set the playback speed" (S26).

Moreover, a respondent of the survey in his/her answer mentioned the connection between such flexibility of the online course and the efficiency perspective:

> The solution at NTNU (name of the city) was that all the lectures were recorded, it made it possible to adapt the speed to the pace you needed either if you wanted to make it more efficient by setting the speed or reducing the speed. It provides good opportunities for efficient use of time in a relatively hectic everyday life (S5).

In addition, Students 4,9 and 15 commented that besides the opportunity to regulate the playback speed of the videos, the online course allowed them to choose a place for watching the pre-recorded lectures:

> "Can be done anywhere and if you watch recordings you have the opportunity to pause when you want and rewind if you do not bring anything" (S4).
> "Could watch recordings of lectures whenever I wanted and as many times as I wanted. I was able to watch the lectures at double speed and could pause and rewind if there was something I did not understand" (S9).
> "Having pre-recorded videos you can watch whenever you want, in addition to being able to choose speed, as well as stop and rewind when you need to, I think is a great strength" (S15).

Besides, the respondents that were taking online courses found an opportunity to "control time and space" (S10) by themselves and "study at the time that suits best" (S19). It was also found that online courses allowed students not only to take responsibility for time management but simultaneously organize the place for online learning on their own:

> "You can choose the time and place. And video recordings were very good with a review of theory and calculation examples" (S22).
> "You can choose the time and place yourself" (S2).
> "The ability to choose the place and time to watch lecture recordings" (S24).

Table 1. *Student response distribution on the survey statement*

	Agree	Neither agree, nor disagree	Disagree
I was given a choice about the types of the online activities and assignments that I would complete.	32,3%	12,9%	54,8%

In the present survey, the students were also asked if the online courses provided a variety of assignments with the following opportunity for students to choose on their own which task to complete (see Table 1). According to the results, **approximately 32% of respondents agreed with the statement "I was given a choice about the types of the online**

activities and assignments that I would complete", while over 54% of the respondents disagreed with the following statement and only 12,9% had chosen the "neither agree, nor disagree" answer.

6.2.4. Characteristics of flexibility principle through course documents

Referring to the information provided in section "Learning methods and activities" of the Mathematical methods 1-course web page (see Figure 15), there was a requirement for exam admission in the form of completing the "compulsory works' . Thus, "at least 4 of 6 exercises must be approved for the admission exam".

Consequently, students in the online course had an opportunity to choose the number of assignments that they would complete and deliver, but only if they reached the minimum amount of it, namely four exercises.

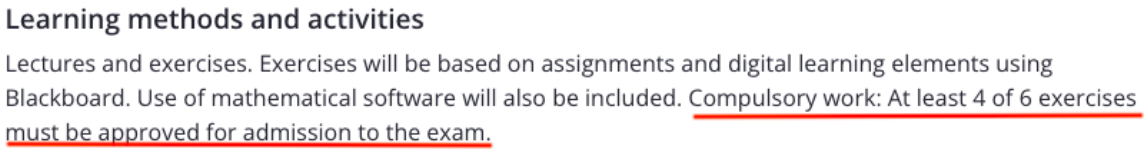


Figure 15. *"Learning methods and activities" of the IMAG1001 course* (https://www.ntnu.edu/studies/courses/IMAG1001)

Besides that, the information concerning the deadline of the mandatory assignments of the Mathematical methods 1 course stayed in the document "Requirements for assignments" (Arbeidskrav i Matematiske metoder 1). This document was uploaded to the Blackboard learning system. It could be seen from the Figure 16, that under the name of the document were written the following "requirements" (arbeidskravene): "at least 4 of 6 exercises must be approved for the admission to the exam of Mathematical method 1".

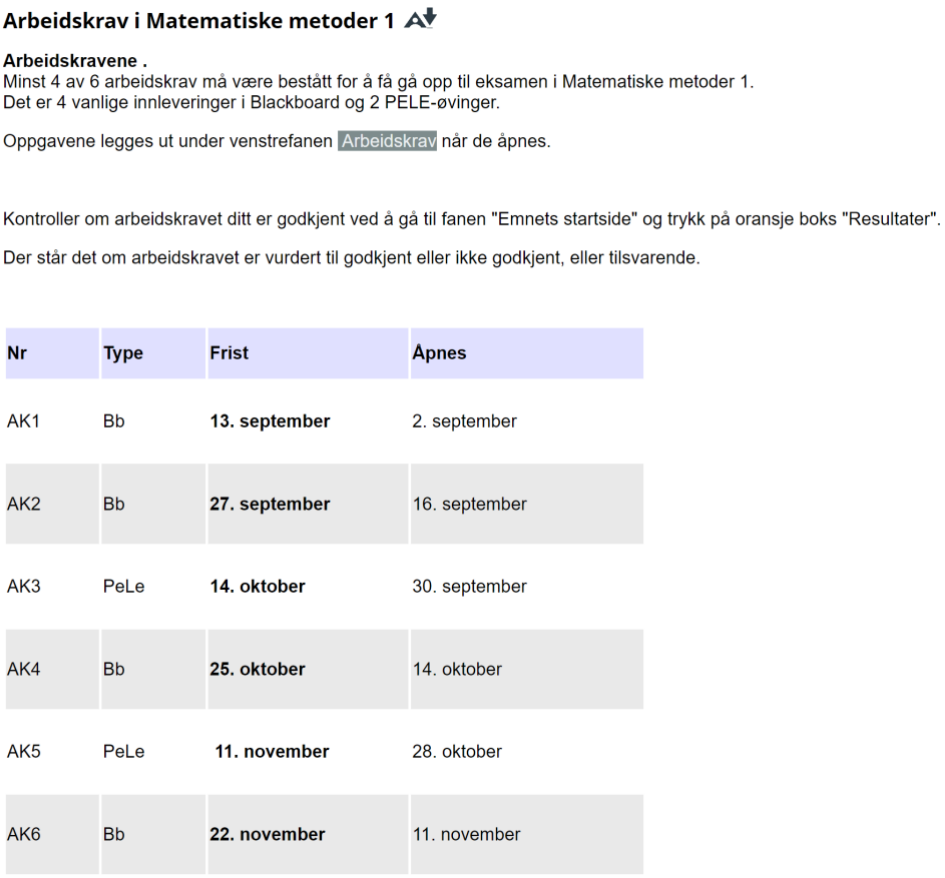
Further, it was written that the assignments could be delivered in the Blackboard system and PELE (Peer Learning Assessment System). In this document, the Teacher placed a timetable with a deadline for each assignment (Frist) separately. In addition, the date when the system is open (Åpnes) for assignment delivery was also described in the table. Thus, for instance, Assignment number "AK1" should be delivered in the Blackboard (BB) within the deadline, from "2nd September" due to "13. September".

The information concerning the deadline for assignment submission was also stated on the course plan of the Mechanics course. This document was uploaded to the Blackboard learning management system. At the very beginning of this document was written the following sentence: "Mandatory calculation exercises must be delivered by the end of the week, i.e. by

Sunday 23:59.” In addition, the deadline for submission of each mandatory exercise stayed in the “Timetable” section of the course plan (see Figure 11). Where the teacher and students could see a particular date when the assignment should be delivered.

Based on the document analysis findings, none of the place and path characteristics of the flexibility principle were found in the online course design of both courses.

In addition, it could be seen from the Figure 17, the teacher integrated in a learning management system a space for the course assignments, which students could choose on their own whether to fulli them or not. In the system, such place is called “Oppgavebank” (exercises’ bank).



Arbeidskrav i Matematiske metoder 1

Arbeidskravene .
Minst 4 av 6 arbeidskrav må være bestått for å få gå opp til eksamen i Matematiske metoder 1.
Det er 4 vanlige innleveringer i Blackboard og 2 PELE-øvinger.

Oppgavene legges ut under venstrefanen Arbeidskrav når de åpnes.

Kontroller om arbeidskravet ditt er godkjent ved å gå til fanen "Emnets startside" og trykk på oransje boks "Resultater".

Der står det om arbeidskravet er vurdert til godkjent eller ikke godkjent, eller tilsvarende.

Nr	Type	Frist	Åpnes
AK1	Bb	**13. september**	2. september
AK2	Bb	**27. september**	16. september
AK3	PeLe	**14. oktober**	30. september
AK4	Bb	**25. oktober**	14. oktober
AK5	PeLe	**11. november**	28. oktober
AK6	Bb	**22. november**	11. november

Figure 16. *“Requirements for assignments” of the IMAG1001 course*

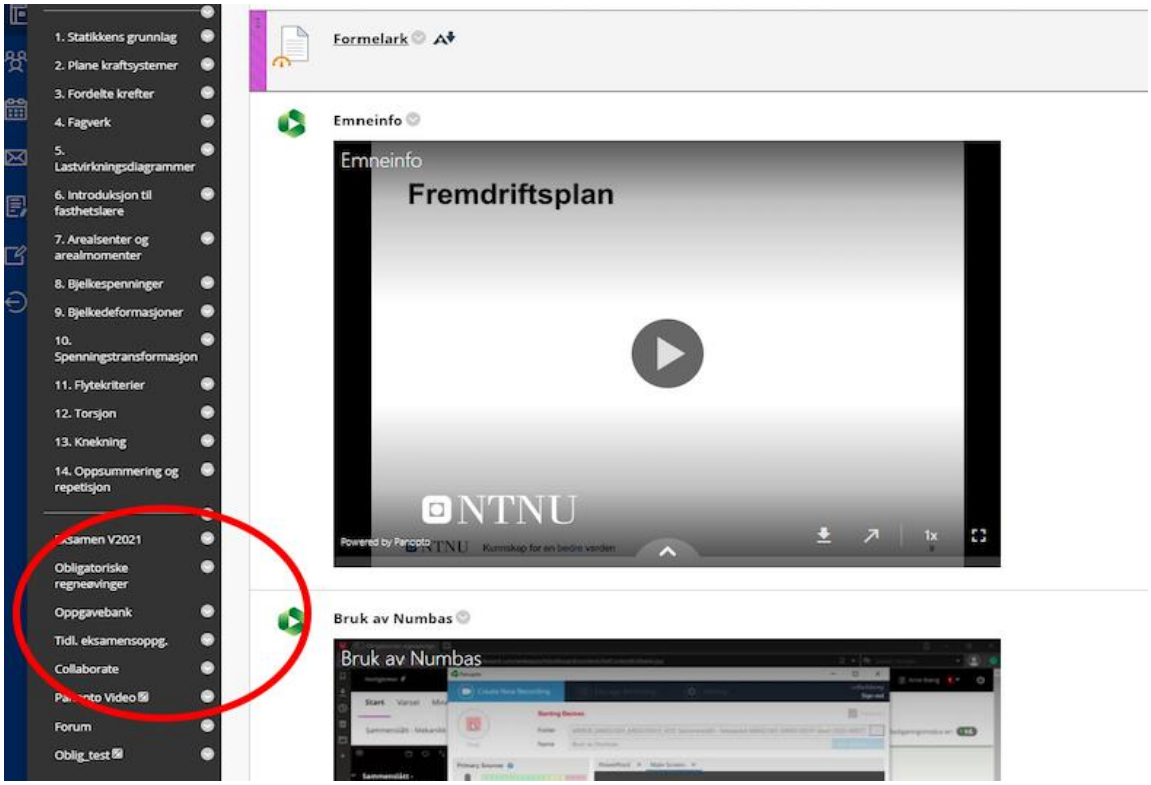


Figure 17. *Screenshot of the Blackboard system MEKG1001 course*

6.3. Principle of interaction in the online course design

6.3.1. Teachers reflections on the interaction with the students

According to the interviews, the interaction process between teachers and students was organized in both online and face-to-face environments. Referring to the teacher's opinion, the digital interaction activities had a purpose "to maintain the interactive session as on-campus", where students could ask questions as soon as it was necessary for them (Teacher 2). While analyzing the interview with the teachers, it was found that the digital tools & platforms that were used in the online courses determined the forms of interaction. The Zoom digital platform or/and Microsoft Teams meetings were used to introduce "one-to-one session with teacher or assistance" through the breakout rooms feature:

> "they can also reach out to me for a "Teams meeting" or whether they have specific questions" (T1).

However, emailing was described by the teacher as the easiest form of communication in the online environment. For instance, students could reach the teachers when experiencing obstacles in the completing the exercises:

> I receive emails quite often, uh, but usually, they are asking questions when they're doing their exercise on their own and they are stuck. It's easier to give supervision on that, give an explanation on the math questions. A student just took a picture of what she did and sent it to me… and I just point out this stuff is wrong… that's why it is easier by answering on email (T2).

In addition, Teacher 1 characterized the forum as an effective form of communication with the students, because it allowed not only to interact with the students "without fixed time or fix arrangements", but also make this interaction visible for other students, while consequently creating a unit of information for others. Here is how he/she explained it in the interview:

> I tried to limit the number of emails rather than have this on the forum so that I don't get drowned in the emails with the same questions. So that's the idea with the forum, that it's open. It's normally just for communication because it's one asking the questions and the other being answering, but at least it's open. So that is if others have the same questions, they can see my answer. Um, so that it also gets the answer that I gave is for everyone it's not for close to communication, not, just one to one students. So it's two purposes with the forum. It's both to limit the workload and also to spread the information and be open (T1).

The importance of the teacher's body gesture was also made apparent. According to the Teacher's 2 opinion, the body gesture plays an important role during the process of the concepts explanation and consequently positively influences on the students' understanding. Here is how he/she commented on this in the interview:

> The body gesture from the lecturer, I think especially for mathematics, it's a very, very important part. Like you can show them with your body gesture, uh, point at things, measuring things. So I think that's an important part to make a connection between the one that is explaining and the content that is being displayed. So it's easier for understanding as well and more engaging for all students (T2).

It was also added that such application of the body gesture could be possible in the online learning environment, where the online teaching methods would be a matter.

> "As for online, there will be some challenges with teachers to do that, but of course, it depends on which kind of method you are using online" (T2).

In addition, both teachers described that the communication with students in the face-to-face environment was usually happening before, during, and after the lecture as well as during the lecture's breaks,

> "they normally approached me during the lecture or in the lecture break"(T1),
> "I do use a break during the lectures, and if they have questions after class, uh, are also possible for them to ask as long as I don't have to run" (T2).

However, Teacher 2 mentioned how the Corona pandemic influenced the face-to-face part of the blended learning in the context of the opportunity for students to contact the teacher on the campus:

> "..before the Corona time, I usually gave the information of where my office is, so students can stopping, dropping by, but in the past two years there haven't been that opportunity". (T2)

It was also explained by the Teacher 1, that all physical guidance hours, where students could ask questions and interact with the teachers were transferred to the online environment due to the restrictions that were introduced due to the pandemic:

> Last year in November, it was a new restriction and sound starting also with this two-meter distancing, um, that was not possible to the physical guidance under those constraints. So then we swapped to digital. (T1)

6.3.2. Students' reflections on the interaction with the teachers

In the present survey, students were asked about their experiences of online communication with the teacher during online learning (see Figure 18). Consequently, it was found that around 70% of the respondents agreed that the teacher communicated effectively during online lectures and less than 55% of the students agreed that the teacher communicated effectively during online seminars. However, it was interesting to highlight that **around 35% of the students found it difficult to assess the effectiveness of teachers' online communication during the online seminars with the students and it is almost three times higher than the percentage of the respondents who disagreed with it**. In addition, it was found that 48,3% of all respondents agreed with both statements. Moreover, around 75% of those surveyed confirmed that the teacher was accessible for interaction & communication outside the online course, while the percentage of students who had chosen the answers "disagreed" and "neither agree, nor disagree" divided equally and was 12,9%.

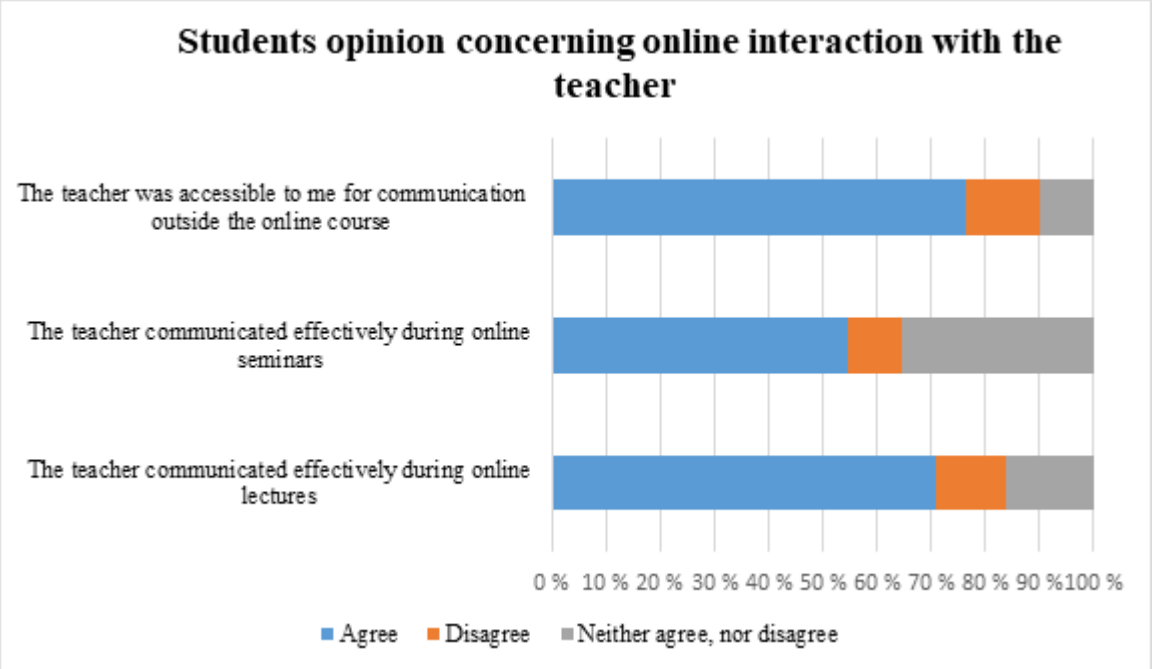


Figure 18. *Students responses on online interaction with the teacher*

Among the students, who described the challenges that occurred during their online learning experience in the open-ended questions at the end of the survey, 35,4% of respondents described the difficulties with online communication and interaction with the teacher in that section. Here is what some of the who surveyed commented in the open-ended answer to the question:

> "Little interaction with the teacher, where questions must be gathered for one hour" (S11).
> "Difficult to communicate with teachers who are not so technologically proficient" Student 14.
> "Communication with the lecturer has been challenging" (S15).
> "Guidance and dialogue (live) with the teacher is incredibly difficult and time-consuming. Experiencing it as very inefficient and could do without me" (S16).
> "Difficult with communication, a bit cumbersome to formulate an email when one is wondering about something every time" (S22).
> "Difficult to ask about small simple things that one wonders. Feels that you have to have a good question to contact teacher online" (S29).

Besides, the survey results showed that 80,6% of the students were satisfied with the amount of online communication with the teacher during the online course (see Table 2). Surprisingly, none of the respondents disagree with the statement, while around 20% of the students found it difficult to neither agree nor disagree with the satisfactory amount of online communication. Besides, among the respondents who were satisfied with the amount of online

communication, 80% of the students felt comfortable interacting online with the teacher, while only 5% of the participants disagreed with that statement.

Table 2. *Students response distribution on the survey statement (2)*

	Agree	**Neither agree, nor disagree**	**Disagree**
The amount of online communication with the teacher was satisfactory	80,6 %	19,4%	0%

6.3.3. Organization of students' activities

According to the Teacher 1 the students' engagement during the online course was mainly placed in the face-to-face environment within physical guidance hours on the campus:

> We have this now physical guidance hours, uh, were being encouraged and encouraged them to sit together and work together with, uh assignments, as it is very useful to collaborate on this assignments. And it, uh, I believe, that it enhances learning outcomes (T1).

Despite that, the first teacher also used the online forum on a Blackboard as the main platform for organizing the students' engagement activities in the online learning environment, where the students can ask and answer the questions to each other concerning assignments, videos and other topics:

> Now, it's mainly through this forum, discussion page. Uh, so we have an online forum on a Blackboard again, where they can ask you questions related to the assignments or related to the videos or whatever (T1).

