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IT3915 - MASTER IN INFORMATICS, PREPARATORY PROJECT

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# Preparatory Project

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# 1 Introduction

## 1.1 Motivation

Group work is an integral part of a student's academic journey, fostering collaborative skills and a deeper understanding of the subject matter. However, group work also presents challenges such as lack of leadership, team development, scheduling conflicts, free-riding, and students prefer to work alone [1]. Solving these issues requires knowledge, effective communication, and strategic planning from both professors and students. These challenges can significantly impact learning outcomes and group dynamics if they are not properly managed. Recent studies highlight an increasing trend over the past two decades in the use of work teams and the growing importance of teamwork skills, which are highly valued by future employers [1].

As students ourselves, we bring a unique perspective and personal interest to the challenges of group collaboration. We strive to contribute meaningful insights through existing literature, aiming to identify approaches that can serve as effective tools for facilitating successful group work. Our goal is to develop a solution that serves as a practical tool for both students and professors, integrating evidence-based strategies from existing research, to promote a more productive, and collaborative environment in group projects. This solution will facilitate a better learning curve, but also uphold the integrity of the group learning process. Thereby, enriching the educational journey for students in group-based projects.

## 1.2 Project Description

In this project, we aim to design and develop a solution to enhance group collaboration, strengthen interactions among group members, and improve group dynamics, with a focus on students in higher education. Students can join groups in several ways: either randomly, based on skill sets, or through self-selection. A key feature of the application is its functionality to create and manage a group contract, allowing students to clearly define roles, responsibilities, and expectations, as well as establish guidelines for how the group should handle conflicts.

To monitor the engagement of members, which is important for professors in their follow-up of group collaboration, the professor will have access to an activity log for each group, allowing them to track the activity level of individual group members. Inactive group members will be regularly notified that they are not active and that it is time to contribute. The application offers a feature for periodic feedback on group collaboration, enabling continuous improvement and increased productivity. The feedback will include questions about how the group collaboration has evolved and other members' participation levels. This feedback can be arranged after completing an assignment, ensuring that group dynamics and collaboration are continuously evaluated and improved. The application also includes a feature for peer review, where students are required to evaluate and provide feedback on exercises to their fellow students. This contributes to a more engaging and interactive learning environment, where students develop critical thinking skills and a deeper understanding of the subject, this will also provide the professor valuable insights in each group.

## 1.3 Research Questions

Group work in an educational context presents multiple challenges [1]. In this section, we explore the essential questions that guide our exploration of this problem. We aim to get a deeper understanding of the concepts and mechanisms that may solve the fundamental problems within collaborative work. Additionally, identifying questions will enable us to search for effective strategies and best practices that can enhance the group collaboration experience for students. Our objective is to find solutions that resolve current challenges, such as free-riding and formation of groups, and improve the overall group work experience for the students, but also improve the experience for the professors. Additionally, we plan to explore the ethical aspects of our solution, particularly

focusing on students' perceptions regarding its usage. We aim to ensure that the application is justifiable for all members of the team while considering factors such as autonomy, fairness, and privacy. We have chosen to focus on the following research questions:

1. What are the primary challenges faced in group work within an educational context?
2. How to support effective group collaboration through the use of educational technologies and methods?
3. How do students perceive the impact of this application on fairness and autonomy in their group collaboration?

## 1.4 Design Science Research

Design Science Research (DSR) is the research methodology we have chosen to use in this project and later in our master's thesis. DSR emphasizes developing solutions that address actual problems and enhance the contexts in which they are applied. This approach integrates theoretical and practical knowledge to broaden the understanding of design processes [2].