It was also highlighted that the forum in the course has two additional purposes "to limit the workload and also to spread information" (T1). However, the teacher mentioned the difficulties of placing students' collaboration in the course structure for the following reasons: first of all, due to the specificity of the subject:

> Mechanics, again it is very like it is right or it is wrong. It has a few like "gray areas. So it is not that much to discuss. It is more either you have the wrong answer or the right answer (Teacher 1).

Another comment was added in regard to the student's knowledge and ability to discuss:

> Uh, so mechanics is a very, let's say mathematical course. Uh, so, uh, and it's a course in computations for forces, um, uh, material behavior. So it's not easy to make general discussions among the students because if they don't have any prior knowledge, it does not make sense to ask them to discuss how the should

> be formula there…It's not the same as discussing something that you have a prior relation to. (T1)

The second reason for the complexity of the integration of students' engagement element in the online course was connected with the digital environment. The engagement activities were organized during the digital guidance hours that were placed in the Zoom Meetings or Teams Meetings digital tools. The Teacher 1 explained that "it was hard to facilitate any type of collaboration" during the digital guidance hours, because "people who attended were mainly coming into the room, asking their questions and leaving".

The third reason was given by the Teacher 1 in terms of placement of the learners' engagement was connected with the ability to organize the students, who were employed:

> Many of these students are part-time students working at their own pace. Uh, some during the nights on, during the weekends, some during different times and, and besides, uh, full-time or part-time jobs. So it's, uh, difficult to arrange meeting arenas for them.

It is necessary to mention that the teacher (T1) investigated this problem by conducting the questionnaires and found that students were not actively participating, because:

> "students did not feel comfortable with digital guidance" and "students don't feel confident even if they know they answer" (T1).

In addition, it was an attempt to organize the space for collaboration between students during completing the assignments in the groups, where a mathematical problem was introduced with the same decision method, but the answer number was different. Here is how he/she commented it on the interview:

> So it's a calculation problems uh, and each student gets a random variation of that problem. So the method for, uh, for solving the problem, it's the same for each student, but the answer, the number is different. So it's a way to try to get the students to collaborate on the method, but they cannot just copy the solution of a friend" (T1).

Furthermore, another perspective of the students' interaction within the online course. According to the teacher (2), student engagement was an essential part of the course structure, because the mathematical course was "based on the dialog between students". He/ she also added:

> "So actually almost all my lectures that were given online they were live streaming. And there, students can have the opportunity to answer questions, quizzes, and stuff" (Teacher 2)

Besides, **it was mentioned that the students were encouraged by the teacher to participate in the discussions during the synchronous online lectures and asynchronous online forums**:

> In addition to that my answer, my favorite one is...I usually let my student open the microphone and speak. So it will also be more like when you're on campus…So instead of our turn on and off, I suggest they hold the space key that unmutes themselves, ask a question and just let go of the space (T2).
>
> I encouraged them, to answer questions that they can answer, but, uh, it's very few who they are. So last year it was a few students who actually participated in them, answered questions, and engaged in discussions (T1).

Moreover, the teacher (2) also supported students, who were not confident in public speaking, by allowing them to participate in the online discussions through the chat:

> "but some students think is scary, uh, to speak in front of many students. So some students do that, but, um, so most of them were like writing in the comment" (T2).

However, **it was found challenging to use the chat feature of the learning platform during online communication**. Here is how he/she explained it:

> "As for mathematics, um, it's not, sometimes it's not as easy to answer questions, writing the mathematical expressions through the chat, cause they're not prepared well for subjects like mathematics. So their functions are limited" (T2).

6.3.4. Students experience of collaborative learning

In the present survey, students were asked about online interaction and engagement with each other, including group activities within the online course (see Table 3). According to the results, **around 60% of the students confirmed that the online course included activities and assignments**, where students could collaborate with each other, while 25,8% of those surveyed disagreed with this statement. Besides**, the results also showed that around 80% of the students agreed that they were exchanging their ideas during the online course with the other students**, and only 6,5% of respondents disagreed with this statement. However, it is interesting to highlight that the percentage of the respondents that had chosen the answer "neither agree, nor disagree" is almost twice as high as the percentage of those who disagreed.

Table 3. *Students response distribution on the survey statement (3)*

	Agree	Neither agree, nor disagree	Disagree
This online course included activities/assignments where students could collaborate with each other	61,3%	12,9%	25,8%
I exchanged my ideas with classmates during this online course.	80,6%	12,9%	6,5%
I was able to acquire new knowledge from my classmates during this online course.	87,1%	9,7%	3,2%
I was able to acquire new skills from my classmates during this online course.	74,2%	16,1%	9,7%
I felt comfortable interacting online with the students in this course.	67,7%	25,8%	6,5%
I felt uncomfortable participating in the online course discussion.	19,4%	29,0%	51,6%
I felt uncomfortable participating in the online group assignments	12,9%	32,3%	54,8%

Furthermore, around 87 % of the respondents were able to acquire new knowledge from their classmates and 74,2% of the respondents were able to acquire new skills from their classmates within online learning. In spite of this, 67,7% of the respondents felt comfortable interacting with each other during the online learning, while only less than 7% of the students felt uncomfortable. Nevertheless**, more than 19% of the students felt uncomfortable participating in the online course discussions and 12,9% of the respondents found it uncomfortable taking part in the online group assignments**. In addition, it is necessary to add that the percentage of the respondents that had chosen the answer "neither agree, nor disagree" with the statement "I felt uncomfortable participating in the online course discussion" is 29% and it is almost double the percentage of those who agreed with it. Besides, 32,3% of the respondents that selected "neither agree, nor disagree" in the statement "I felt uncomfortable participating in the online group assignments". As a result, it is almost three times higher than the percentage of those who agreed.

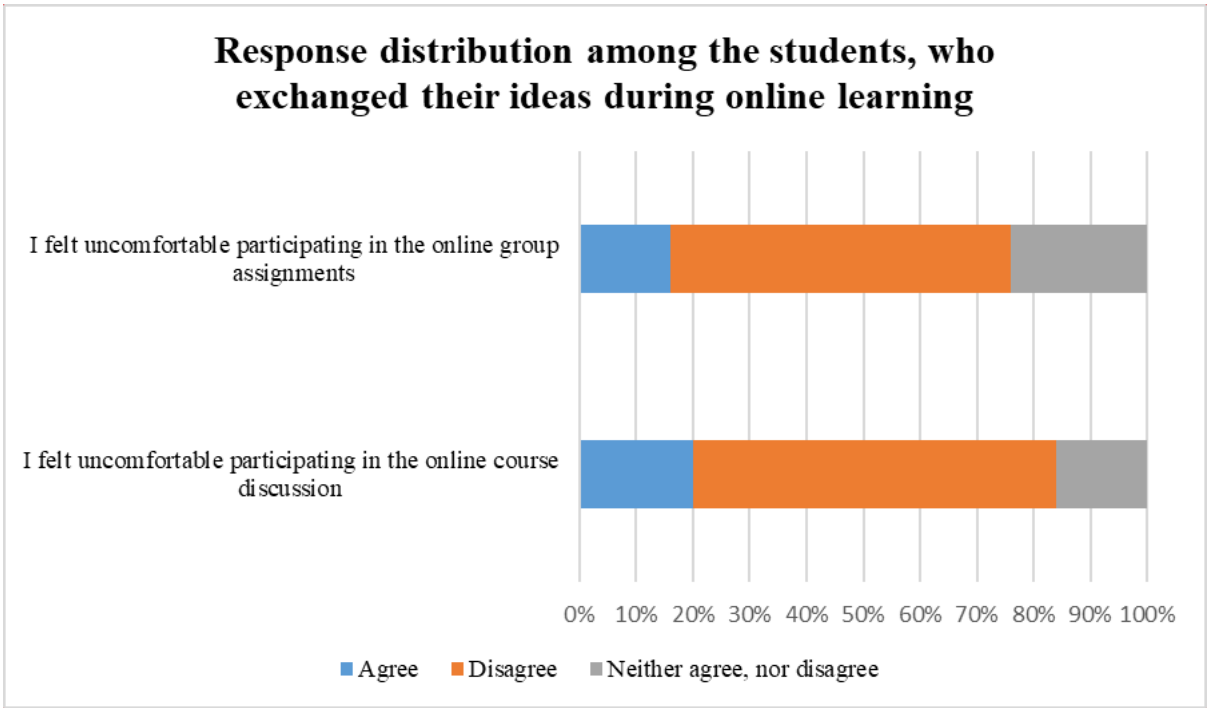


Figure 19. *Student responses on the exchanging ideas during online learning*

However, it was interesting to find that among the students, who exchanged their ideas with their classmates during the online course, around 20% of the respondents felt uncomfortable participating in the online discussions, and 16% of the students felt uncomfortable taking part in the online group assignments (see Figure 19). While continuing to analyze this group of respondents, it showed the following results: despite unenjoyable feelings during communication and engagement with the classmates during the online course, it did not dramatically influence the knowledge. Thus, **83% of the students eventually were able to acquire new knowledge during online discussions**. **However, only half of the respondents that felt uncomfortable taking part in the group assignments were able to acquire new skills during online engagement activities**.

Besides, students were also asked in the survey what they learned most from the online course (see Table 4). Despite the high percentage of the knowledge and skills acquired among all the students and overall satisfaction with the engagement and communication, none of them had chosen the answer “online group activities”, while prioritizing “online lectures” and “individual assignments”.

Table 4. *Student response distribution on the survey statement (4)*

	Online lectures	**Online seminars**	**Literature**	**Online group activities**	**Individual assignments**	**External materials**
What do you think you have learned the most from… ? (choose one option)	64,5%	6,5%	0%	0%	29%	0%

As it was previously mentioned, the open-ended questions were a part of the present survey, where students were asked about the benefits and the challenges of online learning based on their experience within the investigated courses. According to the results, some respondents described “working in groups” (Student 19) and “exchange of experience" (S30) challenges their online learning. In addition, the interaction and engagement with the classmates were also found challenging for the students. Here is what they wrote in the open-ended answer:

> “Collaborating with others online can be difficult” (S12).
> “Little dialogue and discussion with fellow students and lecturer” (S28).
> “Get a good relationship and effective communication” (S10).

It is also necessary to add while analyzing the students' responses**, it was found that none of the students highlighted neither engagement nor communication/interaction with the classmates in the online learning environment as a benefit of the online courses.**

6.3.5. Principle of interaction through the document analysis

According to the section “Learning methods and activities” of the Mechanics course web page, the interaction process between teacher and students during the course was organized “through the learning platform” in the form of “guidance”. In addition, it was given an opportunity to assess the mentioned guidance in a variety of modes, namely “synchronously” and “asynchronously” with the help of the “forum” and “Collaborate” digital tools.

Learning methods and activities

Lectures, assignments and academic supervisions. The course is organized for web based students and lecture videos with theory and calculation examples will be put on the learning platform. Guidance is done through the learning platform, both synchronously using tools such as Collaborate, and asynchronously using "forum".

Figure 20. *Screenshot of "Learning methods" of MEKG1001 course* (https://www.ntnu.edu/studies/courses/MEKG1001)

Referring to the course structure in the Blackboard learning system, there was organized a place for the teacher's interaction with students as well as the opportunity to discuss questions between students in the "Collaborate" and "Forum" digital tool (see Figure 21).

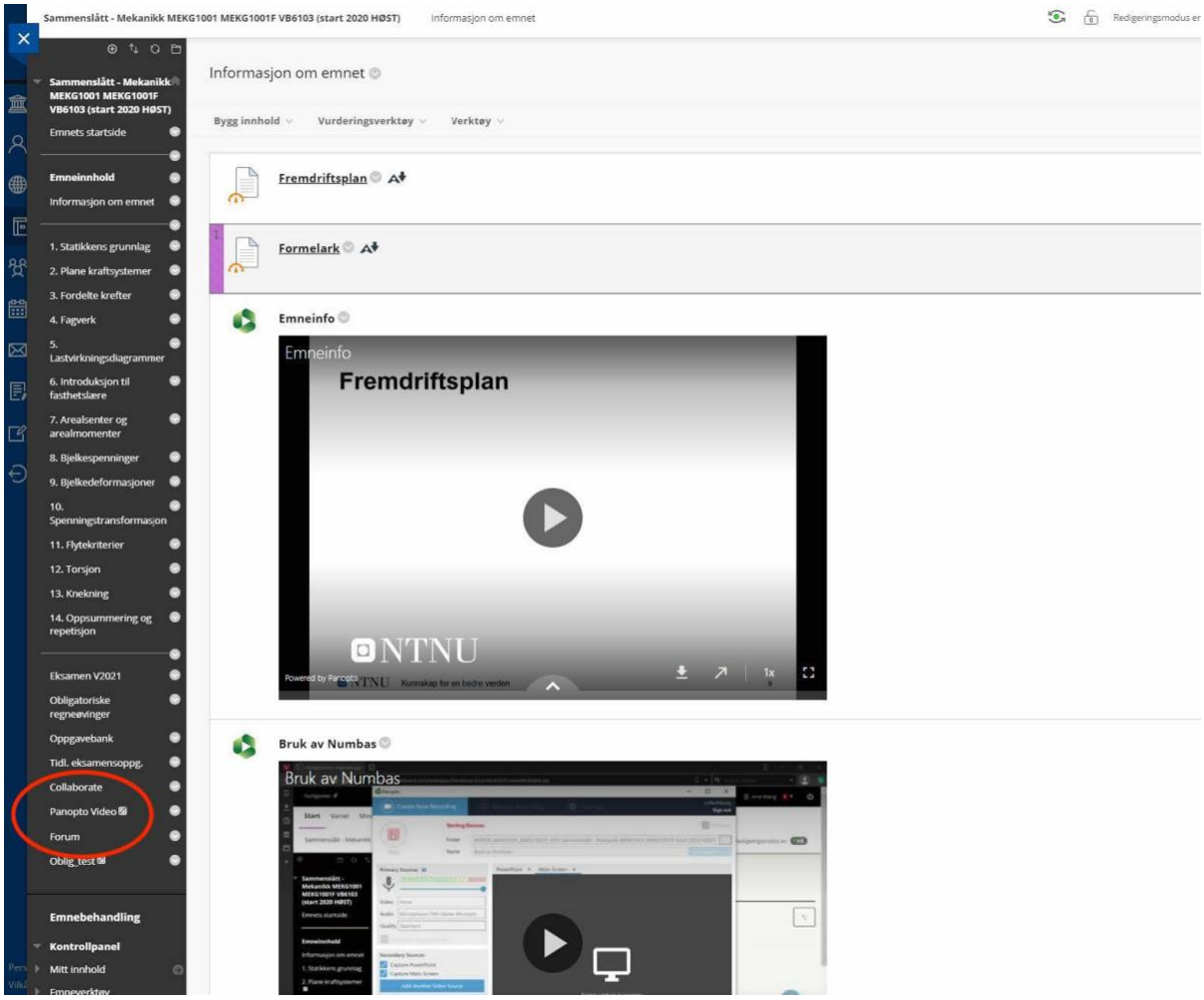


Figure 21. *Screenshot of the interaction element in Blackboard system MEKG1001 course*

According to the statement that was placed in the Instructions view on the "Forum" feature is "a good tool for getting students to think critically in connection with your topic work and to interact with each other's ideas" (see Figure 22). The teachers could "create discussions

for individual topic lessons or for the topic as a whole". Besides, the teacher could add a "description of the question topic" (beskrivelse), monitor the number of "unread posts" (uleste innlegg), see the number of "unread answers" (uleste svar til meg), and finally to monitor "the total number of the participants in the discussion" (totalt antall deltakere). It can be seen from Figure 22 that the lowest number of participants in the discussion was 5, while the highest number was reached by 32 students. While "the total number of posts" (innlegg totalt) to the particular question varied from 13 to 185 posts.

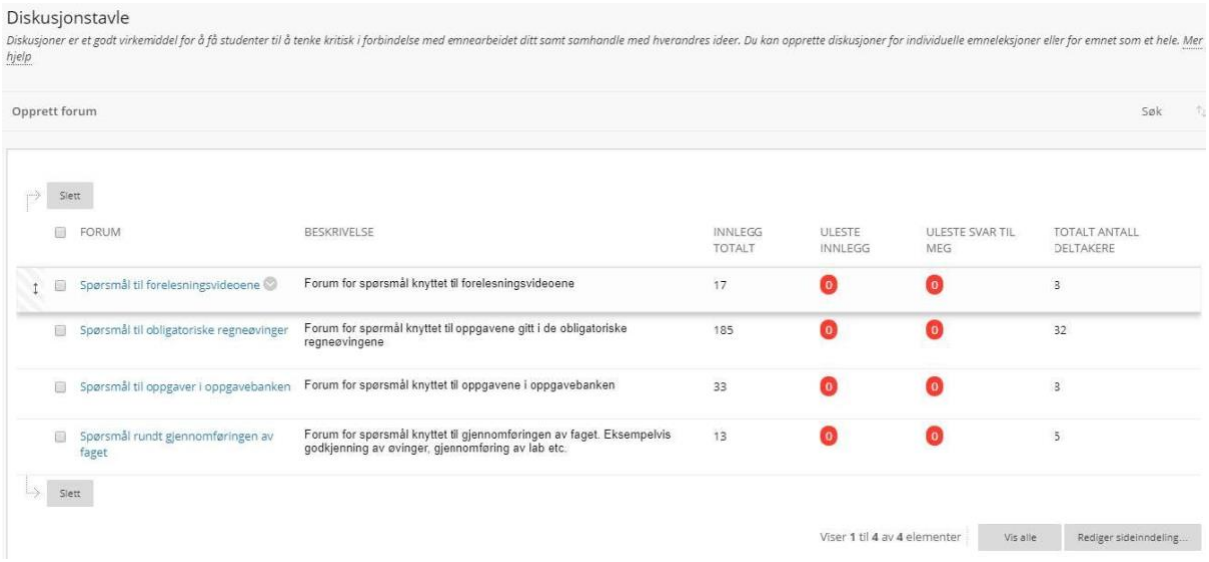


Figure 22.*Screenshot of the "Forum" feature in Blackboard system MEKG1001 course*

Referring to the documents of the investigated online courses, none of them contained any information concerning engagement activities or interaction between the students during online learning.

6.4. Principle of facilitation of the learning process in online course design

6.4.1. Teachers assistance in the learning organization

In the present interview, the teachers mentioned the necessity to organize guidance for the students at the beginning of the course. The main reason for taking the mentioned actions was that teachers took into consideration that students might not know how the learning management system works and they need to get acquainted with it. For instance, this is what the teacher expressed in the interview:

> "In the mathematical one, most of the students, they're quite new in university. They do not know how a Blackboard works, many people didn't even ever heard out Blackboard before" (Teacher 2).

In addition, “some students are not as good as the other students in getting information” and as a result “students will need a guidance to find the information they needed” (T2).

Consequently, as a solution to the emerged problem, various help and guidance was required at various stages. For instance, as a very first step, the students received an email on the private account with the first instructional information and the link for the meeting, where the learning management system would be explained to students. Here is how the mentioned step was described by the teacher (2):

> I sent out an email, I gathered a private email because we do have NTNU email, but you cannot expect every student already know how to log on the NTNU email. So I asked the private email address from the apartment that have the access. So I send an email to them. Um, at the beginning of the semester with all the info they needed to know, and where to get the info. So first step, they know how to log on (T2).

Besides, the Teacher added that the institution where the online courses were placed had a department where students could get help with all questions that were connected with the IT and usage of the learning management system. As a second step of the guidance, the teachers organized an instructional lecture as the very first lecture of the online course. During it, students received information concerning the structure of the online course, including course goals, plan of the course. In addition, the teachers introduced the functions of the learning management system in the context of the course, for instance, the features of the system such as a forum or the placement of the materials or assignments for the students. Here is what the first teacher of the online course mentioned in the interview:

> I have the first lecture, I kind of give an overview of the plan and state where is it located, um, uh, that they can follow, follow the plan there. The plan for the whole course, uh, with each week there's a set of videos. So it's structured, um, very defined. Where you're going through the semester with the specific videos each week, and then it's the assignments and the deadline for the assignment (T1).

And here is the piece of the comment of Teacher 2 concerning the lecture guidance:

> So when I send the email, they will also get the zoom link with the time when the lecture is and on the first lecture, the first part of the lecture there will be practical information like we were showing them Blackboard and showing them where you can find information (T2).

Moreover, **both teachers pointed out that assistance and help were provided to the students not only at the beginning of the course but also during it within the completing assignments in the online and face-to-face environments**. For instance, teachers received and answered the emails, where “they are asking questions when they are doing exercises on

their own and stuck" (Teacher 2), or assisted students "during the digital hours guidance" (Teacher 1). In the physical guidance hours, "there is a student assistant, who goes around them and helps them" (Teacher 1). Besides, students could receive help by asking the questions in the forum feature of the learning management system without "the fixed time or fixed arrangement" (Teacher 1). Moreover, the breaks during the lectures were used as a space for answering the questions by both teachers.

6.4.2. Student reflections on the online assistance

At the present survey, students were asked if the important online course goals were explained and introduced in the investigated online courses. As a result, **around 80% of the respondents confirmed and agreed that the teacher explained the important course goals within online learning**, while the percentage of the students who disagreed and found it difficult neither agree, nor disagree with the statement was 19,4 %. Besides, exactly the same percentage of those surveyed agreed that the course goals were clearly presented on the webpage of the investigated online courses and exactly the same percentage of the respondents who selected the answer "disagree" and "neither agree, nor disagree" with the statement (see Table 5).

Table 5. *Student response distribution on the survey statement (5)*

	Agree	**Neither agree nor disagree**	**Disagree**
The online course goals were explained by the teacher	80,6%	9,7%	9,7%
The goals of the online course were clearly presented on the web-page	80,6%	9,7%	9,7%

Furthermore, students were assessing if the teachers' instructions during online learning were clearly provided (see Figure 23). **The results of the survey showed that more than 50% of all respondents confirmed that the teacher provided clear instruction on participation in online lectures, seminars as well as in online assignments**. However, it is necessary to highlight the relative percentage of the students who found it difficult to neither agree nor

disagree with the statements. Thus, almost 30% of those surveyed neither agreed nor disagreed with the statement that the teacher provided clear instruction on how to participate in online lectures. In addition, around 20% of the students selected the same answer, but in the context of participation in online assignments. And 35,5% of the respondents, who could not agree or disagree with the clearness of provided instructions in the context of participation in online seminars. In addition, it is nearly three times higher in comparison with the percentage of the students who disagreed with the mentioned statement.

Besides, the students were asked if the teacher was helpful and guided the class during their online learning. The results of the survey indicated that **almost 75% of the respondents agreed that the teacher was helpful in guiding the class towards an understanding of the online course concepts during lectures**, while only 9,7% of the students disagreed with it. In addition, around 68% of those surveyed also agreed that the teacher was helpful in guiding the class towards an understanding of the online course concepts during seminars, while 6,5% had chosen the answer "disagree". Overall, **54,8% of the students agreed with both statements of the survey and found the teachers' guidance helpful not only during the lectures but also during seminars.**

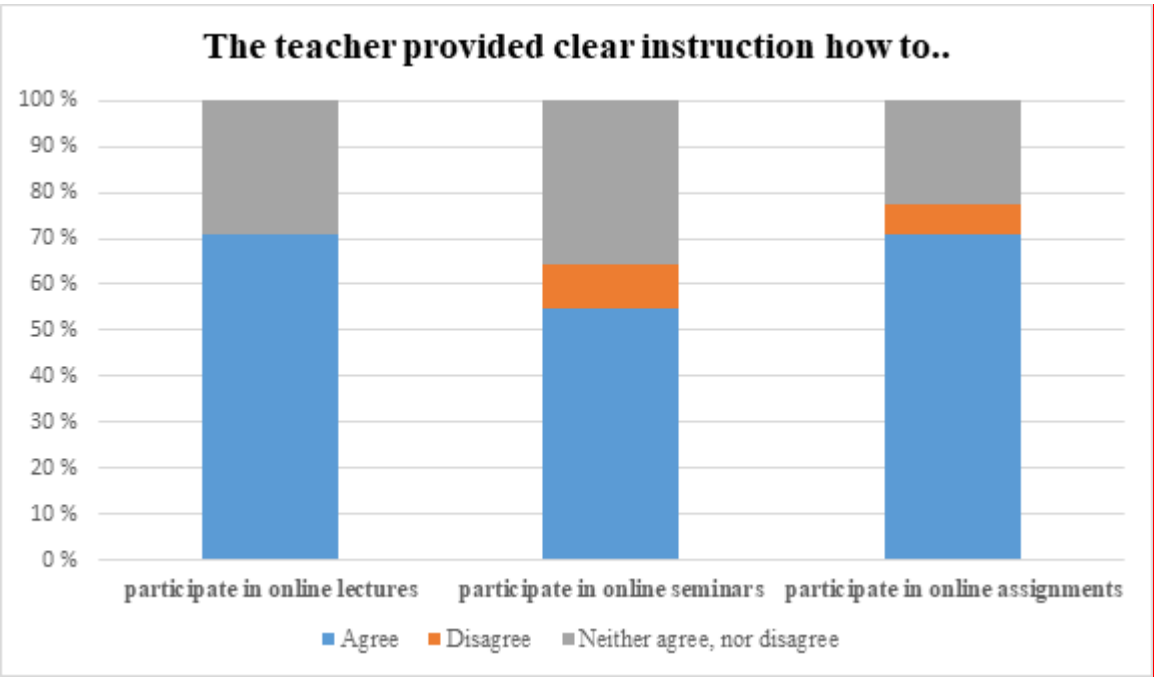


Figure 23. *Student responses on the teacher's instruction*

Among the students who found getting help and guidance from the teacher by challenging during the online course, explained and commented on it in the following way. For instance, one of the students (S4) experienced that "teacher guidance becomes more

demanding". Besides, another respondent (S25) found that it is "more difficult to get help with tasks" in comparison with face-to-face learning environments. Student 27 who also participated in the present survey found it complicated to get help from the teacher, especially "if there's something you do not understand".

6.4.3. Evaluation of the students' progress

In the present interview, the teachers were asked about the assessment part that was constructed in the online courses. Referring to the teachers' answers, **it was found that the assessment was placed during the online lectures and seminars, both synchronously and asynchronously, at the end of each module and at the end of the online course**. Thus, according to the teacher (1) with a pre-recorded teaching, quizzes were used and integrated either in each video, or after the video in order to assess students' knowledge. However, such quizzes were placed only at the beginning of the course and further were removed due to their uselessness. Here is how he/she commented in the interview:

> In the videos I made, I put some quizzes, but it was mainly at the beginning. Um, I felt that it was not that useful. Because it stops the video when you have to answer a quiz before it continues. Um, maybe it gets more frustrating that you have to stop the video all the time for doing these quizzes instead of just watching the video and getting, finding the information that you are missing (T1).

Teacher 2 in the synchronous online teaching was using the "polls", "yes or no reactions", "quizzes" features as a tool in the Zoom digital platform to maintain the students' assessment. Besides, Teacher 2 used a Mentimeter (digital tool for interaction & evaluation) as well as "given a choice" and "open microphone" features in the Microsoft Teams platform. In addition, it was highlighted students' speed of answer and involvement in such form of assessment in the following way:

> "most of my students, they are quite good at like "right on" answer, like "given a choice", "yes or no" answer or something else. So, that's what I am quite proud of" (T2).

Furthermore, it was pointed out that the ease at which a personalized assessment of the student during an "open microphone" discussion in the online environment:

> I feel like it's easier online rather than on campus. Because when you're in a zoom meeting, you can see their names, so I am usually the kind of teacher like to, if someone hasn't asked or haven't answered the question, I will usually ask what's your opinion that I will refer to his/her name (T2).

However, **both teachers highlighted the importance of the mandatory assignments that were placed in the course after each module/unit of the online course**, "they have to

pass them in order to have the opportunity to take the final exam" (Teacher 2). The number and form of mandatory assignments vary from the course, one course contained "12 mandatory assignments"(T1), where all of them should be passed in order to take the exam, and another included "8 assignments during the semester" (T2), where students needed to submit a minimum 6 assignments. Here is how Teacher 1 described the assessment through the mandatory assignments in the interview:

> We also have the main assessment in the course is 12 mandatory exercises. Uh, it is more or less one each second week. And I think those sorts of ones that the students are focusing on. Uh, so, and I guess that they use the videos to find the information they need for doing those exercises. Uh, and those exercises are most of them as 11 of them are in a digital system. Where we program the problem. So it's a Numerical problem normally. As long as they do the assignments, that's where I check the other day, to have the necessary knowledge through these assignments (T1).

It was also mentioned by Teacher 1 that they used pre-recorded videos in the course as The main teaching method that there was an opportunity to monitor the students progress through the Blackboard system and Nimbus program:

> I can monitor every detail so I can monitor how they move through the assignments, uh, what they type, um, every, every single detail. So I can check whether the students, um, get their answers correct on the first try or whether they are guessing and checking numbers to see if they get the green box. So I can see if they have one attempt before they pass, or if they have hundreds of attempts before they pass (T1).

As well as through the Panopto program, which was used not only in making videos but also for monitoring user progress in terms of which videos were watched, how many times, and if the videos were watched fully or partially**. Despite the mentioned opportunities for monitoring students' progress, the teacher did not embrace them, because of the lack of time**, "everything is possible to monitor, but I don't have the time to do that" (T1).

6.4.4. Student experiences with assessment activities

Table 6. *Student response distribution on the survey statement (6)*

	Agree	**Neither agree nor disagree**	**Disagree**
The online assignments in the course were useful for me	96,8%	3,2%	0%
I think that the connection between online lectures &	83,9%	12,9%	3,2%

seminars and online assignments is strong			

In the present survey, students were asked about the assignments that were constructed in the online courses (see Table 6). According to the results, **96,8% of the respondents agreed that the assignments in the investigated online courses were useful**, while only 3,2% of the students neither agreed, nor disagreed with that. Besides, students were asked about the alignment and connection between online course lectures & seminars with online assignments. As a result, almost 84% of the respondents agreed with the statement "I think that the connection between online lectures & seminars and online assignments is strong", while 3,2 % of the students disagreed with the statement and around 13% selected the answer "neither agree, nor disagree". Overall, **84,3% of all students found the assignments in the online course useful as well as strongly connected with the other online learning activities, such as online lectures and online seminars.**

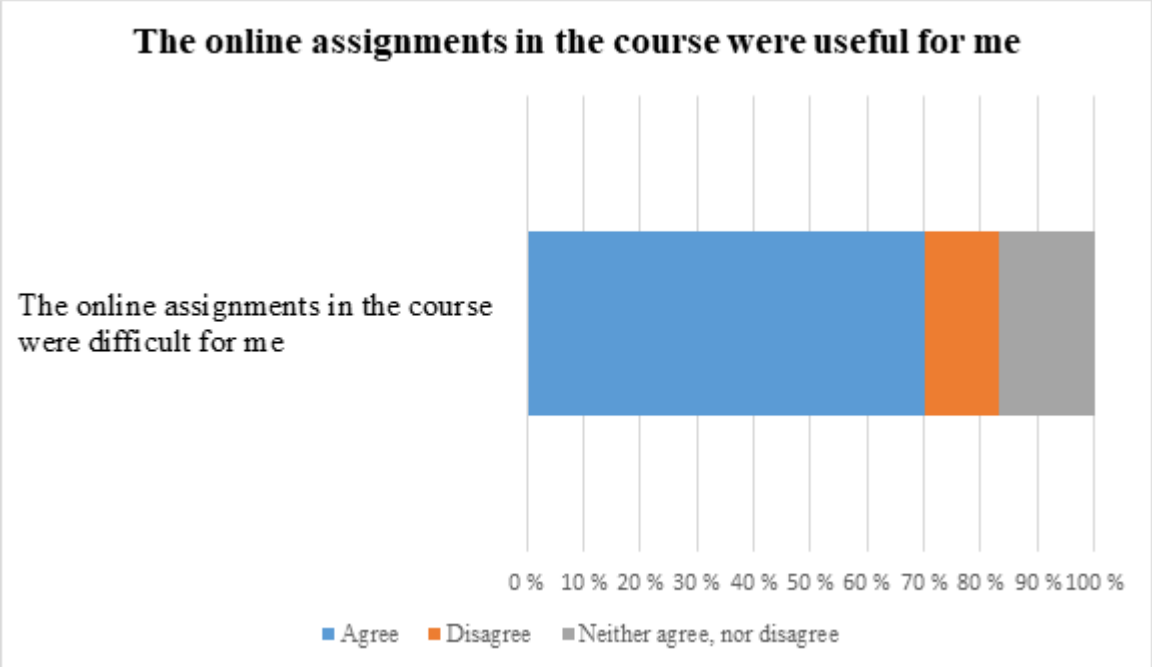


Figure 24. *Student responses on the usefulness of online assignments*

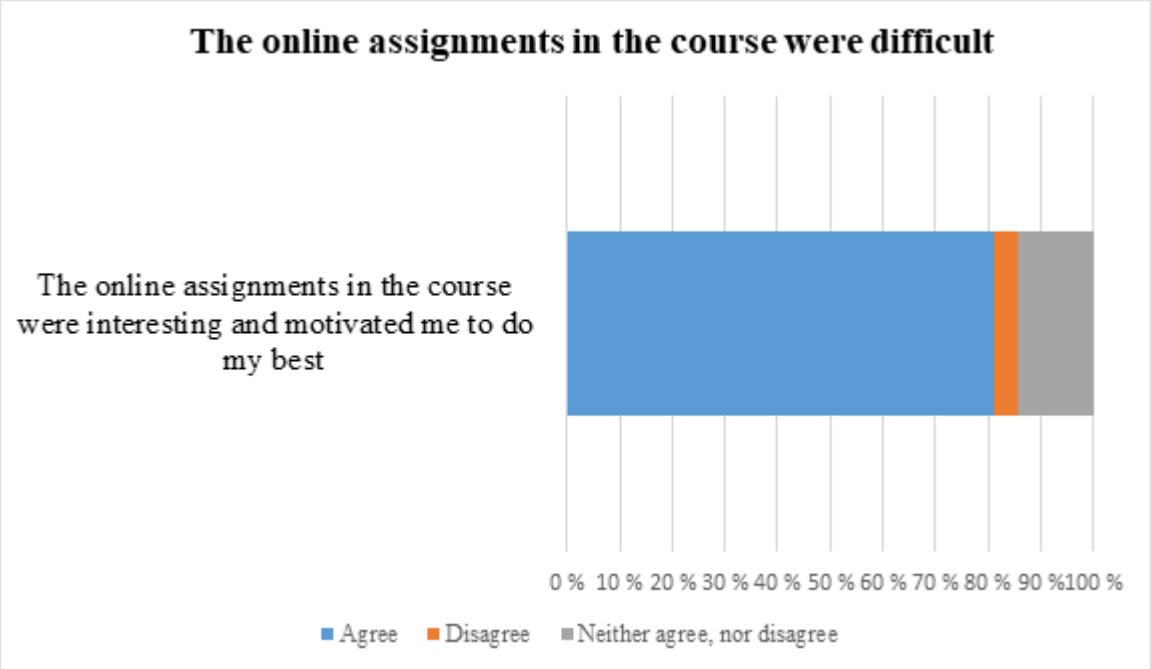


Figure 25. *Students responses on the difficulty of online assignments*

Within the further descriptive analysis of the data, it was found that among the students who characterized that online assignments were useful, 70% of the respondents described such online assignments as difficult and 13,4% of the students described them as easy assignments, while 16,6 % those surveyed could not characterize them either difficult or easy (see Figure 24). Despite the high percentage among the students who found the online assignments as difficult exercises in the online course, around 81% of students characterized the online assignments as both difficult and interesting and motivational for the students to do their best. While less than 5% of those surveyed experienced difficult assignments as boring and non-motivational for them (see Figure 25). Finally, around 29% of the students answered that they learned the most from the online course by doing the individual assignments.

6.4.5. Representation of the assessment component in the course by the educational institution

Referring to the courses' web pages, the section "Examination" provides the user with information about "examination arrangement" (see Figure 26 and Figure 27). It was also presented shortly in the section "About", but here it included "Date", "Time" and "Examination room". However, the details of the particular day and time of the exam were described only on the web page of the Mathematical methods 1 course (see Figure 27). Besides, both courses used the "Inspera" digital system as a "digital room", where the exam assignments were placed.

Inspera allows educational institutions to organize and place the exam in online and face-to-face environments. According to the information provided in the section, it could be seen that written exams of both courses were organized in the physical classroom, “The location (room) for a written examination is published 3 days before the examination date”.

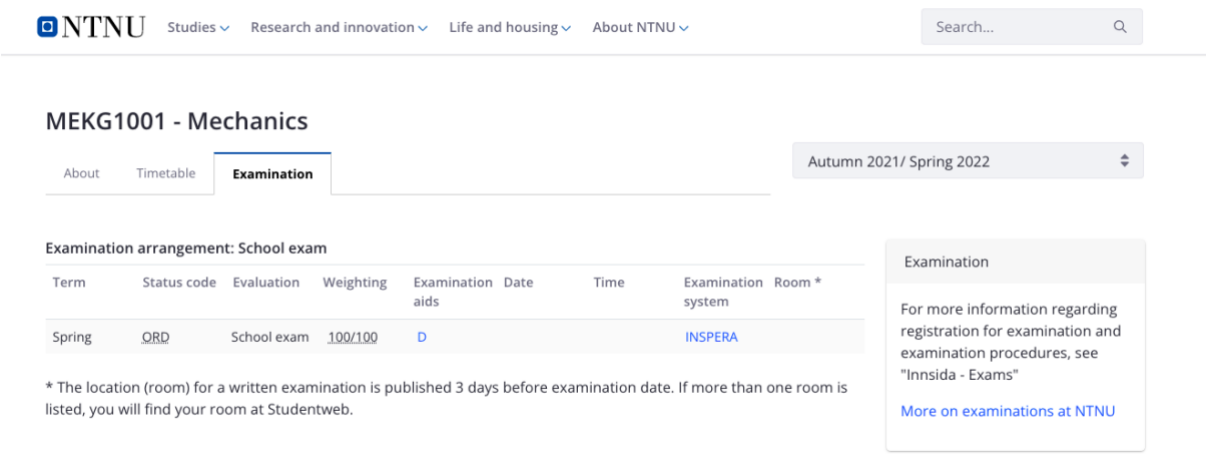


Figure 26. *Screenshot of “Examination” part of the MEKG1001 course* (https://www.ntnu.edu/studies/courses/MEKG1001)

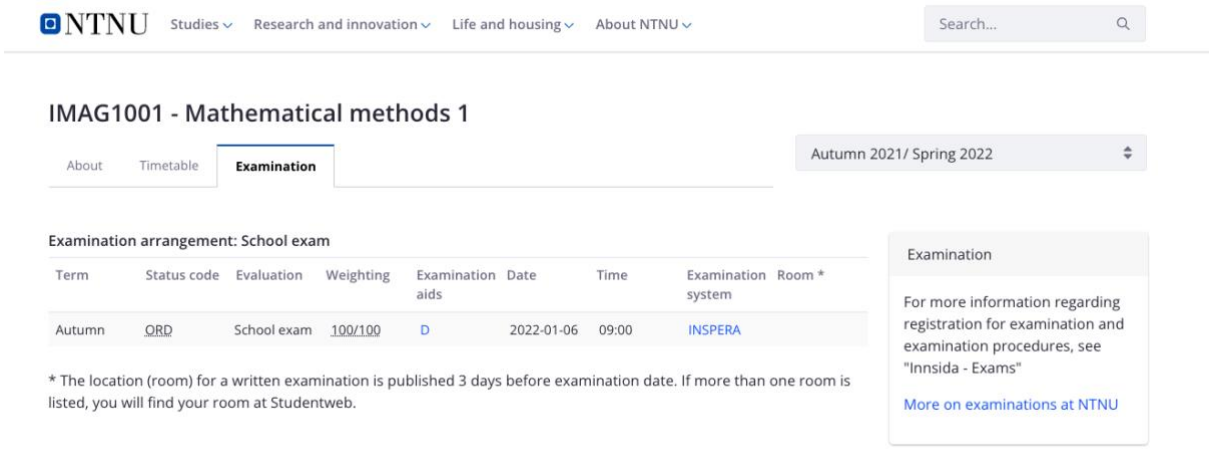


Figure 27. *Screenshot of “Examination” part of the IMAG1001 course* (https://www.ntnu.edu/studies/courses/IMAG1001)

Besides, according to the web pages of both Mathematical methods 1 and Mechanic courses, the section “Examamination” had additional information regarding the exams procedures at the NTNU. Thus, in the lower right corner of the page, there was placed a note with the following text: “for more information regarding registration for examination and examination procedures, see "Innside - Exams" with the following link “More on examination at NTNU”. The page “Exams for students” contains detailed information about the examination

procedures and the form of guidance that was available in the Norwegian and English languages (see Figure 28).