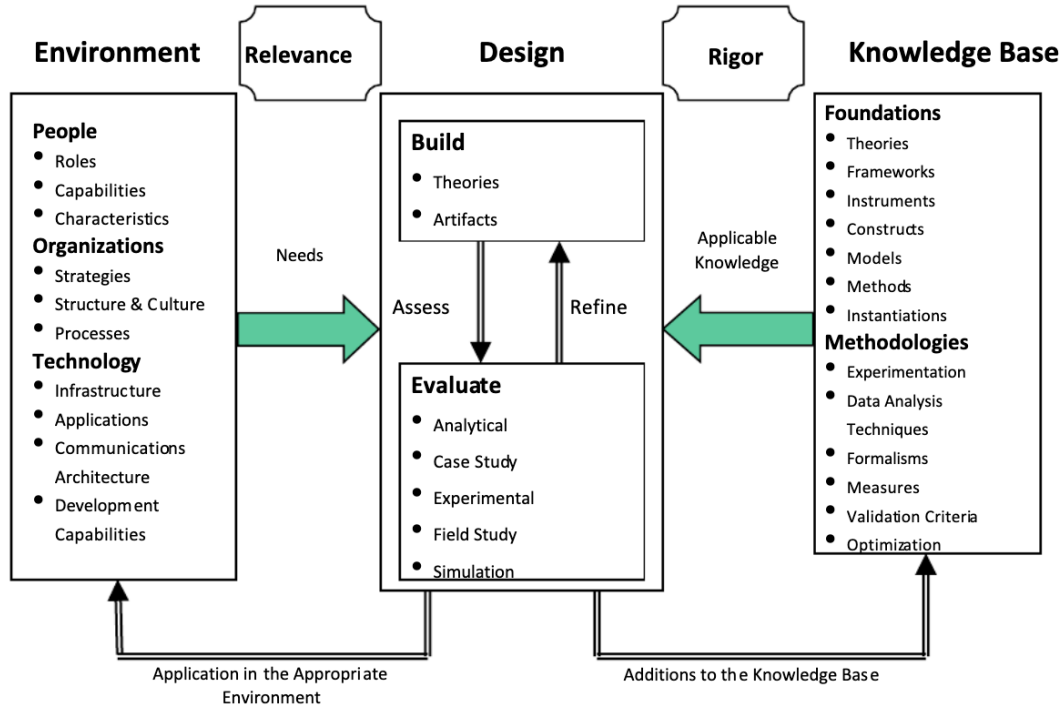


Figure 1: Design Science Research framework [3]

The conceptual framework for understanding, conducting, and evaluating DSR is presented in Figure 1. On the left side of the figure, we find 'the environment', which is divided into three categories: people, organizations, and technology. Within this environment, goals, problems, and opportunities are identified, collectively defining the research problem. This is accomplished by assessing needs in the context of the organization's strategies, structure, culture, and existing work processes, as well as considering the current technology infrastructure[3].

On the right side of the figure, the knowledge base is represented, consisting of foundations and methods. The foundation includes previous research, as well as theories, tools, various frameworks, and models. This provides a solid basis for how the research study should be structured. The other

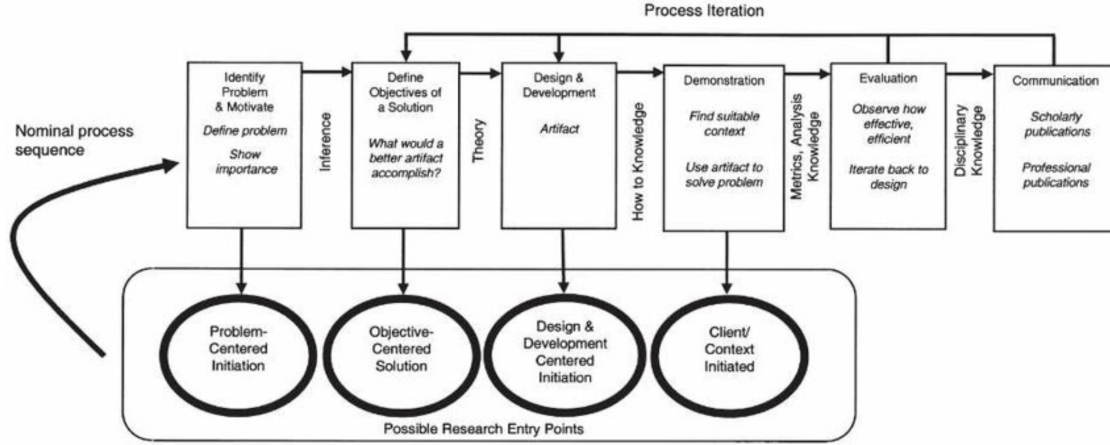


Figure 2: Design Science Research process [3]

part of the knowledge base is methods, which can be seen as research evaluation guidelines. To achieve rigour, one must use the existing foundation and method correctly [2].

The DSR process consists of six steps: (1) identification, (2) definition, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication. The first step focuses on identifying the problem and formulating relevant research questions. This is followed by the definition phase, where the goals for a potential solution are established. The next step is the design and development process, where the solution is shaped. The fourth step involves demonstration, where the solution is used to solve the problem. This leads to evaluation, where the solution is assessed by comparing the original goals with the actual results achieved through the use of the solution. Finally, in the communication phase, insights about the problem, the solution, its utility, and its effectiveness are shared with others [2].

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## 2 Background

In this section we will go through some of the research we have explored, these are papers that address and discuss problems in group work in an educational setting as well as come up with solutions and different approaches for creating effective groups. These papers help us understand problems in group work such as free-riding, group-formation problems, lack of communication, and other conflicts within groups. Despite group work may come with problems, the increasing popularity of group work in higher education is beneficial for gaining teamwork and communication skills [4]. Over 80% of organizations use some form of teamwork, where skills like problem-solving, communication, collaboration, and time management are highly valued by employers [1]. A study conducted by Maiden and Perry [5] emphasizes the significance of teamwork skills by students. Students with teamwork experience are valued by employees, and by having group work in their daily life students can develop valuable teamwork skills [5].

### 2.1 Challenges Within Group Collaboration

The selected papers highlight several challenges encountered in group work, where the free-rider issue is a primary concern. Maiden et al. [5] define a free-rider as someone who benefits, but contributes less than their fair share of the the work. Hall et al. [4] delve deeper into this issue, highlighting the frustration and unfairness it causes for those who contribute more. The authors also identify potential reasons for free-riding, which include (1) language barriers, particularly for international students, (2) feelings of incompetence, and (3) different work styles among the members of the group. This analysis reveals that free-riding can be both a voluntary and involuntary issue, indicating that we need more detailed and specific solutions [4].

Another significant challenge in group work is defining how the groups should be formed. An observation by Benning [6] based on a study involving 257 students, emphasizes the importance of deliberate group formation. Benning argues against random team formation, he suggests using smaller and more thoughtful groups [6]. This approach is suggested to facilitate more effective communication and collaboration, reducing the likelihood of issues related to group work. Additionally, proper group management is crucial, as it not only enhances learning through engagement but also prepares students for future collaborative endeavours [1].

Hall and Buzzwell [4] mention three ways of forming effective groups: (1) profiling-based, (2) professor-formed (mixed) and (3) student-formed. In the first approach, the students create profiles and the groups are formed based on expectations of which profiles work well together. Here, the groups can be formed based on academic- grades and background. This can be effective in the way that the group can share the same expertise and experience.

The second approach, professor-formed, the professor builds groups based on a mix of students. Here students may have different levels and backgrounds than others. A mix of students can create balanced groups, but this kind of group may also produce groups consisting of students who feel not skilled and incompetent, a problem mentioned by Hall et al. [4]. In an ideal scenario, the students would benefit from this collaboration with stronger students gaining knowledge by assisting others. However, due to pressures and time constraints for the students, this often doesn't happen. Instead, academically stronger students may feel overloaded by carrying the group, resulting in involuntary free-riders [4]. Soetanto and MacDonald [7] found that mixed groups, formed by the professor face more issues related to personality and lack of leadership, problems mentioned by Hansen [1]. One approach for solving this issue it to rotate the groups, if some groups are not working properly [8]. The students can then be placed in new and hopefully more effective groups.

The final approach is student-formed groups, here the students build their groups, and this can be effective since they are likely to select students they have experience with [4].

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## 2.2 Developing Effective Groups

The way the groups are formed plays a crucial role in developing effective groups, but it is not a guarantee of preventing problems. For instance, there is no guarantee that the students are placed in groups without free-riders. As mentioned earlier, this problem can be created by other factors such as communication difficulties, for instance, the language barrier for students [4]. Using Hall and Buzzwell’s third approach (student-formed) for creating groups can prevent this problem, here the students can pick groups themselves. In the language barrier example, international students can form a group consisting of other international students. Additionally, students could form groups consisting of members who have previously worked together successfully. This method of forming groups is also supported in Benning’s research, he concluded that the students preferred self-selection of groups over random assignment [6].

Having students assess each other’s contributions can help mitigate conflicts within the group. Several papers emphasize that peer evaluations could be an effective tool for the students to assess each other’s contribution [1, 4, 6]. When the students assess the other members they can write about their own experiences with their teammates and mention problems if there are any. Hall et al. discuss various strategies for addressing free-riding, and the paper stresses the need for early detection of free-riders, where implementing peer-assessment methods is one strategy [4]. Hansen [1] provides ten suggestions to enhance the effectiveness of team projects one of them is the use of *detailed peer evaluation as a part of grading team effort*. The author suggests that implementing a tool for peer evaluation can provide the instructor with useful information when grading [1].