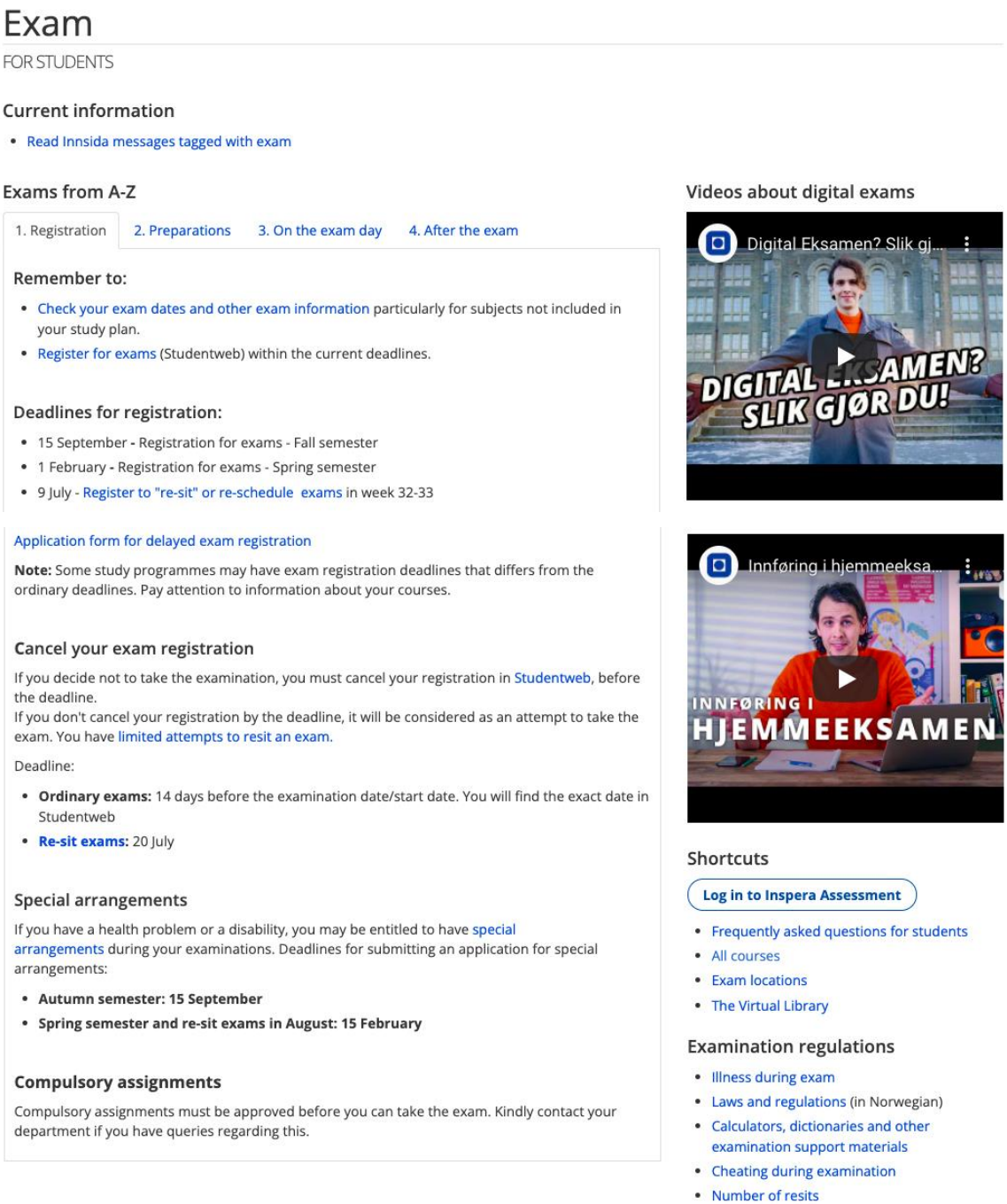


Figure 28. *Screenshot of "Exam for students" of the NTNU web-page* (https://i.ntnu.no/en/eksamen)

Thus, students got access to explicit step-by-step instructions in terms of "Registration", "Preparation", "On the exam day ", "After the exam" exam actions. In addition, two videos "about digital exam" were uploaded to the page, which contained information about "Digital

Exam" and "Digital Exam at Home" and provided detailed instructions for students (see Figure 28). However, the mentioned videos were recorded in the Norwegian language, but the subtitles in the English language were also available. Besides, the web page had "Shortcuts", where the user could search for the information about "All courses", "Exam locations", "The virtual library" and read "Frequently asked questions for students". Moreover, the web page had a section with "Examination regulation" where was provided law-based information concerning the following cases: "Illnesses during exam", "Cheating during the examination", "Examination support material", and "Number of resists on the exam". At the bottom of the web page, the user could find contact details of all campuses of the NTNU, including "emails", "telephone numbers", and "addresses".

6.4.6. Assessment components in the course design

While analyzing the course plan of the MEKG 1001 20/21 course, it was found that the mentioned course contains 12 mandatory assignments. The requirements for deadline delivery of exercises written at the beginning of the document, namely: "Mandatory calculation exercises must be delivered by the end of the week, ie by Sunday 23:59" (Obligatoriske regneøvinger (oblig) skal leveres innen utgangen av uken, dvs innen søndag 23:59). It could be seen from Figure 29 and Figure 30, each assignment is highlighted in the course with the blue colour and is placed approximately after each second week. Moreover, each assignment has its own number, name as well as the deadline for each. For instance (see Figure 29), the mandatory assignment number 3 "Joint constructions" (oblig nr.3 - Leddkonstruksjoner) must be delivered by the end of the week number 41 (Uke 41-ukeslutt). After two weeks, students must submit another mandatory assignment number 4 "Timber framing" (oblig nr 4 - Fagverk) by the end of the week number 43 (Uke 43- Ukeslut).

Uke 41 – Ukeslutt	Frist oblig nr. 3 - Leddkonstruksjoner	
Uke 42 (12.10-16.10)	5. Lastvirkningsdiagrammer	«Intro» «Eksempel: Bjelke med punktlast» «Eksempel: Bjelke med jevnt fordelt last»
Uke 43 (19.10-23.10)	5. Lastvirkningsdiagrammer	«Eksempel: Lyktestolpe» «Sammenheng mellom V og M (og deformasjon)» «Eksempel: Bjelke med overheng»
Uke 43 – Ukeslutt	Frist oblig nr. 4 – Fagverk	
Uke 44 (26.10-30.10)	5. Lastvirkningsdiagrammer	«Eksempel: Kraftledningsmast» «Eksempel: Ramme»
Uke 45 (2.11-6.11)	5. Lastvirkningsdiagrammer	«Skrå komponenter» «Eksempel: Ramme med skrå søyle»
Uke 45 – Ukeslutt	Frist oblig nr. 5 - Lastvirkning	

Figure 29. *Illustration of the course plan of the MEKG 1001 (part 3)*

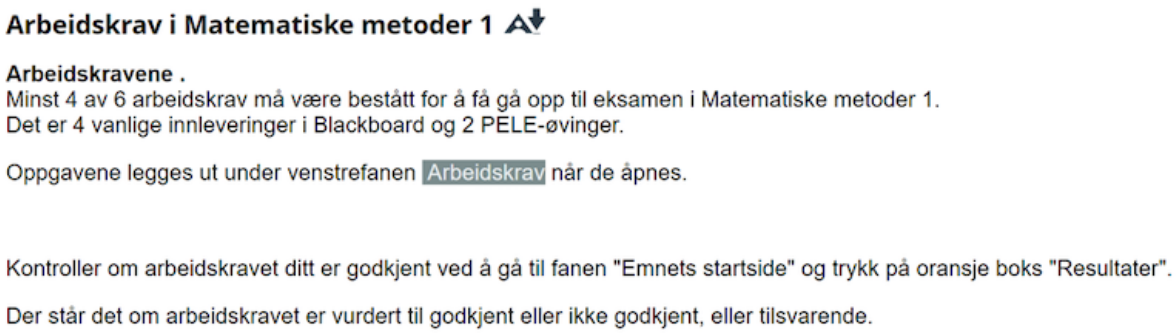
Uke 18 (3.5-7.5)	13. Knekning 14. Oppsummering og repetisjon	«Eksempel: Estimat av knekklast» «Eksempel: Avstivning» «Oppsummering og repetisjon»
Uke 18 - Ukeslutt	Frist oblig nr. 12 – Knekning og torsjon	
EKSAMENSPERIODE		
Uke 23 (Mandag 7.6)	Eksamen	

Figure 30. *Illustration of the course plan of the MEKG 1001 (part 4)*

Besides, the exam period (Examenperiode) was also mentioned twice in the course plan and underlined in the plan with a red color (see Figure 30). The particular date of the exam is stated once, at the end of the course. Thus, students have a final exam on the week number 23 on the 7th of June, Monday (Uke 23 (Mandag 7.6)).

6.4.7. Institutional requirements for the summative assessment

In the document "requirements for the assignment" for the Mathematical Methods 1 course (Arbeidskrav i Matematiske metoder 1) were written requirements and terms of the delivery of the mandatory assignments. At the beginning of the documents (see Figure 31), it was described a minimum number of the exercises that students must submit in order to be admitted to the final exam, "At least 4 of 6 work requirements must be passed in order to sit for the exam in Mathematical Methods 1" (Minst 4 av 6 arbeidskrav må være bestått for å få gå opp til eksamen i Mathematiske Metoder 1). Then, there are described the types of the exercises, "there are 4 regular assignments in Blackboard and 2 PELE exercises" (Det er 4 vanlige innleveringer i Blackboard og 2 PELE-øvinger).



Arbeidskrav i Matematiske metoder 1

Arbeidskravene .
Minst 4 av 6 arbeidskrav må være bestått for å få gå opp til eksamen i Matematiske metoder 1.
Det er 4 vanlige innleveringer i Blackboard og 2 PELE-øvinger.

Oppgavene legges ut under venstrefanen Arbeidskrav når de åpnes.

Kontroller om arbeidskravet ditt er godkjent ved å gå til fanen "Emnets startside" og trykk på oransje boks "Resultater".

Der står det om arbeidskravet er vurdert til godkjent eller ikke godkjent, eller tilsvarende.

Figure 31. *"Requirements for assignments" of the IMAG1001 course (part 2)*

Besides, it was explained the location where the mandatory assignments are uploaded, "the assignments are posted under the left tab Requirements for the assignments when they are opened" (Oppgavene legges ut under venstrefanen Arbeidskrav når de åpnes). In addition, students could see if their requirements have been assessed as "approved or not approved" (godkjent eller ikke godkjent).

Nr	Type	Frist	Åpnes
AK1	Bb	**13. september**	2. september
AK2	Bb	**27. september**	16. september
AK3	PeLe	**14. oktober**	30. september
AK4	Bb	**25. oktober**	14. oktober
AK5	PeLe	**11. november**	28. oktober
AK6	Bb	**22. november**	11. november

Figure 32. *"Requirements for assignments" of the IMAG1001 course (part 3)*

Furthermore, the mentioned web document contains a tab (see Figure 32), where each assignment has a number (Nr), type (type), deadline (frist) and the date when the learning system is open for assignments delivery (åpnes). Thus, it could be seen from the figure 32 that the online course includes 6 mandatory assignments. For instance, students must submit an

assignment number 6 (AK6) by the 22nd of November (22. november), while the Blackboard system (Bb) would be open from 11th of November (11. november).

6.4.8. Providing feedback for students

Teachers were asked about how the feedback was constructed in the online courses. Referring to answers, **teachers (T1, T2) provided feedback to the students during the physical and digital hours guidance and seminars**, "if the students attend the exercise classes, they will get the feedback right away" (Teacher 2)

In addition, it was explained that all online exercises and online assignments that were introduced in the online courses had a feature to provide feedback automatically. It was explained that the assignments and exercises in the course were based on calculations or numerical problems. Here is how the teachers described it during the interview:

> "Calculating problem assignments, they are automatically corrected. So the students automatically get feedback if their answer is correct or wrong (T1).
> "The assignments in the Blackboard have automatic self-rating. So the students get the feedback right away" (T2).

Besides, according to the teacher (T2), the feedback was also provided via email, when the students needed assistance because they were stuck in the process of the fulfillment of the assignments and without feedback from the teacher, they could not move further and finish the assignments. That was also previously described in the previous section of the findings (read facilitation of the learning process: organizing the learning).

6.4.9. Student reflections on the teacher feedback

In the present survey, students were asked about their experiences with the provided feedback during online learning. The survey showed that **almost 55% of the respondents agreed that the teacher provided the feedback due to time**, while around 20% of the respondents disagreed with the statement and 25,8% of those who surveyed had chosen "neither agree, nor disagree" answer.

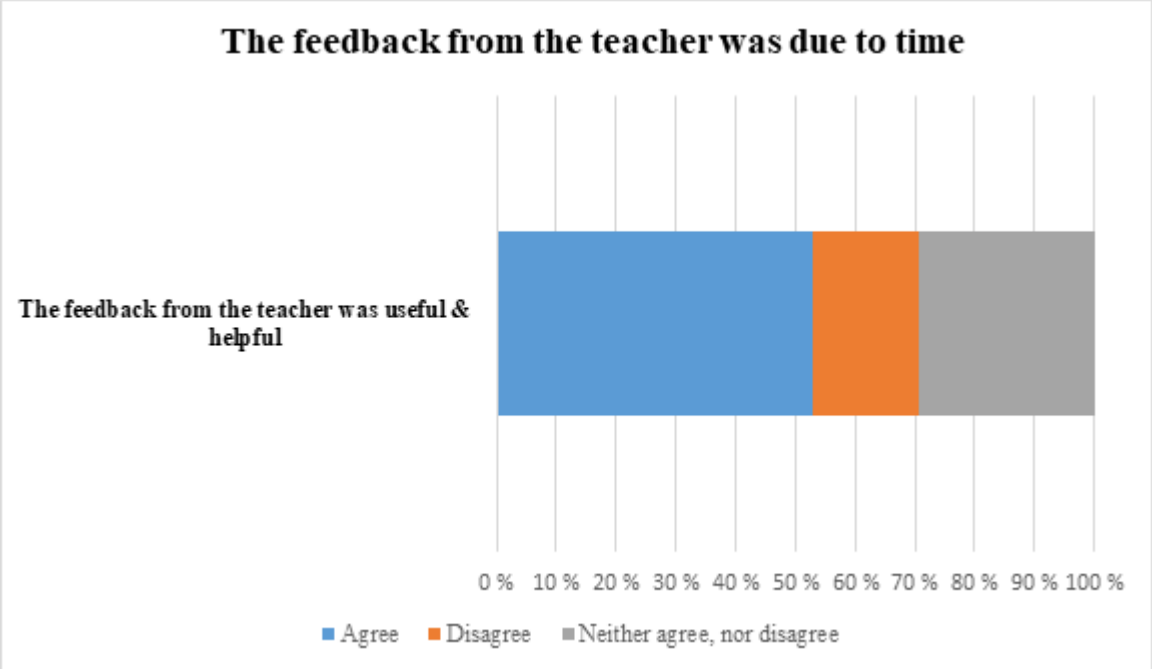


Figure 33. *Student responses on the feedback*

However, the analysis also showed that **among the students who considered the feedback from the teachers was delivered in a timely fashion, almost 52% of the respondents found it helpful in terms of understanding strengths and weaknesses in the connection with the online course goals** (see Figure 33). Whereas, 17,6% of those surveyed disagreed and found the feedback unhelpful despite the fact that it was delivered due to time. Whilst, 29,4% of the students found it difficult to neither agree, nor disagree with the statement.

6.5. Summary of findings

This section summarizes the main findings that were illustrated in detail in the previous sections. Whereas, a discussion on the interpretation of the findings would be introduced in the chapter "Discussion".

6.5.1. General characteristics of course design

According to the findings gathered from the different data collection tools following was found: both online courses were designed in the tradition of **blended mode of instruction, with a combination of 60% digital activities and 40% of physical activities** (see Table 7). The duration of the courses was about 31 weeks and was equal to two semesters. Both blended courses were structured into **modules**, where IMAG1001 course contained 11 modules, while MEKG1001 course structure included 14 modules. The **teaching method varied** in the courses from **pre-recorded to synchronous live approach, including the asynchronous guidance for students**.

The Blackboard learning management system was used **to create individual access for students to course contents**. Besides, the Zoom platform and the Teams platform also used as additional tools for facilitating teaching and learning activities in both courses. Both courses had mandatory assignments as pre-requisite for the final exam. However, the number of mandatory assignments differed. In addition, the Inspera platform used for **conducting the final assessment** as an 4-5 hours exam.

Features	**Mechanics**	**Mathematical Method 1**
Course code	MEKG1001	IMAG1001
Type of online course	blended course	blended course
The proportion of the activities	60% digital activities 40% physical activities	60% digital activities 40% physical activities
Information and description	Web-page on the institutional web-site	Web-page on the institutional web-site
Duration of the course	31 weeks	1 semester
The type of course structure	in module-section traditions (14 modules)	in module-section traditions (11 modules)
Mandatory assignments	12 individual tasks	4-6 individual tasks ref. to

		web-page or 6-8 individual tasks ref. to teacher
Final assessment	5 hours digital exam, Inspera platform	4 hours digital exam, Inspera platform
Learning Management System	Blackboard	Blackboard
Online digital tools	Video conferencing platforms: Zoom, Microsoft Teams	Video conferencing platforms: Zoom, Microsoft Teams
Changes due to Pandemic Covid 19 restrictions	all physical activities moved to online environment	all physical activities moved to online environment

Table 7. *Description of the online courses based on the findings*

Both blended courses were presented on the official website of the education institution. Each course had its own web page and its code. The web pages contained the necessary information of the courses, including the description of the course, goals, learning activities and assessment. Additionally, timetables and detailed information about the final exam of both courses were presented on the webpages.

6.5.2. Principle of flexibility in the online course design

Structure

The structure of both online courses contained a flexibility component through a space for the changes that caused by both predictable factors like enhancing the quality of the course, as well as unpredictable changes due to the Covid-19 pandemic. Furthermore, it allowed teachers to redesign the online course structure and teaching methods, but not the content of the course. Before the changes in the course structure were implemented, they were evaluated by the peer-reviewed by colleagues of all mathematical courses at the educational institution.

Time

With regard to time, interviews indicated that, despite the different personal attitudes towards adjusting the deadline requirements, both teachers introduced a space, where students could submit a mandatory assignment whenever they wanted, within a particular time frame. Namely, the teachers opened submission of the mandatory assignments in the learning management systems (LMS) like Blackboard, Pele, and Studentweb two weeks prior to the deadline.

Each mandatory assignment had its own number, type, and deadline when the tasks must be submitted. Besides, the deadline was represented as a time period, where the beginning is indicated by the date when the submission is opened in LMS and the date when it is closed. This time period for submission created a space for flexibility for students in terms of time in the context of the deadline submission of the mandatory assignments.

The survey findings show that the majority of the students (more than 70%) confirmed that the online course design allowed them to choose a time for studying. In addition, 32% of the respondents defined an opportunity to control a time for study in their own way as a benefit of online learning. This indicates that the online course design of the explored courses contains a flexibility component in terms of time from the students' perspective.

Findings from the course documents corroborate with the interviews with teachers and students, and student survey with regard to flexibility principle in terms of time**. Based on this, it can be concluded that there was a space for flexibility principle in terms of time in the investigated online courses.**

Path

The teacher interview data show that teachers created assignments and video materials, where the completing and watching of it was at the choice of the students, namely additional assignments that were placed in the Blackboard system as well as a video that was recorded during the online synchronous lecturing. Additionally, students could also decide the number of the mandatory assignments necessary to deliver in order to be admitted to the final exam. **Based on this, it can be concluded the teachers created a space for flexibility principle in terms of path in the investigated online courses.**

The official web page of the Mathematical method 1 course also contained information about the mandatory assignments and the minimum number of them completed in the "Learning methods and activities" section. In addition, the course plan also highlighted the same total number and number of the minimum mandatory tasks. The results of the document analysis with the results obtained from the interview with teachers complemented each other concerning the flexibility principle (in terms of path) of the investigated online courses.