## 2.3 Approach

By examining these research papers, our goal is to identify diverse approaches and techniques from the literature that can be integrated into our application, ensuring that it incorporates evidence-based methods from the literature to effectively address our research questions, ensuring that group work is enjoyable for the students. Our third question considers the ethical view of the solution, How do the users perceive the impact of this application on both fairness and autonomy? The approaches we use from the literature should be implemented with the user’s perception in mind.



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## 3 Design

In this chapter, we explore the third phase of the Design Science Research process, focusing on the design and development of solutions for challenges in group work. Our research questions aim to identify the primary challenges in group work within educational contexts and how educational tools and strategies can support efficient and effective group collaboration. We examine the dynamics of free-riders and work styles in group formation, and how these lead to conflicts and inefficiency. Moving into the design phase, we will present a use case diagram. This diagram illustrates features designed to address group work problems, such as regular peer evaluations, communication platforms, and conflict management strategies. Throughout this and the next chapter 4 - Prototype, we address these challenges and demonstrate how the proposed solutions can be implemented in practice to improve group work.

### 3.1 Use Case Diagram



Figure 3: Use case diagram

Figure 3 displays a use case diagram that shows the application's key functionalities and identifies *Student*, *Professor*, and *the System* as the primary actors. One of the key features is the notification system, which plays a vital role in keeping the users engaged and informed. For students, this

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system includes notifications related to meetings, messages, and feedback. At the same time, the functionality helps to keep an eye on inactive members by sending them regular reminders to stay active. For professors, this system provides valuable insights by alerting them about students who have not shown activity, enabling them to follow up and ensure continuous engagement in the learning process.

In group work, meetings are a central part of ensuring good cooperation. Therefore, we have facilitated a meeting functionality in the application. This feature allows group members to set up meetings and send out invitations to everyone in the group, including the lecturer. The lecturer, on their side, also can create meetings with various groups. Additionally, the system contributes to finding a meeting time that suits everyone, by considering the different schedules of the group members, to avoid conflicts with other subjects.

The professor can create groups in various ways, and students can join these groups. Within the group, there is also a functionality to establish a group contract, which includes common objectives, tasks, conflict management, and possibly a penalty system, to be signed by the students.

Considering the challenges associated with 'free riders' in group work, we have implemented an "Activity Log" feature for the professor. This function provides the professor with insights into the individual activity status of each student. It allows monitoring of students' engagement and interaction within the group, offering a clear indication of whether certain members have been active or have lacked contact with the rest of the group.

To maintain communication and facilitate easier collaboration within the group, we have introduced a "chat" functionality. This allows the group to communicate internally, as well as to directly contact a professor. The professor, in turn, also can reach out to individual members or groups whenever it is deemed necessary.

Another functionality that has been added is the feature where the students can provide feedback on the group work. They can assess the contributions of each member and share their perspectives on the course's progress over a specific period. Conversely, the professor receives this feedback, which can be instrumental in evaluating the group's performance during the grading process.

The final functionality presented in the diagram is the peer review feature. Based on existing literature we have found out that letting the student assess each other's contribution can serve as a great tool for preventing free-riders. In this feature, the students provide feedback on the other students in their group, and then the professor receives this valuable insight.

For an even more detailed description of some of the functionalities, we have designed some Use Cases, which are presented in the subsection 3.3 Use Cases.

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## 3.2 Users

### 3.2.1 Students

The primary users of the application are university students, who use the platform for effective collaboration on projects, maintaining good group cooperation, and communication with fellow students and professors. Furthermore, we will explore the needs of student users about the platform.

- An intuitive user interface that simplifies the management of academic tasks.
- Group contract feature that enables the establishment of a contract between group members.
- A peer review functionality where the students can assess each other's work.
- A chat feature with separate channels for group and lecturer communication, where messages are sent and received in real-time.
- A calendar integration with one's course schedule to facilitate easy meeting organization.
- Both a PC and mobile version, ensuring accessibility at all times.
- A feedback functionality for providing feedback on other group members that will be available for the professor.
- Functionality for establishing a contract between the group members that should be accepted at the start of the module.

### 3.2.2 Professors

The other user group for the application is lecturers, who are responsible for teaching, group assignments, and grading. Lecturers need the ability to monitor groups, keep track of active and inactive members, and easily provide and receive feedback.

- A dashboard that displays the groups and their division.
- An activity log for each group, showing the engagement and activity of group members.
- A functionality that allows the professor to decide and customize the type of group division.
- A chat functionality, making it easy to communicate with students and groups.
- A meeting functionality for planning, creating, and sending out meeting invitations to students and groups.
- A system that allows the professor to analyze feedback from students.