From the students' perspective, the survey show that students highlighted positively the opportunity to be flexible in the context of watching lectures that were pre-recorded by the teachers. Such flexibility was characterized as a benefit of the investigated online courses by the students of the courses. However, in the context of the flexibility of choosing the

assignments and online activities during their online learning, a majority of students reported that they did not find such opportunities in the course.

As expected, the results of the document analysis corroborate findings from the teachers interview regarding the flexibility principle in terms of the path in the online courses, but the student survey do not confirm that a flexibility principle in terms of the path was addressed.

Place

The interviews show that there was a space for flexibility in terms of the place in the examined online courses. As lectures with the following digital seminars and tutoring activities were organized in the online learning environment, an opportunity was offered to students to choose a suitable physical place for conducting the assignments and attending the online lectures. From a student perspective, the survey data showed that more than 90% of the participants confirmed that the online course allowed them to choose a place for study. Moreover, students also defined this flexibility in terms of place as a benefit of the online course.

Thus, the results from the students' survey corroborate the findings from the interview with the teachers in terms of place in the online courses. Referring to this, **it can be concluded that there was a space for flexibility principle in terms of place in the investigated online courses.**

6.5.3. Principle of interaction in the course design

Teacher-student interaction

Teacher interview data showed that an interaction principle was implemented in the online course through a focus on the communication between the teacher and students. The interaction with the students was onsite, within the lecture and/or lecture break as well as when the students could drop by on campus. Teachers were open to communicating with the students during online teaching activities, where students could ask questions on needs basis. In addition to that, it took place and was organized in the online environment, via emails, forums page discussions, and digital guidance hours. Communication via email with students was characterized as being the easiest form, while the discussion on the forum page was defined as the most effective form of interaction with the students during online learning. Referring to the results retrieved from the students' survey, it shows that an interaction principle in terms of communication between the teacher and students was realized in the online courses. A high

percentage of the respondents (80%) confirmed the satisfactory amount of online interaction with the teacher within the online course, while around 48% of the students defined such communication being effective. The part of the students, who were unsatisfied with the effectiveness of the online communication, explained based on a low level of technical proficiency of teachers as well as with difficulty creating a space for communication in the online environment that would be efficient from the time-management perspective.

Teacher interview and survey findings corroborate, indicating the existence of design features for communication in the online course, at a general level. However, the effectiveness of online communication between the teacher and student, as presented by teachers, is not confirmed by the student survey data.

Student engagement

Document analysis shows that the design of both investigated blended courses had a space for an interaction principle in terms of students' engagement. The official web pages of the online courses provided information concerning the collaboration and interaction activities that are organized synchronously and asynchronously. Besides the learning management system-Blackboard included the features for placement of the students' engagement, such as "Collaborate" and "Forum". However, the statistic that was retrieved from the "Forum" feature reflects the low rate of the participants in the online discussions among the students.

The interview with the teachers showed that the investigated online courses that were designed within the blended mode of instruction traditions contained an interactive principle in terms of students engagement. The collaborative activities were placed both in online and face-to-face learning environments. Despite the challenges and difficulties such as specificity of the subject, low rate of participants, and technological issues, the teachers created a space for interaction and engagement activities between the students. In addition, the teachers encouraged students to collaborate on the mutual fulfillment assignments; to discuss within the forum or/and chat in the online learning management platforms; and to interact with the classmates during guidance hours that were organized both physically and online.

The student survey showed that an interaction principle in terms of student engagement was applied in the online courses. The students' responses confirm that the online courses contained engagement activities and assignments, where students could collaborate and interact with each other. Students were able to obtain new skills and knowledge by participating in the course discussions and online group assignments. However, the results of the students' survey also show that among the students who were engaged or interacted with each other, there were

students who felt uncomfortable within the communication and collaboration. Moreover, there were students who negatively experienced that engagement and interaction with their classmates within the online course. Consequently, some of the students found it challenging to have effective communication during online learning.

Thus, the results of the document analysis corroborate findings from the teachers interview regarding the interaction principle in terms of the student engagement in the online courses, while the student survey also confirm that interaction principle in terms of the student engagement was addressed. Consequently, it can be concluded that there was a space for interaction principle in terms of the student engagement in the investigated online courses.

6.5.4. Facilitation of the learning process in the online course design

Learning organization

Teacher interviews show that investigated online courses contained a principle of the facilitation of the learning process in terms of the learning organization. The organization of the log-in process to the institutional system was introduced to the students at the very beginning of the online course. The first lecture of the online course was used with the purpose to get students acquainted with the online course structure and goals. Students were guided through the organization of the online course in the context of the learning management system (Blackboard) by both teachers. The teachers were open to facilitating the learning process by providing help and assistance not only at the beginning of the course but also during online learning. Emails and forum features were used as the main tools for the facilitation, while breaks and guidance hours were used as a space for assistance and help both in an online and face-to-face environment.

Survey findings show that there was a space for the principle of the facilitation of the learning process in terms of the learning organization. On average, students found the guidance and assistance from teachers helpful during the whole online learning experience, including online lectures and seminars as well as online assignments. Namely, the instruction on how to participate in the online learning activities as well as guidance towards online course goals and concepts were provided by the teachers. However, there were students who negatively experienced the online guidance and found it difficult to receive help from the teacher during online learning. But the percentage of such a category of students was relatively slow in comparison with the students who were satisfied with the teachers' assistance and help.

Based on corroborated accounts from different data types, the investigated online courses contained the course design principle of facilitating the learning process in terms of organizing learning for students; this was confirmed by both students and teachers.

Assessment

The document analysis shows that both investigated online courses contained an element of the principle of the facilitation of the learning process in terms of the assessment. On the official pages of the online courses (MEKG1001 & IMAG1001) was described information concerning the summative assessment of the students' knowledge in the form of the final exam. The course plan and the document of the requirements of the mandatory assignments contained more detailed information concerning the summative assessment, but that was integrated during the whole online course in the form of the mandatory assignments. As a result, one course included 12 mandatory assignments (MEKG1001), while another had 6 mandatory assignments (IMAG1001). The summative assessment of both courses was integrated into the period of each two weeks when the module/unit of the course was finished. None of the documents contained any information concerning the formative assessment of the students' knowledge within investigated online courses.

Teacher interviews indicated that an element of the principle of the facilitation of the learning process in terms of assessment was implemented in the investigated online courses. Formative and summative assessments were constructed online synchronously and asynchronously and integrated into the blended courses during online lectures and seminars. The formative assessment was organized via Mentimeter, quizzes, discussions, and digital tools feature such as poll, yes or no reactions of the digital platforms (Microsoft Teams and Zoom). The opportunity to provide a fast, personalized assessment of the students' knowledge through mentioned forms was pointed out by one of the teachers. However, it highlighted the importance and prioritization of summative assessment of the students that happened after each module/unit of the course as well as at the end of the online course in the form of the digital assignments/exercises. Furthermore, one of the teachers had an opportunity to monitor students' progress, however, he/she found it difficult due to the lack of time.

Students' responses confirm that the assessment of the students' knowledge was integrated into the course in the form of online assignments. A high percentage of the students also highlighted the usefulness of the assignments. A strong connection and the alignment between online lectures and seminars with online assignments were also mentioned by the

respondents. The integrated assessment was characterized by a high number of students as difficult online exercises. Despite the difficulty of the online assignments, students found them interesting and motivational to do their best.

The corroborated findings indicate that formative assessment of students' knowledge was presented in the online course documents. Consequently, the online course design of the investigated online courses contains a principle of the facilitation of the learning process in terms of the assessment of students' knowledge.

Feedback

The results from the interview show that a principle of the facilitation of the learning process in terms of feedback was integrated into the investigated online courses. The teachers organized feedback to students during online seminars and guidance hours, both physically and digitally in a timely fashion. Email was defined as a tool for providing personalized feedback for each student, but only if it was initiated by the students themselves. It is important to add that the main part of the personalized feedback space was occupied not by the teachers, but by the mathematical programs that automatically provided the feedback when the students fulfilled the answer in the online assignments. Such feedback was given due to time, namely immediately to students.

Findings show that the principle of facilitating the learning process in terms of the feedback was partly addressed in the online course. Almost half of the students confirmed that the feedback provided by the teachers was timely fashioned and helpful for the students in terms of understanding their weaknesses and strengths relative to the course goals. However interview and survey findings do not fully align, it is confirmed that the feedback principle was integrated into the online course design but with few students confirming that the feedback was both personalized and delivered in a timely fashion.

7. Discussion

The present chapter first answers the two research questions introduced at the beginning of this thesis. All answers are based on the empirical findings and are discussed in relation to the reviewed empirical research. Further, this section also presents implications for practice, limitations of the research study, and suggestions for future research on this and related topics.

7.1. Materialization of principles in the course design and teaching activities

The answer to the first research question: **"*How do course design and teaching activities address design principles and requirements for blended learning?*"** is based on agregated answers of its three sub-questions.

The first sub-question, ***1.1. In which way is the flexibility principle materialized in the course design elements and teaching activities?*** was answered by analyzing: a) course documents to understand the course design, b) teacher interviews to understand how teachers reasoned about and reflected about their design work on the course, and c) students survey to understand their assessment of the integration of the aforementioned principle. The results show that the structure of both online courses contains a flexibility component by creating the space for the changes caused by both predictable factors, like enhancing the course's quality and unpredictable changes due to the Covid-19 pandemic, such as reorganization of the learning activities and creation of additional guidance hours for students in the online environment. Baran's (2011) study also showed that the course structure that allows introducing the changes is characterized as flexible, due to adaptability to predictable changes caused by constant course evaluation and improvement and unpredictable changes for example caused by uncontrollable external political and economic factors. However, before the teacher introduces any changes in the online course structure, he/she must adhere to institutional requirements that demand a peer review and evaluations of the actions by other colleagues teaching mathematical courses at the same institution. Such evaluation is organized in the form of meetings and negotiations. Only after such negotiations, the teacher has an opportunity to modify the online course structure. Consequently, the current study has also shown the problem of the impact of the instructional requirements on the teachers' autonomy and decision-making procedure in the online course design, in agreement with findings by Tindowen (2019).

The current findings show that flexibility of the online course structure also allows teachers to redesign the online teaching methods, but not the content of the course. Bressoud

(2019) also discusses the problem of the teaching methods and the course content of the hard disciplines in the context of calculus. The results of the current study correlate with the Bressoud's, highlighting the various modifications of the teaching methods around unmodified content.

The present study examined the *principle of flexibility* in the design of investigated online courses, which includes *time, place, and path* dimensions (Boelens et al., 2017). Such principle is aligned with the constructivist learning theory, which provides a basis to create a learning environment where students are mainly responsible for their own learning, while the teachers have the role of teachers and facilitators (Karoğlu et al., 2014; Padirayon et al., 2019). There is a number of research studies in higher education that suggest the implementation of the flexibility principle as an effective element of online course design (Wong, 2008; McDonald, 2012; Goodyear 2015; Chen et al., 2016; Redondo, 2019)**.**

The interview findings show that the design of investigated online courses contains flexibility principle in terms of *time.* Both teachers introduce a space where students could submit a mandatory assignment whenever they want but within a particular time frame. By doing this, the teachers create a learning environment around students' needs and provide students to take responsibility for their own learning. Such findings follow a *student-centered learning environment notion*, which are also based on the constructivism learning theory (Chuang, 2021).

The results also indicate a space for flexibility in terms of the *place* in the examined online courses. For the reason that the lectures with the following digital seminars and tutoring activities are organized in the online learning environment, that is giving an opportunity for students to choose a suitable physical place for conducting the assignments and attending the online learning activities (lectures and seminars).

The findings show a space for flexibility in terms of a *path* in the investigated online courses, at leats according to teachers' account. Teachers created various online assignments and activities that offer choices to students, same as indicated by Carman (2002). However, the student's survey results contradict such findings, as students do not confirm an opportunity to choose activities and assignments on their own. But other findings indicate that students are still able to decide how they want to study, which aligns with the principle of pace suggested by Boelens et al. (2017)**.**

Sub-question ***1.2. In which way is the interaction principle materialized in the course design elements and teaching activities?*** was answered mainly through the analysis of the interview with the teachers to understand which design elements and teaching actions facilitated the interaction process, and the student survey to understand their assessment of the integration of the aforementioned principle.

The *principle of interaction* refers to the communication between teacher and students as well as engagement and interaction between students. One of the reasons for following this principle in the course design is supported by the theory of social learning; accordingly, the acquisition of knowledge of individuals occurs in the interaction with the environment. Vygotsky's classical concept of "zone of proximal development," which is based on the social learning theory, explains that the learning process is placed on two levels. First, through interaction with others, and then integrated into the individual's mental structure (Illeris, 2018). Despite the fact that such a theory was developed in 1978, it is still considered as a basis for contemporary studies (Tinungki, 2019; Xi & Lantolf, 2021; Tzuriel, 2021; Newman & Latifi, (2021). Research in education suggests to include communication and engagement activities as an essential part of the online course design, following this principle (Wong, 2008)*;* Boelens et al. (2017) in the framework mention a *principle for stimulating interaction, and* Robinson et al. (2017) study recommends applying *a dialog principle* to the design of online courses.

The present study's findings show that teachers used emails, Teams Meeting platform, Zoom digital platform, and forums feature in the learning management system as effective tools for facilitating interaction between them and the students within online courses. Furthermore, the obtained results align with findings by Habibi et al. (2018), specifically on the efficiency of usage of the emails, forms, and digital platforms in building the online community in the context of online learning. The teachers also introduce discussion activities within the forum or/and chat in the online learning management platforms, despite the opinion that discussions in the forums are not meant for hard-skills disciplines. The document confirmed a low rate of participants in the aforementioned features of the online learning management platforms. However, such findings contradict Padayachee's (2020), where the discussion activities on the forum page provide an opportunity to build an effective environment for student engagement with a high participation rate.

The findings show that investigated online courses contain an interaction principle in terms of student engagement. Students' responses confirm that the online courses included

engagement activities and assignments, where students could collaborate and interact with each other. In addition, students obtained new skills and knowledge by participating in the course discussions and online group assignments. The aforementioned findings align with the results from the Yang et al. (2014) study, which showed the effectiveness of collaborative learning in the online environment in terms of acquiring new skills and knowledge.

Sub-question ***1.3. In which way is the facilitation of the learning process principle materialized in the course design elements and teaching activities?*** was answered by analyzing the course documents to understand the course design and teachers' interviews to understand how they facilitated students learning process and the student survey to understand their assessment of the integration of the aforementioned principle. The present study addressed the principle of the facilitation of the learning process in the investigated online courses. The main components of the facilitation learning process principle are *learning organization* in terms of help and assistance, *assessment* in terms of evaluation and monitoring students' progress; and *feedback* in terms of provision of personalized and timely-fashion responsiveness. The idea of integrating such principle correlates with the idea of creating a student-centered learning environment, where the teachers are acting in the role of the teacher and gently facilitating the learners' path in the online learning, without rough intervention (Isaías et al., 2015; Santoso et al., 2018). Such facilitation is achieved through: *learning organization, assessment, and feedback.* Moreover, a significant number of studies in higher education field suggest the realization of the principle as an element of effective online course design (Carman, 2002; Wong, 2008; Baran, 2011; Karoğlu et al., 2014; Boelens et al., 2017; Benton, 2019; Martin et al., 2019; Munna, 2020).

Organization of learning activities

The findings show that investigated online courses contain a principle of the facilitation of the learning process in terms of the learning organization. The organization of the log-in process to the institutional system was introduced to the students at the very beginning of the online course. Furthermore, the first lecture of the online course was used with the purpose to get students acquainted with the online course structure and goals. Both teachers in this study guided students through the online course organization in the context of the learning management system (Blackboard) (Baxter, 2012). Such findings correlate with a "transition as induction" typology of the students' transition in higher education, which is described especially in the context of transition activities by Gale and Parker (2014).

Moreover, the teachers provided instruction on how to participate in the online learning activities and guidance towards online course goals and concepts at the beginning of the online course (see Gale & Parker, 2014). Baxter's (2012) study also highlights the importance of the students' support and facilitation, especially in terms of a transition from one course to another and its influence on students' progress. Besides, the teachers facilitate the learning process by providing help and assistance at the beginning of the course and during online learning. Emails and forum features are used as the main tools for the facilitation, while breaks and guidance hours are used as a space for assistance and help both in an online and face-to-face environment. The study conducted by Robb & Sutton (2014) also shows the opportunity to create effective and motivational support for students by using email as the primary tool.

Assessment

Findings show that, in the investigated online courses contained the assessment element, formative and summative assessments were constructed online synchronously and asynchronously and were integrated into the blended courses during online lectures and seminars. The formative assessment was organized via Mentimeter, quizzes, discussions, and digital tools feature such as poll, 'yes' or 'no' reactions of the digital platforms (Microsoft Teams and Zoom). These results align with Martin and colleagues' findings (2019), which showed the opportunity to provide a fast, personalized assessment of the students' knowledge through the aforementioned forms. In addition, the teachers in this study highlighted the importance and prioritization of summative assessment of the students, which happened after each module/unit of the course (Köse, 2010) as well as at the end of the online course in the form of the digital assignments/exercises. However, Ahmed's et al. (2019) study suggests the importance of synergy between formative and summative assessment, rather than prioritizing one of them.

Feedback

The results obtained from the survey and semi-structured interview show that course design included the element of *feedback.* The feedback to students was organized mainly automatically by the computer. The computers system generates personalized prompt feedback when the student submits the answer to the assignment. However, the teachers were also open to providing personalized feedback to students via emails and forum features of the Blackboard management system and organized the space for feedback during the online and face-to-face

guidance hours. The study by Wanner and Palmer (2015) also suggests to increase the amount of personalized feedback within various teaching activities during blended learning which would facilitate the online course effectiveness.

7.2. Teachers and students experience within online course design

This sub-section includes the answer to the second research question of the present study. Research question ***2. How are the course design and teaching activities experienced by students and teachers in relation to the principles of flexibility, interaction and facilitation?*** was answered through the analysis of teacher interviews to understand their experiences within the applied principles and student surveys to understand their experiences withing the aforementioned teaching activities. The majority of students (more than 70% of students) confirmed that the online course design allows them to choose a study time. The respondents defined an opportunity to control a time for study in their own way as the main benefit of online learning. Besides, the survey results also indicate that more than 90% of the students confirm that the online courses allow them to choose a place for study. Moreover, students also define this flexibility in terms of place as a strong advantage of the online course (Chen et al., 2016; Müller et al. (2018). Such findings correlate with the Klimova et al.'s (2017) results, which show that the opportunity to study independently and flexibly in terms of time and place is characterized and experienced by students as the main advantage of the blended courses.

Such flexible online course design helps the learners to integrate online education into their lives and more effectively create a "life routine" around the studies. However, such a point of view contradicts the work of Naidu (2017), where the flexible opportunities in the learning led to negative consequences for the learners, such as procrastination, anxiety, and lost connection with the course content and teachers.

Teachers appear to have a desire to provide more freedom for the students in terms of the deadline assignments submission. However, their actions appear bounded by the institutional requirements, which leads to the conclusion that teachers have limited space for creating time flexibility for the learners (Carvalho & Diogo, 2018).

Interaction

The present study's findings indicate that the teachers experience a variety of challenges while integrating collaborative learning and interaction into the online environment of the investigated online courses. The following factor mainly causes such challenges: the teachers do not have a digital advanced learning platform, appropriate for usage to organize online

engagement activities and place collaborative learning for hard-science disciplines. The interview results suggest that the teachers do not receive enough institutional support to cope with the emerging technological challenges in creating effective collaborative learning. Consequently, the teachers are forced to use the digital platform that is inconvenient for organizing engagement activities for hard discipline. The study conducted by Joia and Lorenzo (2021) also shows the disadvantages of using the Zoom platform for organizing the learning in the hard-science disciplines due to its limited function.

The findings also highlight another challenge among the teachers to effectively organize engagement activities within the environment that would meet the learners' needs, especially in the context of working students. Such a challenge is also confirmed in the study conducted by Martin and colleagues (2019). Teachers struggle to create a learning environment with engagement activities among the employed students because it is challenging to organize an interaction space that is suitable for every student in terms of the schedule.