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### 3.3 Use Cases

<b>ID</b>	UC1
<b>Name</b>	Group Contract
<b>User</b>	Student
<b>Description</b>	Enables students to create, view, and sign a group contract to establish collaboration rules and responsibilities.
<b>Precondition</b>	<ul style="list-style-type: none"><li>• User is logged into the application.</li><li>• User is a member of a group.</li></ul>
<b>Postcondition</b>	The group contract is created, visible, and available for signing by all group members.
<b>Normal Flow</b>	<ol style="list-style-type: none"><li>1. The user navigates to the group contract section of the application.</li><li>2. The user either initiates a new contract or views an existing one.</li><li>3. The user adds or edits terms and responsibilities as needed.</li><li>4. The user saves the contract.</li><li>5. The contract is available for all group members to view and sign.</li></ol>

Table 1: Use Case 1 - Group Contract Functionality.

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<b>ID</b>	UC2
<b>Name</b>	Feedback
<b>User</b>	Students
<b>Description</b>	Users can provide and receive feedback within the group.
<b>Precondition</b>	<ul style="list-style-type: none"><li>• User is logged into the application.</li><li>• User is a member of a group.</li></ul>
<b>Postcondition</b>	Feedback is submitted and visible to the group. All group members can view and respond to the feedback.
<b>Normal Flow</b>	<ol style="list-style-type: none"><li>1. The user navigates to the feedback section.</li><li>2. The user writes and submits the feedback</li><li>3. The feedback is posted and becomes visible to all group members</li></ol>

Table 2: Use Case 2 - Feedback feature

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<b>ID</b>	UC3
<b>Name</b>	Monitor Member Activity
<b>User</b>	Professor
<b>Description</b>	Professor have access to monitor the activity of all members in student groups to assess engagement and participation.
<b>Precondition</b>	<ul style="list-style-type: none"> <li>• The professor is logged into the application.</li> <li>• Student groups have been created and have ongoing activities.</li> </ul>
<b>Postcondition</b>	The professor gains insights into individual and group activities, including participation in discussions, submission of assignments, and responses to meeting invitations.
<b>Normal Flow</b>	<ol style="list-style-type: none"> <li>1. The professor navigates to the dashboard section of the application.</li> <li>2. Selects a specific student group to view activity data.</li> <li>3. The system displays an overview of member activities, including the time of the last activity, the number of messages sent, meeting participation, etc.</li> <li>4. The professor can filter and sort the activity data based on various parameters for a more detailed analysis.</li> <li>5. If necessary, the professor can take actions to increase engagement, such as sending reminders or offering additional resources.</li> </ol>

Table 3: Use Case 3 - Monitor member activity

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## 4 Prototype

In this section, we present the prototype developed in the Figma application, a web application for interface design. The prototype is based on the functionality from Chapter 3 - Design, with a special focus on keeping the design simple. We have emphasized simplicity and user-friendliness, ensuring that our product is not only visually appealing but also intuitive and easy to use for any user, regardless of their technical skills.

### 4.1 Student's User Interface

IT2810 Webutvikling

← Group contract

Edit

### Gruppekontrakt

**Motivasjon og arbeidsinnsats**

- Hvilket ambisjonsnivå har dere som team i prosjektarbeidet?

- Gruppen ønsker å legge ned mye arbeid og innsats for å oppnå høyt nivå på prosjektet. Levere produkt av høy kvalitet gruppen er stolt av.

- Hvilken kompetanse har teammedlemmene?

- Erfaring med språk/rammeverk som Javascript, React, Java, Python, Django
- Erfaring med SCRUM og agile development
- Erfaring med Figma, design
- Erfaring med sikkerhet (RMF)
- Erfaring med brukertesting og menneske maskin interaksjon

**Signed** **Not signed**

Name	Date	Status
Kaja	03.sep	Signed
Per	05.sep	Signed
Anders	03.sep	Signed
Anna	09.sep	Signed
Ola	07.sep	Signed
Jenny		Not signed

Figure 4: Group contract

We have chosen to implement a group contract in the application. This feature allows students to agree on common goals, set guidelines for handling conflicts, and potentially have a point system. Additionally, it is possible to see who has signed the agreement and who has not.