The survey results indicate that some students feel uncomfortable communicating and collaborating online. Moreover, some students experience negatively engagement and interaction with their classmates within the online course (see also Bakhtiar et al., 2018). Consequently, some studentss found it challenging to have effective communication during online learning (So & Brush, 2008). The survey results show that the learners are satisfied with the amount of online communication with the teacher during the online course and highlight the accessibility of the teacher outside the course. However, the students did not assess such communication as effective enough, which aligns with the findings from the Sadeghi (2019) and Venkatesh et al. (2020) studies on the students' experiences of online interaction within the online course. Besides, the findings confirm that learners experience an online interaction with the teacher during the online learning as difficult and challenging for them due to the low technological proficiency of the teacher and ineffective allocation of time by the teacher during online lectures, seminars, and guidance hours (Boumadan et al., 2020). Rasheed and colleagues (2020) also discovered the influence and connection of teachers' technological literacy on the communication aspect with students and course delivery in online education.

The current findings indicate a problem with the effectiveness of online communication. Such a problem is probably raised due to the lack of constant evaluation of the quality of online interaction by the students, which the teachers should initiate during online learning. Major (2015) also highlights the importance of the teachers’ role in building an effective online communication environment and suggests the teachers' necessary practices.

Facilitation

The results show that students experience the guidance and assistance from teachers as helpful during the whole online learning experience, including online lectures and seminars as well as online assignments. Rapanta and colleagues (2020) also suggests a concept of the *facilitatory presence*, where the students experience effective mentoring actions of the teachers during the whole online learning.

Assessment

In this study, teachers had an opportunity to monitor students' progress, but found it difficult due to the lack of time. Verbert and colleagues (2013) also highlighted the difficulty of monitoring the students' progress in the learning management system due to a large amount of available data and the required amount of time for its processing. The students' responses confirm that the assessment of the students' knowledge is integrated into the course through online assignments. In addition, a high percentage of the students highlight the usefulness of the assignments. The respondents also mention a strong connection and the alignment between online lectures & seminars with online assignments. The integrated assessment is characterized by a high number of students as difficult online exercises. Despite the difficulty of the online assignments, students find them interesting and motivational. The study conducted by Andres (2019) also discusses the connection between students' emotional responses (motivation) and cognitive load (the course difficulty), however, through the impact of teachers' pedagogical methods that are implemented in the course.

Feedback

The survey and semi-structured interview results show that course design includes the element of *feedback,* however not in terms of efficiency. The relatively low percentage of students (around half of the participants) confirm that the feedback organized by the teachers is useful, personal, and delivered in time. Such findings do not complement the characteristics of the effective feedback identified in Martin et al. (2019) study. However, feedback provided by the computer system meets such requirements. Despite that, the study by Sancho-Vinuesa et al. (2018) suggests that the automatic feedback in the calculus course does not influence the improvement of the students' performance during online learning.

7.3. Implications for practice

The present finding shows that students have sufficiently developed digital literacy and time-management skills that lead to acceptance of the flexibility component of the online course. Moreover, such a component is strongly highlighted by the students as a benefit of online courses and positively experienced by the students during online learning. Such findings must be taken into consideration by the teachers in the higher educational institutions for developing the design of online courses. In terms of pedagogical design, the principle of flexibility can be followed by the following actions: firstly, to transfer the physical lectures to the online environment by using contemporary platforms and learning management systems that allow placing the lecturing online. Hence, using a pre-recording type of teaching will facilitate its effective transferring; secondly, to keep the face-to-face environment for organizing seminars, guidance hours and collaborative learning activities. Hence, such measures would allow students to effectively allocate time and space according to their needs.

Furthermore, the present study results show that the digital tools for organizing hard-discipline courses should be better developed. Thus, the limited functionality of the contemporary digital platforms (Zoom, Teams), including the learning management system (Blackboard), directly influences the effective delivery of the online courses. Such findings must be considered by the companies which develop digital platforms and management systems for educational purposes and educational institutions that implement them. Consequently, EdTech (education technology) companies and educational institutions should collaborate to develop an appropriate digital solution for educational purposes. The digital solution should be developed in accordance with hard or soft disciplines separately. The LMS and online platforms for the hard disciplines such as calculus should include options and features to use formulas and allow to commit various calculate actions during online learning both synchronously and asynchronously. And finally, it is recommended that each stage of the platform development should be peer-evaluated and tested by the teachers of the discipline.

The present research shows that interaction between the teacher and students is not organized effectively, including the feedback delivery. Besides, the communication with the teacher is experienced as challenging by the students during the online learning. Students mention that the teachers' digital literacy influences the effectiveness of the interaction process. Despite the fact the interaction with the students through the emails is outlined as an effective form of communication, the student’s perspectives do not confirm such results. On the contrary, students find such interaction challenging and time-consuming for solving small questions. Consequently, the teachers must consider such results, and aim to develop and

integrate effective forms of communication with the students within online courses. In terms of pedagogical design, the principle of interaction can be followed by the following actions: firstly, to create a space in the lectures, seminars and guidance sessions where students could ask questions, which are raising during the online learning experience (including inquiries related to the content of the course); secondly, to create additional space for communication with the students behind the lectures, seminars and guidance sessions. For instance, teachers could organize a session with students at the end of each course module, placing the communication around to the students' needs. To make such an interaction session more effective, the teacher should collect the questions and discuss the structure of the session before its start; and finally, constantly evaluate the effectiveness of the online communication. For example, teachers could introduce the questionnaires to the students at the beginning of the course in order to understand the learners' needs, in the middle of the course in order to evaluate if the tools and methods correspond the communication, and at the end of the course to understand overall students satisfaction of the implemented strategies and effectiveness of the communication aspect. Hence, such measures would facilitate the effectiveness of online communication during online learning.

Additionally, the results of the present research show the significant impact of the institutional level on online course delivery. First of all, the institutions need to create and provide an appropriate technological infrastructure in order to facilitate the effective organization of the online courses and programs. Secondly, the educational institutions should support the enhancement of the digital proficiency of the teachers. As a consequence, it would influence the quality of course delivery in the online learning environment. Thirdly, higher educational institutions should actively collaborate with the EdTech companies, which aim to develop digital solutions for educational purposes. Finally, the researcher suggests reconsidering the institutional requirements for the teachers, which effect their professional autonomy.

Finally, the conceptual framework and identified principles of the online course design could be implemented by the teachers at higher educational institutions for the evaluation, development of the online courses.

7.4. Limitations of the study

The present study explored the principles of the online course design, their materialization and teachers' and students' experiences within investigated courses. However, the following limitations of the study should be taken into consideration:

Firstky, the present study was mainly focused on the online component of the blended courses, because it was not possible to investigate the face-to-face elements of the blended courses due to the Covid-19 pandemic. As a consequence, all on-campus activities were transferred to the online learning environment. It led to an impossibility to explore the physical, face-to-face activities that were constructed in the blended courses.

Secondly, the present research was conducted through a case-study with an applied mix-methods approach and with a limited number of survey participants. As a consequence, the results of the study can only partly be generalized to other higher education contexts, because the present study was based on the intensive examination of a single higher educational institution and on its detailed examination of a particular two online courses.

Thirdly, the access to the learning management system from the educational institution was prohibited for unknown reasons, which led to limitation in the data for the document analysis.

Finally, the present study explored the principles of the online course design in the context of the hard-science discipline. The nature of the discipline influence not only the course design but also teaching methods. Consequently, applting the principles to the course design of soft-skill discipline would help identify more challenges and advantages of the designing online course. Hence, it would contribute to a wider understanding of the complex problem of online course design in higher education arena.

7.5. Future research

The present research includes suggestions for topics that could be investigated in future research. Firstly, it is necessary to explore the investigated online course design principles in the other disciplinary context, including synchronous and asynchronous online teaching methods. The nature of the disciplines requires different teaching methods and influences the effectiveness of online course delivery. Besides, the complex investigation of synchronously and asynchronously teaching activities would fully contribute to the design of courses with a blended mode of instruction in higher education.

Secondly, the findings obtained from the students' perspective have shown the possibility and characteristics of the presence of flexibility principle in terms of pace in the

online course design. Consequently, it is suggested to explore the mentioned principle, to understand how it could be organized from the institutional perspective, which teaching activities facilitate its materialization, and whether the pace principle influences the academic achievements of the students.

Thirdly, it is suggested to explore the effectiveness of the teacher-student interaction during online learning, where core elements of the effectiveness of the communication through the online medium should be identified, applied, and evaluated. Hence, it is necessary to research new online pedagogical practices and the application of contemporary digital tools for interaction and engagements activities with the students. Moreover, the problem of online feedback effectiveness should also be examined in future research. The contemporary methodology as well as techniques for efficient online feedback delivery should be explored.

Fourthly, it is suggested to examine the institutional level in the context of facilitation of the courses in the online learning environment. It is important to understand the mechanism of the institutional actions and outline the external and internal factors that influence the effective delivery of the online courses. Besides, it is suggested to explore the institutional requirements for teachers of the online courses, whether it is possible to provide more space for the teachers' professional autonomy.

Finally, it is necessary to investigate the problem of the emotional presence of both students and teachers within online learning that was not explored in the present study, due to the time limitations. The emotional presence of teachers and learners in the online medium could play a considerable role in online communication, learning and teaching. It is necessary to understand how the emotional presence materialized in online teaching and learning, whether there is a connection between the emotional presence and academic achievements of the students, and how the emotional presence of the teacher influences the online teaching quality.

8. Conclusion

In contemporary higher education, online learning is placed thoroughly and substantially. The online learning environment is no longer a future development, but the present reality. Despite the development of the various online learning environments, the blended mode of instruction is considered the most applicable and integrated into European higher educational institutions (Gaebel et al., 2021). In parallel, contemporary researchers have been investigating the problems of online course design in order to enhance the effectiveness of the learning process. Thus, a number of the studies introduced a variety of frameworks and concepts, explored the students' experiences, and examined the teaching activities separately from each other. The finding of the present study contributes to a better understanding of digital higher education by integrating conceptual frameworks into practice and examining the students' and teachers' experiences simultaneously within the investigated online courses. By developing research design in the mixed-method traditions, I was able to obtain knowledge about a complex problem and explore essential perspectives in the context of hard disciplines such as the natural sciences and engineering online courses.

The present study addressed three design principles (flexibility, interaction, and facilitation of the learning process) to the online courses at the Norwegian higher educational institution. It examined whether the teacher's design and teaching activities followed the aforementioned principles and explored the student's experiences within online courses design and delivery. The findings show that the addressed principles can be identified in the online courses in different ways and to various extents. The principle of flexibility is partly integrated into the online course design. Thus, the *flexibility* in terms of *place* and *time* is applied in the online course and confirmed by both perspectives (teachers' and students'), while the element of *path* is not acknowledged by the students. The principle of *interaction* of online course design is fully integrated into the investigated online courses, both in terms of *teacher-student interaction* and *student engagement.* However, the requirements for effectiveness of interaction between the students and teacher have not been met possibly due to digital literacy of the teachers and ineffective allocation of time during online teaching activities (lectures, seminars, guidance hours). The principle of *facilitation of the learning process* is partially constructed in the investigated online courses. Thus, the element of *learning organization* and *assessment* is integrated into the online courses, while the requirements for the feedback element have not been met due to the large integration of automatic feedback, and the lack of consideration of the learner needs when feedback was provided.

Students experienced extremely positively the opportunity to allocate their time and space for online learning. The study suggests that online learners become more independent and responsible for learning. As a result, students combine and more effectively integrate education into their life. However, as institutional requirements bound the autonomy of teachers, the flexibility component of the online course can not be fully implemented in the course design. However, the students experienced difficulties in online interaction with the teachers including the feedback aspect. Whilst, the teachers met challenges in organizing effective online communication for hard-science disciplines as well as facilitating learners' needs.

The study suggests that challenges are connected to several factors. First, the teachers do not constantly evaluate the effectiveness of the digital tool and practices that they use in online communication. Thus, the teachers do not go beyond the traditional online tool for communication - namely, emails, while the students no longer consider emailing as effective. Besides, the digital literacy of the teachers directly influences the effectiveness of online communication and the overall delivery of the course. The aforementioned challenges and factors are mainly caused by the lack of appropriate institutional support in providing technologically advanced infrastructure for online course delivery, and in enhancing the digital and technological competencies of the teachers. The present study suggests that there is still a problem with developing appropriate digital solutions as LMS systems and platforms for educational purposes. It also suggests that the problem lies in the lack of active collaboration between EdTech companies and educational institutions that implement them. Within this cooperation, teachers and the learners are the key actors, who could peer evaluate and help to deliver the peculiarity of the disciplines as well as reflect the effectiveness of the developed digital solutions.

Finally, this thesis has addressed a knowledge gap with regard the design of online courses, which could lead to the effective learning in the higher education field. This thesis has contributed to advancing the understanding of coherence (or lack of it) between the online course design principles, teaching activities, and learners' experiences within the course, by exploring three perspectives simultaneously: design, teachers' and students'. This is valuable knowledge, as the aforementioned perspectives are directly interconnected and influence each other. Thus, the institutional support and technological advancement influence the effectiveness of the materialization of the course design principles, which consequently, determines students' experiences of the online course. Besides, the present thesis has

contributed to a better understanding of digitalization in higher education by introducing pedagogical recommendations for higher education institutions that implement online and blended learning. The study also highlights the importance of close and constant collaboration between external actors like Edtech companies and educational institutions. Such cooperation can lead to the development of contemporary and effective digital tools for online course delivery for different types of disciplines. Finally, the present thesis opens new topics for research in the higher education field, by identifying uninvestigated aspects of online learning and online teaching

References

Agresti, A. (2017). *Statistical methods for the social sciences*. Pearson.

Ahmed, F., Ali, S., & Shah, R. A. (2019). Exploring Variation in Summative Assessment: Language Teachers' Knowledge of Students' Formative Assessment and Its Effect on Their Summative Assessment. *Bulletin of Education and Research*, *41*(2), 109-119.

Akers, R. L., & Jensen, G. F. (2017). The empirical status of social learning theory of crime and deviance: The past, present, and future. *Taking stock*, 37-76.

Al-Furaih, S. A. A. (2017). Perceptions of pre-service teachers on the design of a learning environment based on the seven principles of good practice. *Education and Information Technologies*, *22*(6), 3187-3205. https://doi.org/10.1007/s10639-017-9580-7

AlJarrah, A., Thomas, M. K., & Shehab, M. (2018). Investigating temporal access in a flipped classroom: procrastination persists. *International Journal of Educational Technology in Higher Education*, *15*(1), 1-18. https://doi.org/10.1186/s41239-017-0083-9

AlJarrah, Thomas, M. K., & Shehab, M. (2018). Investigating temporal access in a flipped classroom: procrastination persists. International Journal of Educational Technology in Higher Education, 15(1), 1–18. https://doi.org/10.1186/s41239-017-0083-9

Andres, H. P. (2019). Active teaching to manage course difficulty and learning motivation. *Journal of Further and Higher Education*, *43*(2), 220-235. https://doi.org/10.1080/0309877X.2017.1357073

Ann, F. L. (2017). *Interviewing in social science research: A relational approach*. Routledge. https://doi.org/10.4324/9780203756065

Anthony, B., Kamaludin, A., Romli, A., Raffei, A. F. M., Nincarean, A., L Eh Phon, D., ... & Baba, S. (2019). Exploring the role of blended learning for teaching and learning effectiveness in institutions of higher learning: An empirical investigation. *Education and Information Technologies, 24(6), 3433-3466. https://doi.org/10.1007/s10639-019-09941-z*

Ashraf, M. A., Yang, M., Zhang, Y., Denden, M., Tlili, A., Liu, J., ... & Burgos, D. (2021). A Systematic Review of Systematic Reviews on Blended Learning: Trends, Gaps and Future Directions. *Psychology Research and Behavior Management*, *14*, 1525. https://doi.org/10.2147/PRBM.S331741

Ashraf, Yang, M., Zhang, Y., Denden, M., Tlili, A., Liu, J., Huang, R., & Burgos, D. (2021). A systematic review of systematic reviews on blended learning: Trends, gaps and future directions. Psychology Research and Behavior Management, 14, 1525–1541. https://doi.org/10.2147/PRBM.S331741

Bakhtiar, A., Webster, E. A., & Hadwin, A. F. (2018). Regulation and socio-emotional interactions in a positive and a negative group climate. *Metacognition and Learning*, *13*(1), 57-90. https://doi.org/10.1007/s11409-017-9178-x

Bakhtiar, A., Webster, E. A., & Hadwin, A. F. (2018). Regulation and socio-emotional interactions in a positive and a negative group climate. *Metacognition and Learning*, *13*(1), 57-90. https://doi.org/10.1007/s11409-017-9178-x

Baldwin, Ching, Y.-H., & Hsu, Y.-C. (2017). Online Course Design in Higher Education: A Review of National and Statewide Evaluation Instruments. TechTrends, 62(1), 46–57. https://doi.org/10.1007/s11528-017-0215-z

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review*, *84*(2), 191. https://doi.org/10.1037/0033-295X.84.2.191

Baran, E. (2011). *The transformation of online teaching practice: Tracing successful online teaching in higher education*. Iowa State University.

Barbour, R. (2013). *Introducing qualitative research: a student's guide*. Sage.

Barrier, Qu r, O., & Vanneuville, R. (2019). The Making of Curriculum in Higher Education. Revue d'anthropologie des connaissances, 13,N 1(1), 33. https://doi.org/10.3917/rac.042.0033

Baxter, J. (2012). Who am I and what keeps me going? Profiling the distance learning student in higher education. *International Review of Research in Open and Distributed Learning, 13*(4), 107-129. https://doi.org/10.19173/irrodl.v13i4.1283

Benton, S. L. (2019). IDEA's Teaching Essentials: Quick, Sound Student Feedback. IDEA Paper# 77. *IDEA Center, Inc.*, https://files.eric.ed.gov/fulltext/ED598956.pdf

Boelens, R., De Wever, B., & Voet, M. (2017). Four key challenges to the design of blended learning: A systematic literature review. *Educational Research Review, 22*, 1-18. https://doi.org/10.1016/j.edurev.2017.06.001

Boumadan, M., Soto-Varela, R., Ortiz-Padilla, M., & Poyatos-Dorado, C. (2020). What factors determine the value of an online teacher education experience from a teacher's perspective?. *Sustainability, 12*(19), 8064. https://doi.org/10.3390/su12198064

Bressoud, D. M. (2019). *Calculus reordered*. Princeton University Press.

Broadbent, J. (2017). Comparing online and blended learner's self-regulated learning strategies and academic performance. *The Internet and Higher Education, 33*, 24-32. https://doi.org/10.1016/j.iheduc.2017.01.004

Broadbent, J. (2017). Comparing online and blended learner's self-regulated learning strategies and academic performance. *The Internet and Higher Education, 33*, 24-32. https://doi.org/10.1016/j.iheduc.2017.01.004

Brown, M. G. (2016). Blended instructional practice: A review of the empirical literature on teachers' adoption and use of online tools in face-to-face teaching. *The Internet and Higher Education, 31*, 1-10. https://doi.org/10.1016/j.iheduc.2016.05.001

Bryman, A. (2016). *Social research methods*. Oxford university press.

Carman, J. M. (2002). Blended learning design: Five key ingredients.

Carvalho, T., & Diogo, S. (2018). Exploring the relationship between institutional and professional autonomy: a comparative study between Portugal and Finland. *Journal of Higher Education Policy and Management, 40*(1), 18-33. https://doi.org/10.1080/1360080X.2018.1395916

Castle, S. R., & McGuire, C. J. (2010). An analysis of student self-assessment of online, blended, and face-to-face learning environments: Implications for sustainable education delivery. *International Education Studies, 3*(3), 36-40. https://doi.org/10.5539/ies.v3n3p36

Castle, S. R., & McGuire, C. J. (2010). An analysis of student self-assessment of online, blended, and face-to-face learning environments: Implications for sustainable education delivery. *International Education Studies, 3*(3), 36-40. https://doi.org/10.5539/ies.v3n3p36

Chen, S. C., Yang, S. J., & Hsiao, C. C. (2016). Exploring student perceptions, learning outcome and gender differences in a flipped mathematics course. *British Journal of Educational Technology, 47*(6), 1096-1112. https://doi.org/10.1111/bjet.12278

Chen, Yang, S. J. ., & Hsiao, C.-C. (2016). Exploring student perceptions, learning outcome and gender differences in a flipped mathematics course. British Journal of Educational Technology, 47(6), 1096–1112. https://doi.org/10.1111/bjet.12278

Chickering, A. W., & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *AAHE bulletin, 3*, 7.

Ch'ng L.K. (2019). Learning Emotions in E-Learning: How Do Adult Learners Feel? Asian Journal of Distance Education, 14(1), 34.

Chuang, S. (2021). The applications of constructivist learning theory and social learning theory on adult continuous development. *Performance Improvement*, *60*(3), 6-14. https://doi.org/10.1002/pfi.21963

Cleveland-Innes, & Campbell, P. (2012). Emotional Presence, Learning, and the Online Learning Environment. International Review of Research in Open and Distance Learning, 13(4), 269–292. https://doi.org/10.19173/irrodl.v13i4.1234

Coate, K. (2009). Curriculum. In M.Tight et al, Eds, *The Routledge International Handbook of Higher Education*, pp. 77-90. London: Routledge.

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. SAGE publications.

Creswell, J. W., & Creswell, J. D. (2018). *Research design : qualitative, quantitative & mixed methods approaches* (5th edition.). Sage.

Crews, T. B., & Wilkinson, K. (2015). Online quality course design vs. quality teaching: Aligning quality matters standards to principles for good teaching. *The Journal of Research in Business Education*, *57*(1), 47.

Damşa, C., de Lange, T., Elken, M., Esterhazy, R., Fossland, T., Frølich, N., ... & Aamodt, P. O. (2015). Quality in Norwegian Higher Education: A review of research on aspects affecting student learning.

Diener, E., and Crandall, R. (1978). *Ethics in Social and Behavioral Research*. Chicago: University of Chicago Press.

Er, Kopcha, T. J., Orey, M., & Dustman, W. (2015). Exploring college students' online help-seeking behavior in a flipped classroom with a web-based help-seeking tool. Australasian Journal of Educational Technology, 31(5), 537–555. https://doi.org/10.14742/ajet.2527

Fink, A. (2019). *Conducting research literature reviews: From the internet to paper*. Sage publications.

Fossland, T., & Fossland, T. (2014). *Digitale læringsformer i høyere utdanning*. Universitetsforlaget.

Gaebel, M., Zhang, T., Stoeber, H., & Morrisroe, A. (2021). Digitally enhanced learning and teaching in European higher education institutions. *Geneve (Switzerland)*. https://eua.eu/downloads/publications/digi-he%20survey%20report.pdf

Gale, T., & Parker, S. (2014). Navigating change: a typology of student transition in higher education. *Studies in higher education*, *39*(5), 734-753. https://doi.org/10.1080/03075079.2012.721351

Gedik, Kiraz, E., & Ozden, M. Y. (2013). Design of a blended learning environment : considerations and implementation issues. Australasian Journal of Educational Technology, 29(1), 1–19. https://doi.org/10.14742/ajet.6

Gerring, J. (2017). *Case study research: Principles and practices*. Cambridge university press.

Gleason, N. W. (2018). *Higher education in the era of the fourth industrial revolution* (p. 229). Springer Nature.https://doi.org/10.1007/978-981-13-0194-0

Goodyear, P. (2005). Educational design and networked learning : patterns, pattern languages and design practice. Australasian Journal of Educational Technology, 21(1), 82–101. https://doi.org/10.14742/ajet.1344

Goodyear, P. (2015). Teaching as design. *Herdsa review of higher education*, *2*(2), 27-50.

Graham, C. R. (2018). Current research in blended learning. *Handbook of distance education*, 173-188.

Graham, C. R. (2021). Exploring definitions, models, frameworks, and theory for blended learning research. In *Blended Learning* (pp. 10-29). Routledge.

Graham, Woodfield, W., & Harrison, J. B. (2013). A framework for institutional adoption and implementation of blended learning in higher education. The Internet and Higher Education, 18, 4–14. https://doi.org/10.1016/j.iheduc.2012.09.003

Habibi, A., Mukminin, A., Riyanto, Y., Prasojo, L. D., Sulistiyo, U., Sofwan, M., & SAUDAGAR, F. (2018). Building an online community: Student teachers' perceptions on the advantages of using social networking services in a teacher education program. *Turkish Online Journal of Distance Education*, *19*(1), 46-61. https://doi.org/10.17718/tojde.382663

Habibi, A., Mukminin, A., Riyanto, Y., Prasojo, L. D., Sulistiyo, U., Sofwan, M., & SAUDAGAR, F. (2018). Building an online community: Student teachers' perceptions on the advantages of using social networking services in a teacher education program. *Turkish Online Journal of Distance Education*, *19*(1), 46-61. https://doi.org/10.17718/tojde.382663

Hsiao, Mikolaj, P., & Shih, Y.-T. (2017). A Design Case of Scaffolding Hybrid/Online Student-Centered Learning with Multimedia. The Journal of Educators Online, 14(1).

Illeris, K. (2018). An overview of the history of learning theory. *European Journal of Education*, *53*(1), 86-101. https://doi.org/10.1111/ejed.12265

Illeris, K. (2018). An overview of the history of learning theory. *European Journal of Education*, *53*(1), 86-101. https://doi.org/10.1111/ejed.12265

Isaías, P., Spector, J. M., Ifenthaler, D., & Sampson, D. G. (2015). E-learning systems, environments and approaches: Theory and implementation. In *E-learning systems, environments and approaches* (pp. 1-7). Springer, Cham. https://doi.org/10.1007/978-3-319-05825-2_1

Jaggars, & Xu, D. (2016). How do online course design features influence student performance? Computers and Education, 95, 270–284. https://doi.org/10.1016/j.compedu.2016.01.014

Joia, L. A., & Lorenzo, M. (2021). Zoom in, zoom out: the impact of the covid-19 pandemic in the classroom. *Sustainability*, *13*(5), 2531. https://doi.org/10.3390/su13052531

Karoglu, A. K., Kiraz, E., & Özden, M. Y. (2014). Good practice principles in an undergraduate blended course design. *Egitim ve Bilim*, *39*(173).

Klimova, Simonova, I., & Poulova, P. (2017). Blended Learning in the University English Courses: Case Study. Blended Learning. New Challenges and Innovative Practices, 53–64. https://doi.org/10.1007/978-3-319-59360-9_5

Kung-Teck, W. (2020). Blended learning pedagogical practices: the challenges to cultivate new ways of teaching in higher education institutions and universities. https://doi.org/10.35940/ijeat.A1427.109119

Köse, U. (2010). A blended learning model supported with Web 2.0 technologies. *Procedia-Social and Behavioral Sciences*, *2*(2), 2794-2802. https://doi.org/10.1016/j.sbspro.2010.03.417

Langford, M., & Damşa, C. (2020). Online Teaching in the Time of COVID-19. *Centre for Experiential Legal Learning (CELL), University of Oslo. https://khrono.no/files/2020/04/16/report-university-teachers-16-april-2020.pdf*

Lim, C. P., & Graham, C. R. (Eds.). (2021). *Blended Learning for Inclusive and Quality Higher Education in Asia*. Springer Singapore.

Lim, D. H., Morris, M. L., & Kupritz, V. W. (2007). Online vs. blended learning: Differences in instructional outcomes and learner satisfaction. *Journal of Asynchronous Learning Networks*, *11*(2), 27-42.

Major, C. H. (2015). *Teaching online: A guide to theory, research, and practice*. JHU Press.

Martin, F., Ritzhaupt, A., Kumar, S., & Budhrani, K. (2019). Award-winning faculty online teaching practices: Course design, assessment and evaluation, and facilitation. *The Internet and Higher Education*, *42*, 34-43. https://doi.org/10.1016/j.iheduc.2019.04.001

Martyn, M. (2005). The hybrid online model: Good practice. *Educause quarterly*, *26*(1), 18-23.

McDonald, P. L. (2012). *Adult learners and blended learning: A phenomenographic study of variation in adult learners' experiences of blended learning in higher education*. The George Washington University.

Medina, L. C. (2018). Blended learning: Deficits and prospects in higher education. *Australasian Journal of Educational Technology*, *34*(1).. https://doi.org/10.14742/ajet.3100

Minina, V. N. (2020). Digitalization of higher education and its social outcomes.https://dspace.spbu.ru/bitstream/11701/17547/1/84-101.pdf

Munna, A. (2020). Pedagogies and practice: online teaching during COVID-19. *International Journal of Humanities and Innovation (IJHI)*, *3*(4), 132-138.

Müller, C., Stahl, M., Alder, M., & Müller, M. (2018). Learning effectiveness and students' perceptions in a flexible learning course. *European Journal of Open, Distance and E-Learning*, *21*(2), 44-52. https://doi.org/10.2478/eurodl-2018-0006

Naidu, S. (2017). Openness and flexibility are the norm, but what are the challenges?. *Distance Education*, *38*(1), 1-4. https://doi.org/10.1080/01587919.2017.1297185

NESH. (2019). *Guidelines for Research Ethics in the Social Sciences, Humanities, Law and Theology*. Retrieved 10 February 2021, from https://www.forskningsetikk.no/en/guidelines/social-sciences-humanities-law-and-theology/guidelines-for-research-ethics-in-the-social-sciences-humanities-law-and-theology/

Newman, S., & Latifi, A. (2021). Vygotsky, education, and teacher education. *Journal of Education for Teaching*, *47*(1), 4-17. https://doi.org/10.1080/02607476.2020.1831375

Noddings, N. (2012). The caring relation in teaching. *Oxford review of education*, *38*(6), 771-781. https://doi.org/10.1080/03054985.2012.745047

NTNU. (n.d.). *Exam information.* Retrieved 15 December 2021, from https://i.ntnu.no/en/eksamen

NTNU. (n.d.). *Mathematical method 1 course*. Retrieved 15 December 2021, from https://www.ntnu.edu/studies/courses/IMAG1001

NTNU. (n.d.). *Mechanics course*. Retrieved 15 December 2021, from https://www.ntnu.edu/studies/courses/MEKG1001

NTNU. (n.d.). *Studies*. Retrieved 15 December 2021, from https://www.ntnu.edu/studies

Owston, R., York, D., & Murtha, S. (2013). Student perceptions and achievement in a university blended learning strategic initiative. *The internet and higher education*, *18*, 38-46. https://doi.org/10.1016/j.iheduc.2012.12.003

Owston, York, D., & Murtha, S. (2013). Student perceptions and achievement in a university blended learning strategic initiative. The Internet and Higher Education, 18, 38–46. https://doi.org/10.1016/j.iheduc.2012.12.003

Padayachee, P. (2020). Discussion Forums in Vector Calculus: Reflecting on the quality of engineering students' online interactions. In *2020 IFEES World Engineering Education Forum-Global Engineering Deans Council (WEEF-GEDC)* (pp. 1-6). IEEE.

Padirayon, L. M., Pagudpud, M. V., & Cruz, J. S. D. (2019). Exploring constructivism learning theory using mobile game. In *IOP Conference Series: Materials Science and Engineering* (Vol. 482, No. 1, p. 012004). IOP Publishing. https://doi.org/10.1088/1757-899X/482/1/012004

Paily, M. U. (2013). Creating constructivist learning environment: Role of "Web 2.0" technology. In *International Forum of Teaching and Studies* (Vol. 9, No. 1, pp. 39-50).

Pilgrim, Hornby, G., & Macfarlane, S. (2018). Enablers and barriers to developing competencies in a blended learning programme for specialist teachers in New Zealand. Educational Review (Birmingham), 70(5), 548–564. https://doi.org/10.1080/00131911.2017.1345860

Pilgrim, M., Hornby, G., & Macfarlane, S. (2018). Enablers and barriers to developing competencies in a blended learning programme for specialist teachers in New Zealand. *Educational Review*, *70*(5), 548-564. https://doi.org/10.1080/00131911.2017.1345860

Prasad, Maag, A., Redestowicz, M., & Hoe, L. S. (2018). Unfamiliar technology: Reaction of international students to blended learning. Computers and Education, 122, 92–103. https://doi.org/10.1016/j.compedu.2018.03.016

Prifti, R. (2020). Self–efficacy and student satisfaction in the context of blended learning courses. *Open Learning: The Journal of Open, Distance and e-Learning*, 1-15. https://doi.org/10.1080/02680513.2020.1755642

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital science and education*, *2*(3), 923-945. https://doi.org/10.1007/s42438-020-00155-y

Rasheed, Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. Computers and Education, 144, 103701. https://doi.org/10.1016/j.compedu.2019.103701

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, *144*, 103701. https://doi.org/10.1016/j.compedu.2019.103701

Redondo, J. M. (2019). Improving student assessment of a server administration course promoting flexibility and competitiveness. *IEEE Transactions on Education*, *62*(1), 19-26. https://doi.org/10.1109/TE.2018.2816571

Regan, K., Evmenova, A., Baker, P., Jerome, M. K., Spencer, V., Lawson, H., & Werner, T. (2012). Experiences of instructors in online learning environments: Identifying and regulating emotions. *The Internet and Higher Education*, *15*(3), 204-212. https://doi.org/10.1016/j.iheduc.2011.12.001

Robb, C. A., & Sutton, J. (2014). The importance of social presence and motivation in distance learning. *Journal of Technology, Management & Applied Engineering*, *31*.

Roberts, P. (2015). Higher education curriculum orientations and the implications for institutional curriculum change. *Teaching in Higher Education*, *20*(5), 542-555. https://doi.org/10.1080/13562517.2015.1036731

Robinson, H., Al-Freih, M., & Kilgore, W. (2020). Designing with care: Towards a care-centered model for online learning design. *The International Journal of Information and Learning Technology*. https://doi.org/10.1108/IJILT-10-2019-0098

Robinson, Kilgore, W., & Warren, S. J. (2017). Care, Communication, Learner Support: Designing Meaningful Online Collaborative Learning. Online Learning (Newburyport, Mass.), 21(4), 29.

Sadeghi, M. (2019). A shift from classroom to distance learning: Advantages and limitations. *International Journal of Research in English Education*, *4*(1),

Sadeghi, M. (2019). A shift from classroom to distance learning: Advantages and limitations. *International Journal of Research in English Education*, *4*(1), 80-88.

Salkind, N. J., & Frey, B. B. (2021). *Statistics for people who (think they) hate statistics: Using Microsoft Excel*. Sage publications.

Sancho-Vinuesa, T., Masià, R., Fuertes-Alpiste, M., & Molas-Castells, N. (2018). Exploring the effectiveness of continuous activity with automatic feedback in online calculus. *Computer Applications in Engineering Education*, *26*(1), 62-74. https://doi.org/10.1002/cae.21861

Santoso, H. B., Batuparan, A. K., Isal, R. Y. K., & Goodridge, W. H. (2018). The development of a learning dashboard for lecturers: A case study on a student-centered e-learning environment. *The Journal of Educators Online*, 1. https://doi.org/10.9743/JEO.2018.1.1

Saris, W. E., & Gallhofer, I. N. (2014). *Design, evaluation, and analysis of questionnaires for survey research*. John Wiley & Sons.

Smyth, S., Houghton, C., Cooney, A., & Casey, D. (2012). Students' experiences of blended learning across a range of postgraduate programmes. *Nurse education today*, *32*(4), 464-468. https://doi.org/10.1016/j.nedt.2011.05.014

So, H. J., & Brush, T. A. (2008). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors. *Computers & education*, *51*(1), 318-336. https://doi.org/10.1016/j.compedu.2007.05.009

Sun, Wu, Y., & Lee, W. (2017). The effect of the flipped classroom approach to OpenCourseWare instruction on students' self-regulation. British Journal of Educational Technology, 48(3), 713–729. https://doi.org/10.1111/bjet.12444

Säljö, R. (2010). Digital tools and challenges to institutional traditions of learning: technologies, social memory and the performative nature of learning. *Journal of computer assisted learning*, *26*(1), 53-64. https://doi.org/10.1111/j.1365-2729.2009.00341.x

Thomas, J. E., Graham, C. R., & Piña, A. A. (2018). Current practices of online instructor evaluation in higher education. https://www.westga.edu/~distance/ojdla/summer212/thomas_graham_pina212.html

Tindowen, D. J. (2019). Influence of empowerment on teachers' organizational behaviors. *European Journal of Educational Research*, *8*(2), 617-631. https://doi.org/10.12973/eu-jer.8.2.617

Tinungki, G. M. (2019). ZONE PROXIMAL DEVELOPMENT GIVES A NEW MEANING TO THE STUDENTS'INTELLIGENCE IN STATISTICAL METHOD LESSON. *Journal of Honai Math*, *2*(2), 129-142. https://doi.org/10.30862/jhm.v2T2.69

Tzuriel, D. (2021). *Mediated learning and cognitive modifiability*. New York: Springer.

Venkatesh, Rao, Y. K., Nagaraja, H., Woolley, T., Alele, F. O., & Malau-Aduli, B. S. (2020). Factors Influencing Medical Students' Experiences and Satisfaction with Blended Integrated E-Learning. Medical Principles and Practice, 29(4), 396–402. https://doi.org/10.1159/000505210

Venkatesh, S., Rao, Y. K., Nagaraja, H., Woolley, T., Alele, F. O., & Malau-Aduli, B. S. (2020). Factors influencing medical students' experiences and satisfaction with blended integrated E-learning. *Medical Principles and Practice*, *29*(4), 396-402. https://doi.org/10.1159/000505210

Verbert, K., Duval, E., Klerkx, J., Govaerts, S., & Santos, J. L. (2013). Learning analytics dashboard applications. *American Behavioral Scientist*, *57*(10), 1500-1509. https://doi.org/10.1177/0002764213479363

von Schönfeld, K. C., Tan, W., Wiekens, C., & Janssen-Jansen, L. (2020). Unpacking social learning in planning: who learns what from whom?. *Urban research & practice*, *13*(4), 411-433. https://doi.org/10.1080/17535069.2019.1576216

Wanner, & Palmer, E. (2015). Personalising learning: Exploring student and teacher perceptions about flexible learning and assessment in a flipped university course. Computers and Education, 88, 354–369. https://doi.org/10.1016/j.compedu.2015.07.008

Wanner, T., & Palmer, E. (2015). Personalising learning: Exploring student and teacher perceptions about flexible learning and assessment in a flipped university course. *Computers & Education*, *88*, 354-369. https://doi.org/10.1016/j.compedu.2015.07.008

Watkins, D., & Gioia, D. (2015). *Mixed methods research*. Pocket Guide to Social Work Re https://doi.org/10.1093/acprof:oso/9780199747450.001.0001

Wolfer, L. T., & Jacoby, J. E. (2007). *Real research: Conducting and evaluating research in the social sciences*. Boston, MA: Pearson/Allyn and Bacon.

Wong, A. T. T. (2008, August). 5i: A design framework for hybrid learning. In *International Conference on Hybrid Learning and Education* (pp. 147-156). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-85170-7_13

Xi, J., & Lantolf, J. P. (2021). Scaffolding and the zone of proximal development: A problematic relationship. *Journal for the Theory of Social Behaviour*, *51*(1), 25-48. https://doi.org/10.1111/jtsb.12260

Yang, J., Kinshuk, Yu, H., Chen, S. J., & Huang, R. (2014). Strategies for smooth and effective cross-cultural online collaborative learning. *Journal of Educational Technology & Society*, *17*(3), 208-221.

Yates, & Rice, R. E. (2020). The Oxford Handbook of Digital Technology and Society. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780190932596.001.0001

Zacharis, N. Z. (2015). A multivariate approach to predicting student outcomes in web-enabled blended learning courses. *The Internet and Higher Education*, *27*, 44-53. https://doi.org/10.1016/j.iheduc.2015.05.002

Zacharis. (2015). A multivariate approach to predicting student outcomes in web-enabled blended learning courses. The Internet and Higher Education, 27, 44–53. https://doi.org/10.1016/j.iheduc.2015.05.002

Zhang, & Zhu, C. (2017). Review on Blended Learning: Identifying the Key Themes and Categories. International Journal of Information and Education Technology, 7(9), 673–678. https://doi.org/10.18178/ijiet.2017.7.9.952

Appendices

A. Interview guide

Part 1. Background information about teaching online

1. How long have you been teaching in higher education?
2. How long have you been teaching online?
3. What Learning Management Systems have you used to design and teach online?
4. How would you describe your online class structure? Is it fully online or blended?
5. How would you describe the approach to your online course in terms of synchronous/ asynchronous mode of instruction?