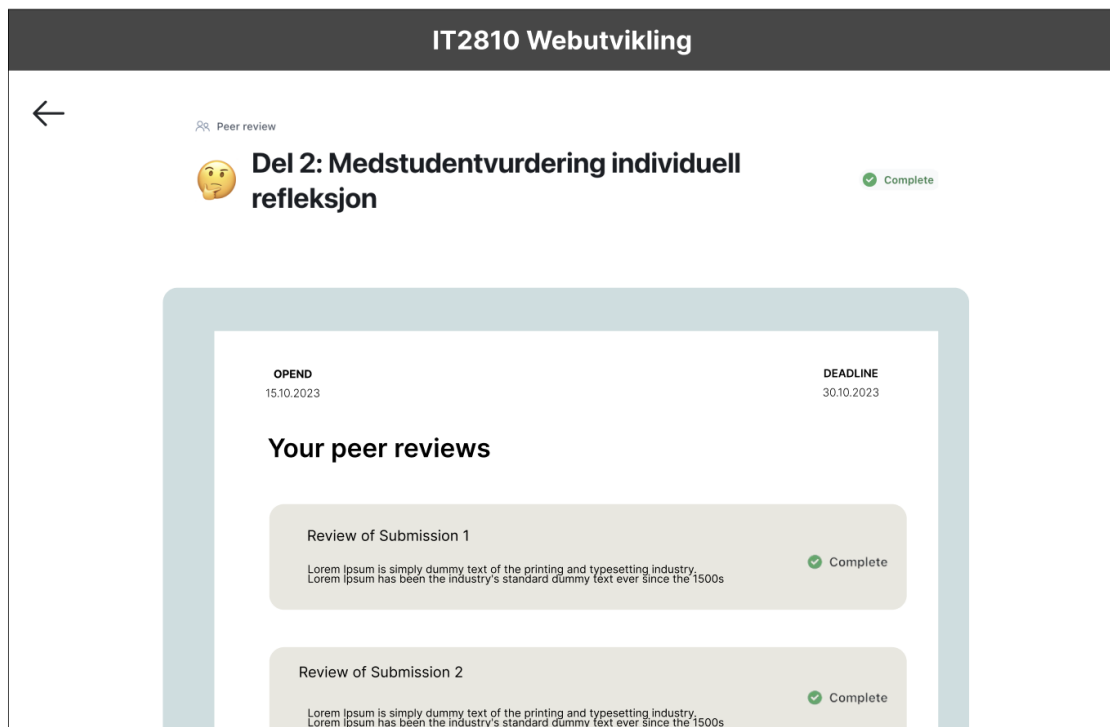


Figure 5: Peer review

Based on existing literature we have found out that peer assessment is a great tool for mitigating conflicts within groups. We want to provide the students with a tool for assessing the other student's contribution, giving the instructor valuable insights within each group.



IT2810 Webutvikling

←

Feedback: 13.sep - 27.sep

How would you rate the collaboration in the group on a scale from 1 to 5, where 1 is very poor and 5 is excellent?

On a scale from 1 to 5, how would you rate the communication within the group, where 1 indicates many misunderstandings and 5 indicates highly effective communication?

How would you rate the overall functioning of the group and the participation of the other members on a scale from 1 to 5, where 1 is very poor and 5 is excellent?

Is there anything else you would like to share about your experience with the group work, any thoughts or feelings that haven't been covered by the previous questions?

Figure 6: Feedback

To facilitate easier oversight for professors regarding group work, we have decided to implement a feedback feature. Which will be available at intervals throughout the semester. This feature is designed to provide feedback on the past exercise period. It allows students to give feedback on how the group work has functioned and who has participated.

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## 4.2 Professor's User Interface