Part 2. Responsibilities, instruction

1. What are the various roles instructors take on in online learning?
2. What do you feel are your responsibilities as an online instructor?
3. What would you describe as the common tasks you implement when designing and teaching an online course?

Part 3. Design

1. How do you organize your online courses?
2. Could you describe to us how you design your course?
3. What is your involvement in the online course design?
4. Do you seek any assistance from specialists (e.g., graphics designers, instructional designers, etc.)
5. Could you describe to us how you teach your course (e.g., the day to day work)?
6. Could you describe what should be taken into consideration while designing an online course? (In comparison with face-to-face courses)? Why?
7. If you could change the design of the present course, what would it be? Why?

Part 4. Assessment, evaluation & facilitation

1. Could you describe to us how and how often you assess your students (e.g., quizzes, discussions, etc.)?
2. How do you evaluate whether your course is meeting intended outcomes/ goals?
3. Which actions do you take for monitoring students' progress?
4. Which teaching activities help/assist students in regulating their learning process?
5. Which online & technological tools resources help you to facilitate teaching?
6. Could you describe how you facilitate the learning process?
7. Could you describe how you motivate students?

Part 5. Teaching activities online (evaluating flexibility)

1. Could you describe which learning activities/tasks contain flexibility component in terms of time (students decide when they do/ submit task)
2. Could you describe which learning activities/tasks contain flexibility component in terms of place (students decide where they do/ submit task)
3. Could you agree that the learners have control or could determine the order in which content is provided in the course?

Part 6. Evaluating activities from an interaction perspective

1. How do you design learning activities to engage students?
2. Which activities are aimed at facilitating student collaboration?
3. How do you interact with students during class?
4. How do you interact with students after the class?

Part 7. Evaluating the learning climate

1. How could you describe the learning climate during your lecture/ seminar? (Are you emotionally engaged with the students?)

Part 8. Challenges

1. What do you think are the benefits of teaching online?
2. What do you think are challenges teaching online?
3. How have you adapted to the mentioned challenges?

B. Information letter and consent form for interview participants

Information about the project 'Course design and teaching in online higher education'

Thank you for agreeing to participate in the project, *"Course design and teaching in online higher education"*!

Purpose of the project
The present project addresses to the complex problem of effective online course design and online teaching in higher education. The purpose of the project is to generate an understanding of the coherence between course design, teaching activities, and students' learning experiences in the context of online higher education. Three research questions will be asked: 1.How do **course design** and **teaching activities** address design principles and requirements for online blended learning? 2. How are the online **course design and teaching activities experienced** by students and teachers in relation to the principles of flexibility, interaction and facilitation?

Who is responsible for the research project?
University of Oslo, Department of Education is the institution responsible for the project.

Why are you being asked to participate?
The study includes teachers who participate in online course design as well as teaching in the online environment. The participation of the teacher in the present study would reflect a necessary and important part of online learning in higher education.

What does participation involve for you?
If you chose to take part in the project, this will involve taking part in an interview. The interview will last maximum 60 minutes including questions about your experience of teaching online, opportunities and challenges during designing your course as well as interaction with students in an online environment. Your answers will be audio recorded.

Participation is voluntary
Your participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data
We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

Only one student and her supervisor will have access to the personal data. Your name and contact details will be replaced with a code. The list of names, contact details and respective codes will be

stored separately from the rest of the collected data. The data will be stored in encrypted remote desktop of University of Oslo.

What will happen to your personal data at the end of the research project?
The personal data, including any digital recordings, will be anonymised.

Your rights
So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?
We will process your personal data based on your consent.
Based on an agreement with University of Oslo, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?
If you have questions about the project, or want to exercise your rights, contact:

- University of Oslo via Crina Damsa, by email: crina.damsa@iped.uio.no
- Our UiO Data Protection Officer: Maren Magnus Voll, by email: personvernombud@uio.no
- NSD – The Norwegian Centre for Research Data AS, by email: (personverntjenester@nsd.no) or by telephone: +47 55 58 21 17.

Yours sincerely,

Students: Daria Volosach
Supervisor: Crina Damsa

Consent form

I have received and understood information about the project *Course design and teaching in online higher education* and have been given the opportunity to ask questions. I give consent:

- to participate in an interview
- for this data to be stored after the end of the project for follow-up studies

I give consent for my personal data to be processed until the end date of the project, approx. June 2022.

(Signed by participant, date)

C. Survey instrument

Information about the project 'Course design and teaching in online higher education'

Kjære student,
Du er invitert til å delta i en spørreundersøkelse om utforming og undervisning av nettkurs. Denne undersøkelsen er en del av et masterstudie som tar sikte på å forstå hvordan nettkurs blir utformet og undervist av lærere, hvordan du som student opplever onlinekurs, og hvordan onlinekurs vil bli forbedret. Studien blir utført av Universitetet i Oslo, og den handler om to kurs ved din institusjon: Mekanikk og Matematisk metode 1.
Du blir bedt om å delta i denne studien fordi du deltok på ett av disse to kursene. Din erfaring med nettbasert læring representerer verdifull data for forskning om undervisning og utforming av onlinekurs.
Din deltakelse i dette prosjektet er helt frivillig, men jeg håper du vil ta 10 minutter på å svare på spørsmålene og komme med forslag til forbedring av onlinekurs ved din institusjon. Svaret ditt vil være helt anonymt, da undersøkelsen ikke ber om personlig informasjon og e-postadresse. Vennligst svar så ærlig og utfyllende som mulig.

Hvis du har spørsmål eller hvis du er interessert i å vite mer om prosjektet, kan du kontakte meg på dariav@student.uv.uio.no.
Takk for din deltagelse!

Survey

Del 1. Bakgrunnsinformasjon.

Denne delen består av spørsmål som hjelper oss å vite litt mer om deg og din erfaring med bruk av teknologiske og digitale verktøy.

1. Hvilket studieår er du på?
2.Hva er kursprogrammet ditt?

- Matematisk metode 1
- Mekanikk

3.Hvilken type onlinekurs hadde du?

- helt online
- blandet (online og klasseromundervisning)

4.Hvor mange blandede kurs har du tatt så langt på læringsstedet ditt?

Del 1a. Digital kompetanse og erfaring med online læring.

Jeg synes det er enkelt å bruke teknologiske verktøy (smarttelefon, nettbrett, datamaskin).	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes det er enkelt å bruke digitale verktøy (læringsplattformer, Canvas, StudentWeb).	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg er flink på å disponere tiden min når jeg studerer på nettet.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

Dette onlinekurset lar meg velge sted selv hvor jeg studerer og får undervisning.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Dette onlinekurset lar meg bestemme selv når jeg vil jobbe med skole og få undervisning.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

Del 2. Studentenes erfaringer med online kursdesign.

I denne delen vil vi spørre deg om din erfaring og synspunkter på nettbasert kursdesign og dets elementer, som kursmål, forelesninger, seminarer og kursmateriell.

Målene for onlinekurset ble tydelig presentert på nettstedet / Canvas.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren forklarte viktige nettbaserte kursmål.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Den nettbaserte kursmodulen i Canvas var godt organisert og enkel å finne frem i.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes at nettbaserte undervisningsaktiviteter (f.eks. forelesninger, veiledning) var skreddersydd for en nettbasert kontekst.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes at seminarene var godt laget i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Det var interessant å lese pensum i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Kursmateriell og tilleggsressurser var nyttige i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes at det var nyttig med oppgaver i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes sammenhengen mellom forelesningene og seminarene var god i onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes sammenhengen mellom oppgavene og seminarene var svak i onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

Jeg synes at forelesninger, seminarer og oppgaver ikke hadde sammenheng i det hele tatt i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Onlinekurset tillot meg å ta ansvar for min egen læring.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Dette onlinekurset var en nyttig nettbasert læringsopplevelse.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

Del 3. Nettbaserte læringsaktiviteter og undervisning.

I denne delen vil vi spørre deg om din erfaring med nettbasert undervisning og om forskjellige læringsaktiviteter du hadde i onlinekurset.

Jeg synes at læreren var entusiastisk (veldig interessert) i onlineundervisning.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren ga klare instruksjoner om hvordan man kan delta i forelesninger på nettet.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren ga klare instruksjoner om hvordan man kan delta i online-seminarer.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren ga klare instruksjoner om hvordan man kan delta i oppgaver på onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren var behjelpelig med å veilede klassen med å forstå de nettbaserte kursmålene under forelesningene.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren var behjelpelig med å veilede klassen med å forstå de nettbaserte kursmålene under seminarene.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Oppgavene i dette nettkurset var interessante og motiverte meg til å gjøre mitt beste.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Oppgavene i dette nettkurset var vanskelige.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg hadde forskjellige nettbaserte oppgaver og aktiviteter, der jeg kunne demonstrere min forståelse av forskjellige kursmål.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

Jeg fikk velge hvilke typer nettbaserte aktiviteter og oppgaver jeg skulle fullføre.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Dette nettkurset inkluderte aktiviteter / oppgaver der studentene kunne samarbeide med hverandre.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg synes at læreren i dette onlinekurset oppfylte forventningene mine for læring.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

I hvilken grad oppfylte nettkurset dine forventninger?	I stor grad	I noen grad	I liten/ingen grad

Hva synes at du har lært mest av? Velg ett alternativ:	Nettbaserte forelesninger	Nettbaserte seminarer	Pensum	Nettbaserte gruppeaktiviteter	Individuelle oppgaver	Eksternt materiale

Del 4. Kommunikasjon og samhandling med lærer og studentene.

I denne delen vil vi spørre deg om hvordan du opplevde kommunikasjon og interaksjon både med læreren og klassekameratene under dette nettkurset.

Læreren kommuniserte effektivt under alle online-forelesningene	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren kommuniserte effektivt under alle online-seminarene	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren var mulig å kontakte utenfor online-undervisning	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Mengden nettbasert kommunikasjon med læreren var tilfredsstillende.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren ga tilbakemelding i god tid.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Læreren ga tilbakemeldinger som hjalp meg å forstå mine styrker og svakheter (i sammenheng med kursmålene).	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg utvekslet mine ideer med klassekamerater under dette nettkurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg var i stand til å ta til meg ny kunnskap fra	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

klassekameratene mine under dette nettkurset.					
Jeg var i stand til å ta til meg nye ferdigheter fra klassekameratene mine under dette nettkurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte at jeg er en del av et læringsmiljø under dette nettkurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg ukomfortabel med å delta i kursdiskusjonen på nettet.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg ukomfortabel med å delta i de nettbaserte gruppeoppgavene.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

Del 5. Online kursmiljø

I denne delen vil vi spørre deg om din samlede opplevelse av nettmiljøet under dette nettkurset.

Læreren respekterte studentenes ideer og synspunkter under onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg komfortabel med å kommunisere online med læreren i løpet av dette kurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg komfortabel med å kommunisere online med studentene på dette kurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg isolert på dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg bekymret i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg følte meg komfortabel med å uttrykke følelsene mine gjennom nettbasert medium.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Jeg var motivert til å delta i forelesning/seminar i dette onlinekurset.	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig

I hvilken grad har onlinekurset oppfylt forventningene dine om det sosiale miljøet?	I stor grad	I noen grad	I liten/ingen grad

Del 6. Nettbaserte læringsfordeler og -utfordringer.

I denne delen vil vi stille deg åpne spørsmål der du skal skrive dine synspunkter om nettbaserte læringsfordeler og -utfordringer i dette kurset.

1. Hva synes du er fordelene med å lære online (basert på erfaringene du har gjort deg på dette kurset)?

2.Hva synes du er utfordringene med å lære på nettet (basert på opplevelsene du har hatt på dette kurset)?

D. Coding scheme 1

Explaining the principles of online course design

Node/ Variables	Sub-node/ Variables	Meaning from the teachers perspective	Meaning from the course design perspective	Meaning from the student perspective
Flexibility	**Course structure**	Statements refer to teachers that describe the course structure as allowing to introduce any type of changes.	Information refers to course documents that describe the course structure as allowing to introduce any type of changes.	-
	In terms of time	Statements refer to teachers that describe the course design/teaching activities as allowing students to maneuver the time to study and submit their assignments.	Information refers to course documents that describe the course design as allowing students to maneuver the time to study and submit their assignments.	Statements refer to students that describe the course design/teaching activities as allowing them to maneuver the time to study and submit their assignments.
	In terms of place	Statements refer to teachers that describe the course design/teaching activities as allowing students to maneuver the place for study.	Information refers to course documents that describe the course design as allowing students to maneuver the place for study.	Statements refer to students that describe the course design/teaching activities as allowing them to maneuver the place for study.
	In terms of path	Statements refer to teachers that describe the course design/teaching activities as allowing students to maneuver the aspect of the study (learning activities)	Information refers to course documents that describe the course design as allowing students to maneuver the aspect of the study (learning activities)	Statements refer to students that describe the course design/teaching activities as allowing them to maneuver the aspect of the study (learning activities)

Interaction	**Interaction online**	Statements refer to teachers that describe different forms of interaction with students in the online environment	Information refers to course documents that describe the course design as including different forms of interaction with students in the online environment	Statements refer to students describing different forms of interaction with a teacher in the online environment
	Interaction face-to-face	Statements refer to teachers that describe different forms of interaction with students in the face-to-face environment	Information refers to course documents that describe the course design as including different forms of interaction with students in the face-to-face environment	Statements refer to students describing different forms of interaction with a teacher in the face-to-face environment
	Online engagement activities	Statements refer to teachers that describe different forms of engagement activities between the students in the online environment	Information refers to course documents that describe the course design as including different forms of engagement activities between the students in the online environment	Statements refer to students describing different forms of engagement activities between the students in the online environment
	Campus-based engagement activities	Statements refer to teachers that describe different forms of engagement activities between the students on campus	Information refers to course documents that describe the course design as including different forms of engagement activities between the students on campus	Statements refer to students describing different forms of engagement activities between the students on campus

Facilitation of the learning process	**Learning organization**	Statements refer to teachers that describe different forms of assistance and help for students related to the course integration.	Information refers to course documents that describe the course design as including different forms of assistance and help for students related to the course integration.	Statements refer to students describing different forms of assistance and help from the teacher related to the course integration.
	Assessment	Statements refer to teachers that describe how they evaluate and monitor students progress	Information refers to course documents that describe the course design as including activities for evaluation and monitoring students progress	Statements refer to students describing how their knowledge were assessed within the course
	Feedback	Statements refer to teachers that describe which forms of the feedback was used and the time frame of its delivery	Information refers to course documents that describe the course design as including feedback component	Statements refer to students describing which forms of the feedback was used and the time frame of its delivery

E. Coding scheme 2

Teacher experiences in relation to the principles of flexibility, interaction and facilitation

Node	Sub-node	Meaning
Teachers experience flexibility	Positive experience of flexibility in terms of course structure	Statements refer to teachers expressing advantages towards introducing any type of changes in the course structure
	Negative experience of flexibility in terms of course structure	Statements refer to teachers expressing difficulties and discouragement of flexibility in terms of course structure
	Positive experience of flexibility in terms of time	Statements refer to teachers expressing advantages in organizing space for students to maneuver the time to study and submit their assignments.
	Negative experience of flexibility in terms of time	Statements refer to teachers' expressing difficulties and discouragement in organizing space for students to maneuver the time to study and submit their assignments.
	Positive experience of flexibility in terms of path	Statements refer to teachers expressing advantages in organizing space for students to maneuver the aspect of the course (learning activities)
	Negative experience of flexibility in terms of path	Statements refer to teachers' expressing difficulties and discouragement in organizing space for students to maneuver the aspect of the course (learning activities)
Teachers experience interaction	Positive experience of interaction with students online	Statements refer to teachers expressing advantages in organizing interaction with students in the online environment
	Negative experience of interaction with students online	Statements refer to teachers expressing difficulties and discouragement in organizing interaction with students in the online environment
	Positive experience of interaction with students face-to-face	Statements refer to teachers expressing advantages in organizing interaction with students in the face-to-face environment
	Negative experience of interaction with students face-to-face	Statements refer to teachers expressing difficulties and discouragement in organizing interaction with students in the face-to-face environment
	Positive experience of online engagement activities	Statements refer to teachers expressing advantages in organizing engagement activities between the students in the online environment

	Negative experience of online engagement activities	Statements refer to teachers expressing difficulties and discouragement in organizing engagement activities between the students in the online environment
	Positive experience of campus-based engagement activities	Statements refer to teachers expressing advantages in organizing engagement activities between the students on campus
	Negative experience of campus-based engagement activities	Statements refer to teachers expressing difficulties and discouragement in organizing engagement activities between the students on campus
Teachers experience facilitating learning environment	Positive experience of learning organization	Statements refer to teachers expressing advantages in organizing assistance and help for students related to the course integration.
	Negative experience of learning organization	Statements refer to teachers expressing difficulties and discouragement in organizing assistance and help for students related to the course integration.
	Positive experience of assessment	Statements refer to teachers expressing advantages in organizing evaluation and monitoring students' progress
	Negative experience of assessment	Statements refer to teachers expressing difficulties and discouragement in organizing evaluation and monitoring students' progress
	Positive experience of feedback	Statements refer to teachers expressing advantages in organizing feedback within the course
	Negative experience of feedback	Statements refer to teachers expressing difficulties and discouragement in organizing feedback within the course

F. Coding scheme 3

Students experiences in relation to the principles of flexibility, interaction and facilitation

Variables	Sub-Variables	Meaning
Students experience flexibility	Positive experience of flexibility in terms of time	Statements refer to students expressing advantages in maneuvering the time to study and submit their assignments.
	Negative experience of flexibility in terms of time	Statements refer to students' expressing difficulties and discouragement in maneuvering the time to study and submit their assignments.
	Positive experience of flexibility in terms of place	Statements refer to students expressing advantages in maneuvering the place to study
	Negative experience of flexibility in terms of place	Statements refer to students' expressing difficulties and discouragement in maneuvering the place to study
	Positive experience of flexibility in terms of path	Statements refer to students expressing advantages in maneuvering the aspect of the course (learning activities)
	Negative experience of flexibility in terms of path	Statements refer to students' expressing difficulties and discouragement in maneuvering the aspect of the course (learning activities)
Students experience interaction	Positive experience of interaction with a teacher online	Statements refer to students expressing advantages in interaction with a teacher in the online environment
	Negative experience of interaction with a teacher online	Statements refer to students' expressing difficulties and discouragement in interaction with a teacher in the online environment
	Positive experience of face-to-face interaction with a teacher	Statements refer to students expressing advantages in face-to-face interaction with a teacher
	Negative experience of face-to-face interaction with a teacher	Statements refer to students' expressing difficulties and discouragement in face-to-face interaction with a teacher
	Positive experience of online engagement activities	Statements refer to students expressing advantages in engagement activities between the students in the online environment
	Negative experience of online engagement activities	Statements refer to students' expressing difficulties and discouragement in engagement activities between the students in the online environment
	Positive experience of campus-based engagement activities	Statements refer to students expressing advantages in campus-based engagement activities

	Negative experience of campus-based engagement activities	Statements refer to students' expressing difficulties and discouragement in campus-based engagement activities
Students experience facilitating learning environment	Positive experience of learning organization	Statements refer to students expressing advantages in assistance and help from the teacher related to the course integration.
	Negative experience of learning organization	Statements refer to students' expressing difficulties and discouragement in assistance and help from the teacher related to the course integration.
	Positive experience of assessment	Statements refer to students expressing advantages in the assessment forms within the course
	Negative experience of assessment	Statements refer to students' expressing difficulties and discouragement in the assessment forms within the course
	Positive experience of feedback	Statements refer to students expressing advantages in the forms of the feedback was used and the time frame of its delivery
	Negative experience of feedback	Statements refer to students' expressing difficulties and discouragement in in the forms of the feedback was used and the time frame of its delivery

G. NSD letter

NSD NORSK SENTER FOR FORSKNINGSDATA

Assessment

Reference number

583552

Project title

COURSE DESIGN & TEACHING IN ONLINE HIGHER EDUCATION

Data controller (institution responsible for the project)

Universitetet i Oslo / Det utdanningsvitenskapelige fakultet / Institutt for pedagogikk

Project leader (academic employee/supervisor or PhD candidate)

Crina Damsa , crina.damsa@iped.uio.no, tlf: 22840725

Type of project

Student project, Master's thesis

Contact information, student

Daria Volosach, dariav@student.uv.uio.no, tlf: 40858745

09.06.2021 - Assessed