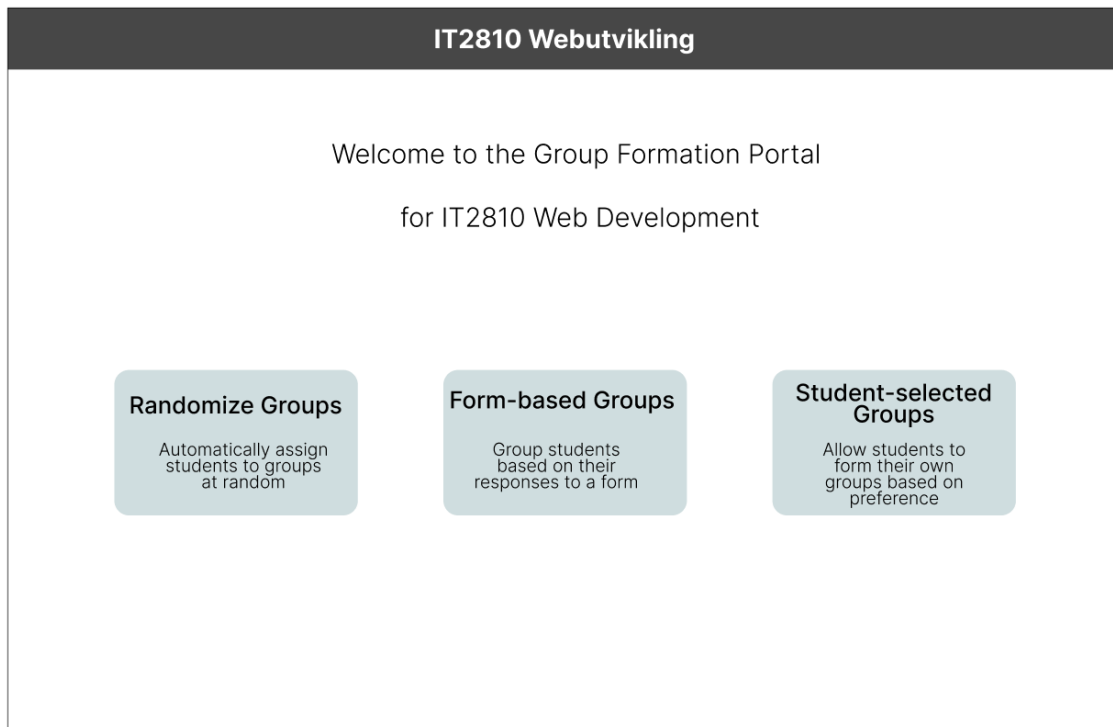


Figure 7: Group formation portal

Figure 7 presents the 'Group Formation Portal'. This is where professors have the option to select the method of group formation among students. It offers three alternatives for group division: Random Groups, Form-Based Groups, or Student-Selected Groups. We want to follow the recommendations from Hall and Buzzwell where the authors recommended these three ways of forming groups [4].

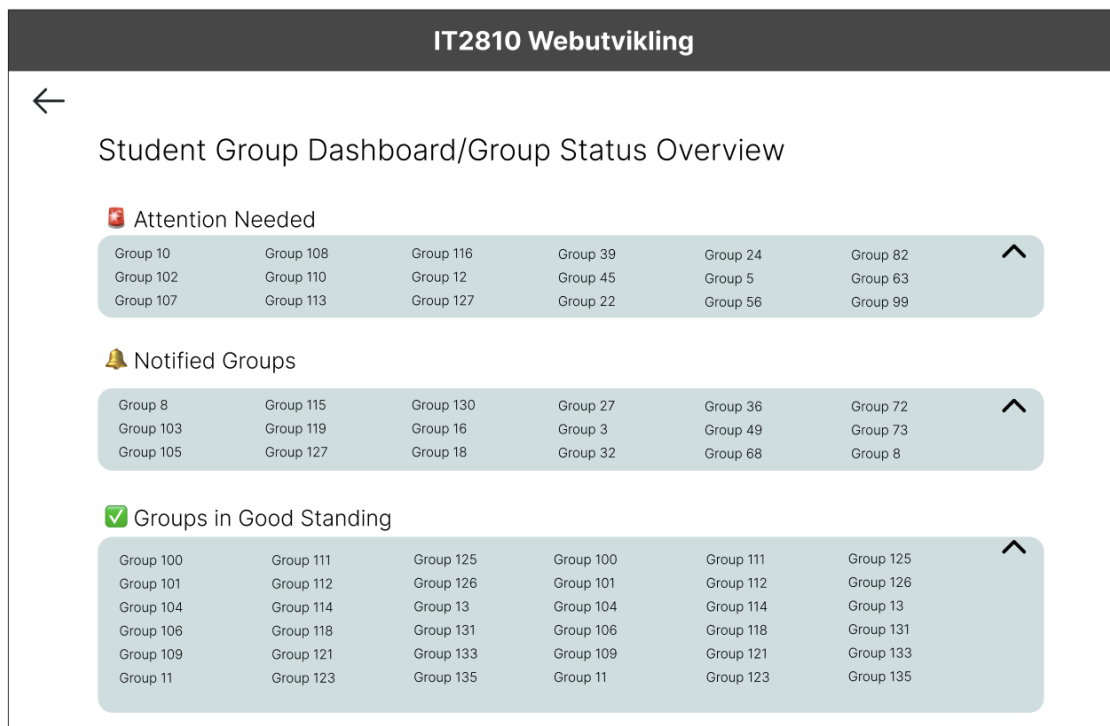


Figure 8: Student Group Dashboard

The figure above shows the Group Dashboard that the professor sees after all the groups have been formed. This page is divided into three sections: Attention Needed, Notified Groups, and Groups in Good Standing.

The 'Attention Needed' section indicates which groups the professor should take a look at. The reason they are in this section is either because some of the members are not active, conflicts have arisen, or the group work is not functioning properly.

The 'Notified Groups' section: here are the groups that have been in the attention needed category, and where the professor has visited and notified the group.

The 'Good Groups' section: here are all the groups that are in order, without any problems at the moment.

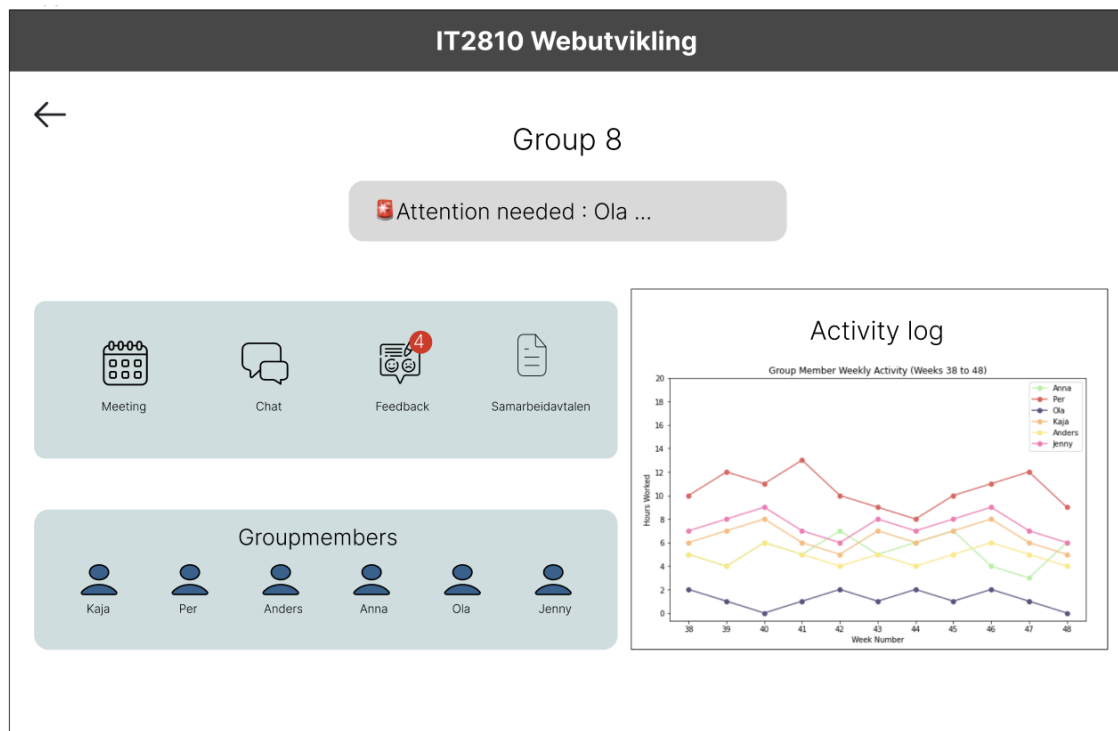


Figure 9: Group 8

For a deeper insight into each group, we have developed a separate page for each group, so that the professor can have better control. Here, the status of the group will be displayed, either 'attention needed', 'notified groups', or 'good groups'. On this page, the professor can see the activity log, where one can see how active the various group members are, and who the group members are. The professor also has access to the collaboration agreement, the opportunity to set up a meeting, send a message, and receive feedback

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## 5 Further Work

In the design section, we described that we are currently in the development phase of a prototype. The next step in the process will be, to begin with the implementation of the solution and implement the functionality to improve group work and group dynamics. In addition to the implementation and coding, we aim to delve deeper into further literature regarding the ethical aspects of the application. This is to ensure that the choices we make in functionality align with and support the ethical values of the students. Following this, we plan to test the prototype on a focus group consisting of students over a period to evaluate its functionality in practice. During the testing period, our goal is to collect data that will help us answer our research questions, and ensure that all aspects of the prototype's development and testing are targeted and relevant to these questions. In addition to testing our solution on a focus group over time, we also plan to conduct user interviews with students. This will allow us to gain a deeper understanding of the prototype's functionality, efficiency, and user-friendliness. Through such interviews, we hope to gather qualitative insights that can complement the quantitative data from the focus group, thereby providing a more comprehensive assessment of the prototype's impact.

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